Beyond the Bennett Hypothesis: Financial Aid, College Quality, and Education Expansion*

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Abstract

This paper investigates the impact of college financial aid on tuition prices and explores how colleges allocate additional revenues. We leverage exogenous variation from a large-scale aid program in Colombia, where loan recipients can only enroll at high-quality colleges. Using a difference-in-differences strategy and data for all colleges in the country, we find that tuition increased by about 5.8 percent after the government launched the aid policy. We present evidence that colleges likely face capacity constraints in the short term, as they cannot entirely expand to meet the upward shift in demand caused by the aid program. We also study how colleges respond in the medium run to the increase in revenues. Our findings indicate that colleges maintain their focus on education quality, as evidenced by a constant student-to-faculty ratio amidst a growing student body. This is achieved by hiring additional faculty, including individuals holding doctoral degrees. Finally, we show that colleges expand their supply by creating new undergraduate programs and hiring new personnel.

Keywords: financial aid, tuition, education quality, college expansion

JEL codes: I21, I22, I23, I28, H22, H27

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I. Introduction

Financial aid programs are widely used to promote access to college education, especially among low-income students who are underrepresented at the postsecondary level (Ferreyra et al., 2017; Hoxby and Avery, 2016). However, aid programs often raise concerns about their effectiveness and overall impact on education markets (Kane, 1995; Dynarski, 2003). In particular, policymakers have long expressed concerns about the potential impact that financial assistance can have on tuition prices (Bennett, 1987). While several studies have explored the effect on tuition (e.g. Espinoza, 2017; Lucca, Nadauld and Shen, 2019; Kelchen, 2019, 2020), a gap remains in the literature regarding how other outcomes might respond to financial aid policy. An impact on tuition, and therefore on profits, can introduce incentives for colleges to attract more loan recipients, likely motivating them to expand their educational offerings or adjust quality standards. Understanding changes in other dimensions is important because it can ultimately impact students' welfare. Any reduction in the consumer surplus that students experience after tuition increases can be offset or exacerbated by improvements or declines in service quality.

Our main contribution is studying the effect of financial aid on outcomes beyond tuition prices. In particular, we examine whether the program changed hiring decisions, student-to-faculty ratios, and educational offerings. We pursue this question in the context of a comprehensive aid program in Colombia. Between 2014 and 2018, the program *Ser Pilo Paga* provided public loans to almost 40,000 students. Several reasons make the Colombian setting appealing. First, beneficiaries of the program were only allowed to enroll at high-quality colleges, which represent 15 percent of all higher education institutions in the country, and must undergo a standardized peer-reviewed process to obtain this distinction. Second, most loan recipients enrolled at private colleges, where tuition prices are commonly the same for all the enrollees in the same program or major (i.e., there is no price discrimination). Third, the higher education market is highly segmented. In the case of bachelor's programs, high-income students mainly attend high-quality private institutions, while high-ability low-income individuals attend high-quality public universities (Ferreyra et al., 2017).[1] Finally, the program was generous and large in scale, seeking to fund tuition and stipends for one-third of new enrollees at high-quality colleges (Londoño, Rodríguez and Sánchez, 2020).[2]

This program enables the possibility to study the effect of financial aid on tuition for a specific type of institution—high-quality universities—that may have their particular ways of reacting to external stimuli as they compete for reputation (Azuero and Zarruk, 2017; Blair and Smetters, 2021; Bulman, 2022). We focus mainly on analyzing high-quality private institutions, as they receive most of the beneficiaries, although beneficiaries could also enroll in high-quality public institutions. We find that high-quality private colleges increased tuition prices by about 6.9 percent after the government introduced the program in 2014. Additionally, we find evidence consistent with high-quality colleges having inelastic supply, as they do not expand the number of admissions as much as the number of applications increases. However, high-quality colleges were able to accommodate additional students, partly due to lower dropout rates (Londoño, Rodríguez and Sánchez, 2020; Londoño-Vélez et al., 2023).

Our findings also suggest that, as a response to the increase in enrollment and tuition, high-quality private colleges hired new instructors, and, in particular, they hired a larger fraction of part-time instructors as an immediate response. As such, we observe a null effect in the student-instructor ratio over time. These trends suggest that high-quality institutions care about their reputation and the quality of the education they provide. A final piece of evidence shows that high-quality private colleges launched about two new undergraduate programs in the medium run, which aligns with the evidence of additional hires of full-time staff and serves as a mechanism to meet the excess demand without drastically increasing their number of seats that could compromise their reputation. All these findings suggest that colleges may utilize the extra revenue generated from the program to enhance their faculty and offerings. Our results align with a story in which high-quality private colleges

[1] Moreover, low-ability students attend low-quality private universities, while low-ability, low-income students attend low-quality public universities (Ferreyra et al., 2017).

[2] We calculate that from 2014 to 2021, the government spent over $1 billion dollars in tuition fees and stipends for the program. This amount is equivalent to 5.6 percent of the 2019 national education budget. The program covered students' full tuition fees at any high-quality college and provided a small stipend. While students received a stipend to cover living expenses, the government directly transferred tuition fees to each college.

may prefer a gradual expansion to preserve quality despite experiencing a surge in demand and revenue increases.

We make contributions to multiple branches of the existing literature. First, we contribute to the literature on the Bennett hypothesis, which investigates the relationship between financial aid and tuition increases. The hypothesis posits that increased financial aid leads to higher tuition rates, thereby examining the incidence of financial aid in higher education. Prior studies conducted in the United States have yielded mixed findings regarding the validity of this hypothesis, often dependent on the type of institution analyzed or the specific variation explored (e.g. Singell Jr and Stone, 2007; Cellini and Goldin, 2014; Turner, 2017; Kelchen, 2019, 2020). Recent studies by Lucca, Nadauld and Shen (2019) and Black, Turner and Denning (2023) exploit variations in policy changes, recognizing that certain institutions have higher exposure to these policy shifts. They provide noteworthy evidence supporting the Bennett hypothesis in the United States, focusing on undergraduate and graduate programs, respectively. We contribute to the literature studying the Bennett Hypothesis when a program targets only high-quality universities. The question of whether the Bennett hypothesis holds in the Latin American context has also been explored in some studies. For example, de Mello and Duarte (2020) and Dobbin, Barahona and Otero (2022) use data from Brazil and, respectively, find positive effects of 4.6 and 1.6 percent in tuition prices. On the other hand, Espinoza (2017) identifies a 6 percent increase for the Chilean context. Our results using data from Colombia are similar in magnitude to the estimates documented in these latter studies.

We also contribute to the existing literature investigating the potential spillover effects of financial aid programs on non-beneficiaries. Prior research by Turner (2012), Turner (2017), Black, Turner and Denning (2023) shows that universities change internal grants allocation due to the availability of financial aid. While Lucca, Nadauld and Shen (2019) and Black, Turner and Denning (2023) identify increases in sticker prices–which affect all enrolled students–in programs that were more exposed to the expansion of federal student loan caps. However, these findings are unlikely to apply to Colombia, where price discrimination and internal grants are uncommon in the private higher education institutions.[3] The Bennett hypothesis in a context where price discrimination is an uncommon practice will affect non-beneficiaries too (e.g., Azuero and Zarruk, 2017; Espinoza, 2017). In contrast, this paper examines whether non-beneficiaries might be affected in other dimensions as universities change margins of choice beyond pricing. Furthermore, we also explore whether spillover effects extend to different market segments. For instance, Bound and Simon (2021) shows funding targeting public higher education institutions affects tuition, composition, and wages of students attending private institutions in the U.S. Contributing to this strand of the literature, we investigate whether non-eligible universities, belonging to the low-quality segment of the market, also have an incentive to increase tuition fees.[4] In Section III, we provide a discussion on the rationale behind exploring this question. In essence, if there is a significant expansion in demand and high-quality universities exhibit an inelastic supply, students may be displaced from the eligible segment. Nonetheless, our findings suggest that there is no significant observed increase in tuition fees within the untargeted segment of the market.

If the program had spillover effects, finding a valid control group is challenging, as all institutions in the higher education market could have been affected. We define two-year low-quality colleges as the control group. We discuss in Section II.1 the institutional reasons supporting why this group is the market segment with the lowest probability of being affected by the program. In summary, the lack of formal paths from two-year to four-year colleges, market segmentation, and stigma make students much less willing to substitute a four-year college education for the education provided in these institutions. In fact, although beneficiaries were allowed to enroll in two-year high-quality colleges, they rarely did so. In Section V, we also present empirical evidence using raw data supporting that if the program affected these institutions, they could still provide lower bound estimates for our primary outcomes. As part of our main arguments, we show that the average number of

[3]According to Londoño, Rodríguez and Sánchez (2020), few private colleges offer aid to low-income high achievers, and only 11 percent of incoming students had access to student loans before SPP.

[4]Azuero and Zarruk (2017) also analyze the Bennett hypothesis, differentiating how high-quality and low-quality universities react to a student loan program. However, in their case, students can use the loans to enroll in any institution. Therefore, all institutions are directly affected by the policy.

applicants these institutions receive remains virtually unchanged in all years in our sample.

Furthermore, the existing literature predominantly focuses on examining the effects of increased financial aid generosity (Turner, 2012 and Frederick, Schmidt and Davis, 2012) and student loan programs (Espinoza, 2017, Kelchen, 2019, Lucca, Nadauld and Shen, 2019, Kelchen, 2020, Black, Turner and Denning, 2023).[5] This paper, however, specifically investigates the introduction of a financial aid program primarily consisting of government loans that were forgivable upon graduation and were advertised as scholarships. This distinction carries noteworthy implications. As discussed by Dobbin, Barahona and Otero (2022), comprehending the price elasticity of demand among financial aid recipients is crucial for understanding the overall impact on tuition fees. Notably, students with loans tend to exhibit reduced price elasticity as they are not directly burdened with the full cost of tuition, leading to tuition increases. Conversely, loan programs often target low-income students, thereby increasing their market share. Since low-income students generally have higher price elasticity, the average price elasticity of the market increases, resulting in reduced prices. However, in the case of a scholarship-based program, low-income recipients are likely to have very inelastic demand. Consequently, universities may have a stronger incentive to increase prices in such a context.

Extensive evidence has documented positive impacts on the recipients of the financial aid program studied in this paper. Previous studies find significant increases in high-quality private college enrollment for this group (Londoño, Rodríguez and Sánchez, 2020), as well as positive effects on earnings, graduation, and learning, seven years after the implementation of the program (Londoño-Vélez et al., 2023). Furthermore, there have been several studies examining the impact of the program on non-recipients, although most of them concentrate on potentially eligible individuals based on their socioeconomic status (SES) since the program targeted low-income, high-achieving students. The evidence shows that the program increased middle- and high-school students' test scores (Laajaj, Moya and Sánchez, 2022), reduced fertility rates among female teenagers (Bloem and Villero, 2021), and reduced the high school dropout rate (Basto Aguirre et al., 2019).

[5] Some exceptions are Cellini and Goldin (2014) and Singell Jr and Stone (2007) who do not have pre-subsidy data and Turner (2017) who uses a regression discontinuity approach.

Londoño-Vélez et al. (2023) also explore effects on enrollment in the private sector to analyze the impact on non-beneficiaries. They consider an event study approach and find that high-quality private colleges expanded their enrollment by 50% during the program's first year. We propose a framework that offers a more global perspective of the market as we consider all first-year students entering private colleges, not only those who took the high school exit exam on time. We also exploit variation not only across time but also across treatment and control groups, demonstrating null effects over four pre-treatment periods. To the best of our knowledge, we are the first to estimate the causal effect of the program on tuition prices.

In the next section, we describe the institutional setting. In particular, we describe important features of the Colombian higher educational system and *Ser Pilo Paga*, the financial aid program providing the variation we exploit in this study. Then, in Section III, we introduce our conceptual framework. This section explains why we postulate this program might have had spillover effects on untargeted sectors. Section IV describes our data and primary sources of information. In Section V, we explain our empirical strategy, discussing the threats to identification and providing empirical evidence supporting our control group selection. Section VI presents our main results, first focusing on the outcomes directly related to the Bennett Hypothesis and then on the outcomes associated with other colleges' choices. Finally, VII concludes.

II. Institutional Setting

II.1. The Colombian Higher Education System

In Colombia, higher education institutions offer different types of programs to meet the diverse academic needs of students. Undergraduate programs can be either vocational or professional. Vocational programs are short-cycle and typically last between two and three years. Individuals graduating from a vocational program obtain either a technical or a technological degree, similar to an associate's degree in the United States. Most technical programs provide instruction for two years, while technological programs do it for three years.

Professional programs, on the other hand, are designed to be completed in four to six years, as their length can vary depending on the field of study and the institution where the program is offered. Graduates from professional programs are granted a diploma equivalent to a bachelor's degree. In this paper, we refer to vocational programs as *two-year* and to professional programs as *four-year*.

Two-year programs are considered terminal, and students rarely transfer to four-year ones due to a lack of formal pathways to make such transitions (Dinarte et al., 2023). In fact, only about 6 percent of the students in two-year programs eventually graduate from a four-year program (Ferreyra, Galindo and Urzúa, 2022).[6] Although colleges are allowed to offer two-year programs where students earn credits transferable to four-year programs in the same field, these kinds of programs are uncommon.[7] The absence of a system that facilitates transfers between different types of programs segments the market and influences students' decisions regarding which type of program to apply for and enroll in.

Higher education institutions are classified into four types: technical institutes, technological institutes, university institutes, and universities. Throughout the paper, we refer to any of these types generically as *colleges*. Depending on their classification, colleges can offer two-year programs, four-year programs, or both. Technical and technological institutes exclusively offer two-year programs, while university institutes and universities have the flexibility to offer two-year and four-year programs alike.[8] Based on their primary funding source, colleges can also be categorized as private or public. Private colleges represent 65 percent of all institutions, offer 64 percent of the undergraduate programs, and enroll approximately 60 percent of all students.

Colleges and programs are highly heterogeneous in terms of quality, selectivity, tuition

[6] Using data from the college exit exam, which is mandatory for all students in their last year, we find that for the 2009-2014 high school cohorts, between 4.6 percent of seniors in four-year programs have also been enrolled in a two-year program from 2009 to 2020. Conversely, among seniors in two-year programs, 16.2 percent have taken the exam specifically designed for students in four-year programs.

[7] Two-year programs with transferable credits are regulated in Decrees 749 of 2002 and 1188 of 2008, through which the Ministry of Education authorized colleges to offer programs known in Colombia as *propaedeutic-cycle* programs. (Ministry of Education, 2024)

[8] To clarify why colleges are classified into four types, it is worth mentioning that technical institutes can only offer technical programs, while technological institutes are allowed to offer both technical and technological degree programs. Universities can offer graduate degree programs, such as master's or doctoral degrees, while university institutes cannot.

fees, and reputation (MacLeod et al., 2017). To provide educational services, colleges and programs are required to obtain a *quality registry*, which must be renewed every seven years to continue operating. This policy helps ensure minimum educational standards are maintained. Colleges and programs can voluntarily undergo a rigorous process to obtain *high-quality accreditation*. The accreditation process consists of several evaluation stages that culminate in a final statement by the National Accreditation Council.[9] Colleges are eligible for accreditation if they have operated for at least five years and if one-quarter of their programs have already been granted accreditation. In this paper, we refer to colleges with accreditation as *high-quality colleges*, as this certificate is correlated with quality measures such as test scores and labor market earnings (Camacho, Messina and Uribe, 2017). For simplicity, we refer to colleges without accreditation as *low-quality colleges*. By 2014, only 12 percent of the approximately 300 colleges operating in the country had been awarded accreditation.[10]

Tuition varies substantially across colleges and programs. At public colleges, tuition fees are determined based on the student's financial capacity.[11] This allows public colleges to allocate a higher share of governmental subsidies toward low-income students. Tuition represents, on average, about 10 percent of public college revenues, while governmental transfers account for around 55 percent (Bayona, Rueda and Ome, 2023). For students with the same ability to pay, public colleges can be less costly compared to private colleges.

Tuition at private colleges can be expensive or even exceed income parity standards in more developed economies (OECD and World Bank, 2012). The Ministry of Education regulates the annual increase in tuition that private colleges can implement. According to Decree 110 of 1994, tuition increases must be capped by the year's inflation rate. However, the same regulation also allows colleges to raise tuition above the inflation ceiling if they justify that additional revenues are being invested to improve education quality. In practice, most private colleges increase prices above the inflation rate every year (Ministerio de Educación

[9] The National Accreditation Council is supervised by the Ministry of Education, but its members belong to the academic and scientific community. Therefore, accreditation is considered a peer-reviewed process.

[10] The number of private and public colleges that have been granted accreditation has increased over time, as illustrated in Appendix Figure A.1.

[11] At enrollment, colleges determine a student's ability to pay through various measures such as family income, high school tuition fees, and the household's socioeconomic stratum.

Nacional, 2006).[12] Consequently, market dynamics seem to influence tuition prices, as programs in fields with higher demand –such as law or business– have lower tuition rates than programs in other areas.[13] Other factors, like quality, reputation, or even campus amenities, can also influence tuition across private colleges. Students in private schools are typically charged the same tuition price, and their tuition payments account for 70 to 80 percent of the school's revenues.

In Colombia, the college application process is decentralized, with students applying directly to individual colleges instead of through a centralized system. At the time of application, students must declare their major (or program), as these can have different admission requirements across and within colleges. A common factor that determines students' admission outcomes is their performance on the high school exit exam, known as *Saber 11*. Similar to the SAT in the United States, the exam evaluates knowledge in various subjects, including mathematics, natural sciences, social sciences, reading comprehension, and English proficiency. The exam is a mandatory requirement to enroll in college, but most students take the test regardless of whether they intend to apply for college or not. Colleges open admissions twice a year, to accommodate the different academic calendars in which high schools operate. This is necessary as most seniors graduate during the fall semester, but a significant share graduate in spring. Student characteristics differ widely based on the semester of graduation, as most seniors graduating in spring attend elite private schools.

II.2. Merit-based Financial Aid Program: *Ser Pilo Paga*

Access to college education has increased dramatically in Colombia over the last few decades. In the early 2000s, the enrollment rate of individuals aged 17 to 21 was approximately 23 percent, a lower rate than in other countries in Latin America. By 2014, enrollment reached 48 percent, a remarkable 25 percentage point rise in just fifteen years. However, access has remained unequal across income groups. Indeed, while 54 percent of high school graduates from middle- and upper-income households enroll in college, only 25 percent

[12]In Appendix Figure A.3, we show evidence that a large number of private colleges increase their tuition prices above the inflation ceiling suggested by the government.

[13]See Appendix Figure A.2.

from low-income ones pursue higher education. Although various factors contribute to these access disparities, the absence of a well-functioning financial aid system is commonly cited as one of the most significant reasons (Holm et al., 2003; de Wit et al., 2005; OECD and World Bank, 2012).

In an effort to improve access for low-income students at high-quality colleges, the Colombian government launched the financial aid program *Ser Pilo Paga* in October 2014. The program was advertised as a scholarship, although student aid consisted of a publicly funded loan to cover all tuition charges at any college with high-quality accreditation, whether public or private.[14] The government directly transferred tuition payments to colleges, so students had no access to such funds. The program also provided a modest stipend twice a year to help loan recipients cover some living and educational expenses.[15] The amount of a student's loan included both tuition fees and stipends, comprising a debt forgivable only upon graduation. This condition implied that students must repay their accumulated loans if they dropped out of college.[16]

Eligibility was determined by merit and need criteria. The merit condition was based on the student's scores in the *Saber 11* exam. The minimum score for eligibility increased over the years, moving from 310 out of 500 in 2014 (or the 91st percentile) to 318 in 2015 (92nd percentile), 342 in 2016 (96th percentile), and 348 in 2017 (97th percentile).[17] Students were informed of their eligibility for financial aid alongside their *Saber 11* exam scores, which many universities use as one component in their admission decisions, and hence, contributed to a high program's take-up rate. The need condition relied on a poverty index, known as SISBEN, to target students from disadvantaged households.[18] Eligibility varied depending on the student's residence location. Consequently, students living in the main metropolitan areas required an index below 57.21 points, while those in other urban and

[14] See Appendix Figure A.4.

[15] The stipend amounts ranged from one to four times the minimum wage, depending on whether the student had to relocate and the city's living costs.

[16] By June 2022, approximately 11 percent of all loan recipients had begun to repay their debt after dropping out (Espectador, 2022; Ministerio de Educación Nacional, 2022).

[17] Various reasons explain the increase in eligibility thresholds over time, including a tight budget, the high take-up rate of the program, and the motivational effect of the program that encouraged high school seniors to get higher scores (Londoño, Rodríguez and Sánchez, 2020; Laajaj, Moya and Sánchez, 2022).

[18] The Colombian government allocates most social welfare benefits through SISBEN (Sistema de Identificación de Beneficiarios de Programas Sociales in Spanish).

rural areas needed values below 56.32 and 40.75, respectively. These conditions allowed the government to identify high-achieving, low-income students who would benefit the most from financial assistance. Finally, for students to obtain the loan, they must have applied and been admitted to a high-quality college.

From 2015 to 2018, almost 40,000 students enrolled in high-quality institutions as program beneficiaries. Nearly 80 percent of them enrolled in private colleges (see Figure A.5), with a high concentration observed among specific schools (see Figure 1a). In fact, in just ten private colleges, the number of loan recipients accounted for 54 percent of all beneficiaries. On the other hand, as Figure 1b shows, for a considerable number of private colleges, the number of loan recipients among first-year students was over 20 percent. This suggests that *Ser Pilo Paga* represented a significant shock for high-quality private colleges.[19]

III. Conceptual Framework

Before conducting any empirical analysis, we introduce a conceptual framework to guide our discussion of the impacts of financial aid on higher education markets. This framework provides an economic rationale that allows us to focus on specific college outcomes. We start assuming an education market that is segmented into low-quality and high-quality sectors. Colleges can offer programs in only one sector, while students are allowed to apply to and enroll in colleges from either segment. However, some individuals do not participate in this market, including a group that faces credit constraints. We also assume that colleges in the low-quality sector provide education at a lower price than high-quality colleges. Finally, suppose that a market regulator—the government—introduces a financial aid policy that affects exclusively one side of the market, for instance, the high-quality sector. This simple setting allows us to understand the implications of the financial aid program *Ser Pilo Paga* broadly, described in Section II.2. It also highlights the potential spillover effects that

[19]The sorting of loan recipients into private colleges is challenging to explain. Appendix Table A.2 and Appendix Figure A.6 show that the share of beneficiaries across schools is uncorrelated with information that students might consider when they apply to college, such as graduation rates, employment rates, average earnings of recent graduates, and the geographic location of schools. Only two factors seem to influence the observed sorting: an indicator equal to one if the college is private and a measure of college reputation that we compute following MacLeod et al. (2017).

can emerge from a policy that targets a specific college type.

Figure 2 shows a graphical representation of our model. S_i and D_i represent the inverse supply and demand curves for sector $i = \{HQ, LQ\}$.[20] Tuition prices (P) are displayed on the vertical axis, while the horizontal axis depicts the seats supplied by colleges or the number of college applicants (Q). In both sectors of the model, demand is downward-sloping, and supply exhibits capacity constraints after a given level of seats. We introduce such constraints to capture the idea that, after receiving a given level of students, colleges can only provide (or prefer to offer) a limited number of seats, which is a reasonable assumption, at least in the short run. Therefore, the supply curve is upward-sloping, but it kinks when capacity constraints hold, which is visually represented by the perfectly inelastic section of the curve. However, a perfectly inelastic section is not a necessary condition. Colleges may still have a margin for small adjustments. This idea could be illustrated using alternative representations.[21]

Consider initially that in equilibrium, the demand for high-quality education intersects the supply curve at its perfectly inelastic section (see Figure 2). In such equilibrium, high-quality colleges provide seats at their maximum capacity, $\bar{Q}_{HQ}$. This assumption is plausible, as high-quality colleges are usually oversubscribed. The assumption can also hold if colleges maximize profits by considering their installed capacity, reputation, the resources available for enrolled and incoming students, and the quality of instruction they can provide. In fact, previous literature has focused on understanding why elite colleges have been reluctant to expand their supply over time (Blair and Smetters, 2021; Bulman, 2022). In reality, the validity of this assumption depends on the ability of colleges to adjust their resources and their objective to maintain particular education and reputation standards. Empirically, operating at capacity could be related to the process by which colleges monitor measures such as the student-to-faculty ratio, the student-to-staff ratio, and the ratio to other educational resources.

Now, assume that the regulator introduces a subsidy (or financial aid program) that can

[20] The subscript HQ is used to denote the high-quality sector, while LQ is used for the low-quality sector.

[21] A supply curve such that $S_i' > 0$, $S_i'' >> 0$ would also capture the idea that colleges might face capacity constraints or difficulties in adjusting the number of seats that they offer after some $\bar{Q}$.

only be used to enroll in high-quality colleges. By relaxing students' financial constraints, the subsidy induces an upward shift in demand. The after-subsidy demand curve is represented by $D_{HQ} + Govt$, as seen in Figure 2. Given the inelastic supply, this upward shift in demand causes an increase in tuition prices at high-quality colleges. As the additional number of offered seats does not keep pace with the additional applicants—who probably have a higher willingness to pay due to the subsidy—some students who could have been offered admission before the introduction of the subsidy may no longer be admitted. This implies that the demand for low-quality colleges might shift upwards, as some students could be better off by enrolling in this sector rather than not pursuing any higher education. Graphically, the demand for low-quality colleges shifts from D_{LQ} to D'_{LQ}. Again, the increase in demand implies an increase in tuition prices, this time at low-quality colleges. These spillover effects on the demand and tuition at low-quality colleges will depend on different factors, such as the ability or willingness of high-quality colleges to respond to the surge in their specific demand, students' preferences, and the elasticity of demand and supply for low-quality education. To examine if the financial aid program studied in this paper created a displacement effect, we estimate the causal impact of this policy on the number of first-year students enrolling in each market segment. This framework leads to the following prediction:

Prediction 1. *The enrollment of first-year students at high-quality colleges does not respond to the upward demand shift that resulted from the introduction of a financial aid program in this sector. Yet, tuition prices increase at high-quality colleges. This is,* $\Delta Q_{HQ} = 0 \Rightarrow \Delta P_{HQ} \geq 0$.

In Figure 2, we assume that the specific demand for low-quality colleges intersects the supply in the less elastic section of the curve, where capacity constraints are not binding. This assumption is not necessary to observe an increase in tuition at low-quality colleges, although the degree of the elasticity of supply certainly affects the magnitude of the rise. Yet, the assumption can be reasonable since low-quality colleges might focus more on enrolling a large number of students rather than investing in their quality. Therefore, low-quality institutions will likely have greater flexibility to accommodate additional students than high-quality ones. A second prediction from our conceptual framework states that:

Prediction 2. *If first-year students' enrollment at low-quality colleges increases (stays unchanged), so will tuition prices. This is,* $\Delta Q_{LQ} \geq 0 \Rightarrow \Delta P_{LQ} \geq 0$*.*

Assuming that the above predictions are correct, the pink area in Figure 2 would represent the surplus lost by students who do not receive the subsidy. However, the program's overall impact on these students is not necessarily negative. Previous research has discussed that the net welfare effect on students depends on how colleges allocate additional tuition revenues (Black, Turner and Denning, 2023; Espinoza, 2017). For instance, if colleges invest these extra funds to improve education quality, the net effect on students without the subsidy could be smaller than the pink area or even positive. Yet, there is no evidence in the literature showing that colleges utilize the revenues from tuition hikes to enhance their quality. Our analysis aims to provide evidence to fill this gap.

Our conceptual framework makes several implicit assumptions about the demand for higher education. For instance, we assume that some students may not apply to either sector because they face substantial credit constraints. Financial aid programs relax these constraints, allowing them to apply to college. Observe that if all students could apply to both sectors, the subsidy may not affect the demand for either college type. On the other hand, if eligible students for financial aid (i.e., low-income students) would only apply to low-quality colleges in the absence of the program, then the demand for low-quality education could shift downward and not upward. In addition, although we do not stress the importance of the elasticity of demand in our framework, we recognize that it can explain the direction and magnitude in which tuition changes (e.g. Espinoza, 2017; de Mello and Duarte, 2020; Dobbin, Barahona and Otero, 2022). Furthermore, since the financial aid program *Ser Pilo Paga* represented an important shock for the composition of first-year students in the high-quality sector, especially for the private colleges, it is likely that the elasticity of demand had also changed as a result of the policy. Especially if we consider that loan (or subsidy) recipients display an inelastic demand for higher education. We do not explore changes in demand elasticity due to the aggregated nature of our data, which makes it impossible for us to study compositional changes or differential effects across income groups.

IV. Data

We use administrative data of all higher education institutions in Colombia spanning from 2009 to 2018. This data is collected by the Ministry of Education through SNIES (the National Information System for Higher Education) and is available upon request. All colleges in the country are required to report annually various types of information to this system, including the number of applicants to each program in the spring and fall semesters, the number of admissions offered, the number of first-year students who enroll, the total number of enrolled students, and the number of teaching and administrative staff hired by the institution.[22] Information on the type of college (i.e., private or public) and the level of all programs (i.e., two-year or four-year) are also recorded in the data. We also obtained information from the National Accreditation Council that allows us to determine which colleges received and renewed high-quality accreditation and in what year. This is particularly relevant for our study since loan recipients from the aid program *Ser Pilo Paga* could only enroll in colleges with accreditation. The data is organized into cross-sections that can be linked using unique college identifiers or program identifiers, depending on the level of granularity.

Tuition information is recorded in SNIES annually at the program (or major) level. In particular, colleges report the following year's tuition for each program, as mandated by the Ministry of Education's Resolutions 1780 of 2010 and 12161 of 2015. The information is submitted every year between November 1st and December 15th. We focus our analysis of tuition on private colleges since these schools typically charge a uniform price for all students without offering any discounts. On the contrary, public colleges charge differential tuition prices depending on the student's financial needs using rules that change across institutions.[23] As we do not observe sticker prices or tuition at the student level for public colleges, we can not study the effects of financial aid on tuition in the public market segment.

As mentioned in Section II, colleges can offer two-year programs, four-year programs,

[22]The deadlines and details of the information that colleges must report can be found in Resolution 1780 of 2010, issued by the Ministry of Education.

[23]As discussed earlier, public colleges in Colombia employ third-degree price discrimination, as students' tuition is determined through college-specific rules based on their socioeconomic backgrounds and family assets at enrollment.

or both, depending on their type. We define a "two-year college" as any college where more than 50 percent of the students are enrolled in two-year programs. According to this definition, all technical and technological institutes are classified as two-year colleges, as well as a subset of university institutes and universities. We refer to the remaining institutions as "four-year colleges."[24]

V. Empirical Strategy

We estimate the causal effect of financial aid on various college outcomes using a difference-in-differences design that compares four-year and two-year colleges. We further classify colleges according to whether or not they have high-quality accreditation. The latter division allows us to study the direct and spillover effects of the policy as students eligible for *Ser Pilo Paga* aid were only permitted to enroll in the colleges with high-quality distinction. We use low-quality two-year colleges as our control group. The identifying assumption of this approach is that, in the absence of financial aid, the observed outcomes for high-quality and low-quality four-year colleges would have followed similar trends to those of low-quality, two-year colleges. In other words, we assume that two-year, low-quality colleges serve as a valid counterfactual to estimate the effects of providing financial aid to enroll in high-quality schools.

If the program had spillover effects, as we postulated, then finding a control group proves challenging, as all institutions in the higher education market could have been affected. However, two-year programs in Latin America have a poor reputation and are often viewed as "second-class programs and an academic dead end," to cite Di Gropello and Ferreyra (2022). Given this stigma, market segmentation, and the lack of formal and common pathways from two-year to four-year college education, low-quality two-year colleges are the market segment with the lowest likelihood of being exposed to the program's effects. To define this group as our control group, we assume that students interested in and capable of attending high-quality colleges, which mainly offer four-year programs, are unlikely to

[24]Table A.1 describes the type of higher education institution in each sample group.

substitute this type of education with that provided in a low-quality two-year college. Nevertheless, this control group still has production and cost functions similar to other colleges, meaning low-quality two-year colleges are still comparable despite students' preferences and their substitution patterns.

Suppose this assumption does not hold, and a significant number of students still end up applying to two-year low-quality colleges. In that case, it is plausible to believe they would still react to the program in the same direction as the other sectors—either increasing or keeping constant tuition, seats, and other production inputs—hence, our control would generate lower bound estimates. If, on the other hand, these institutions did not receive additional students but lost them, our estimates could be upper bounds. This last situation is plausible if we believe that beneficiaries of the program would have enrolled in two-year colleges in the absence of the policy. We present evidence supporting the first hypothesis, validating that usage of these colleges as our control group.

Figure 3 presents the raw average of the number of freshmen and applicants for the control group in purple and our main group interest—private four-year high-quality colleges—in blue. We can observe that the control group remains relatively stable and does not show significant falls in terms of first-year students or applicants. This pattern is observed for the cohorts entering and applying in the Spring term—when program beneficiaries enter college—and in the Fall term. In addition, we also examine the evolution of college characteristics that the program should not have altered. The raw mean for these characteristics are shown in Figure 4. Panel (a) presents the share of female applicants, Panel (b) the share of females offered admission, Panel (c) the share of first-year female students, and Panel (d) the share of female students enrolled. In all these cases, we can see that the evolution of these groups is very similar and that they all remain relatively stable through time. Overall, the absence of significant changes in the trends observed for the low-quality two-year colleges provides confidence that this group is a valid control.

We use the following difference-in-differences strategy:

$$\begin{aligned}
Y_{ct} =& \delta^{Private}\,(\text{Private HQ 4-Year}_c \times \text{Post}_t) + \beta^{Private}\,(\text{Private LQ 4-Year}_c \times \text{Post}_t) + \\
& \delta^{Public}\,(\text{Public HQ 4-Year}_c \times \text{Post}_t) + \beta^{Public}\,(\text{Public LQ 4-Year}_c \times \text{Post}_t) + \\
& \mu_c + \mu_t + X'_{ct}\gamma + \varepsilon_{ct},
\end{aligned} \tag{1}$$

and the equivalent event study representation to analyze dynamic responses:

$$\begin{aligned}
Y_{ct} = & \sum_{\tau \neq 2013} \delta_\tau^{Private} \cdot \mathbb{1}[\tau = t] \cdot \text{Private HQ 4-Year}_c \; + \\
& \sum_{\tau \neq 2013} \beta_\tau^{Private} \cdot \mathbb{1}[\tau = t] \cdot \text{Private LQ 4-Year}_c \; + \\
& \sum_{\tau \neq 2013} \delta_\tau^{Public} \cdot \mathbb{1}[\tau = t] \cdot \text{Public HQ 4-Year}_c \; + \\
& \sum_{\tau \neq 2013} \beta_\tau^{Public} \cdot \mathbb{1}[\tau = t] \cdot \text{Public LQ 4-Year}_c \; + \mu_t + \mu_c + X'_{ct}\gamma + \varepsilon_{ct},
\end{aligned} \tag{2}$$

where Y_{ct} is the outcome of program i offered by college c in year t. Several outcomes are of interest in this paper: tuition, applicants, admissions, freshmen, enrollment, student-to-faculty ratio, number of faculty members, and number of undergraduate programs. Private HQ 4-Year$_c$ is an indicator variable equal to one if college c is a private four-year institution and holds high-quality accreditation. Public HQ 4-Year$_c$ is the analogous variable for public high-quality colleges. Private LQ 4-Year$_c$ is an indicator equal to one if college c is a private four-year institution and does not have accreditation. Public LQ 4-Year$_c$ is the equivalent dummy for public four-year colleges without such distinction. To control for time-invariant heterogeneity across colleges and for structural changes that may affect all higher education institutions over time, we include college fixed effects, μ_c, and year fixed effects, μ_t. Our most saturated specification includes a set of controls, X_{it}. Controls include department-specific time trends.[25] The time trends control for heterogeneity in geographic markets (departments), which likely evolve following different patterns. We estimate equation (1) by Ordinary Least Squares (OLS) and cluster the standard errors across all specifications at the college level.

[25]Cities (or municipalities) in Colombia are grouped into 32 administrative regions known as departments.

It is important to remember that, as discussed in Section IV, the information colleges report by December 15th of each year corresponds to the tuition prices they will charge students in the next academic term. Given that the government announced *Ser Pilo Paga* on October 1st, it is possible that colleges responded to this policy in the same year of its announcement. Consequently, we consider the years before 2014 to be our analysis's "pre-treatment" period. This definition is particularly relevant to estimate the effect of financial aid on tuition, but to be coherent through the analysis, we also keep this definition to assess the impact on other outcomes.

The effects of financial aid over time are captured by the coefficients δ_{τ}^{κ} and β_{τ}^{κ}, $\tau \in \{2009, ..., 2012, 2014, ...2018\}$ and $\kappa \in \{Private,\ Public\}$. The parameters δ_{τ}^{κ}, associated with colleges where loan recipients enrolled, estimate the *direct effects* of introducing the financial aid program *Ser Pilo Paga*. On the other hand, the parameters β_{τ}^{κ}, associated with colleges where aid recipients could not enroll, capture the *spillover effects* of the program. However, the main parameters of interest are $\delta_{\tau}^{Private}$ since most beneficiaries decided to enroll in private colleges. The identifying assumptions for this empirical design cannot be directly tested. Although the estimates of δ_{τ}^{κ} and β_{τ}^{κ} for "pre-treatment" years (i.e., years when the program was not yet introduced) provide a natural test of validity, the absence of effects in the pre-treatment period is, however, not sufficient. As we described earlier in this section, if our control group was still subject to changes because of the program, their trends could have also varied after the program's launch. In that case, our estimates would be biased, and we previously presented some evidence supporting that our estimates would likely be downward biased.

VI. Results

VI.1. Testing the Bennett Hypothesis

Effects of Financial Aid on Tuition – We begin by examining the Bennett hypothesis in the Colombian context, where the government implemented a comprehensive financial aid program in 2014, aiming to improve the enrollment of low-income students in high-quality colleges. We investigate whether colleges raised their tuition above previous observed trends due to the introduction of this financial aid program.

Figure 5 presents the estimates of our event-study strategy, using the logarithm of the average tuition at private colleges as the outcome variable. Various observations are worth highlighting from these results. First, between 2009 and 2013 (the pre-treatment period), mean tuition at four-year high-quality colleges (the treatment group) and at two-year low-quality colleges (the control group) followed similar trends (see Figure 5a). As such, during the pre-treatment period, the normalized tuition gap between these two groups cannot be statistically distinguished from zero.[26] If we consider low-quality four-year colleges, which could be affected indirectly by the program, the same conclusion holds (see Figure 5b). These results provide empirical evidence supporting the validity of our identification strategy.

Second, from 2014 to 2018 (the post-treatment period), there was a change in the tuition trends among high-quality colleges (see Figure 5a). In fact, real prices increased by about 4 percent a few months after the government had announced the financial aid program *Ser Pilo Paga*. Average tuition continued rising throughout 2017, reaching a 7 percent average increase compared to the evolution of prices during the pre-treatment period, a further increase observed just after the number of beneficiaries enrolling in private colleges peaked in 2016 (see Figure A.5). In 2018, the tuition gap between the treatment and control groups ceased widening as high-quality colleges reverted to their previous trend of annual price adjustments. These findings provide direct empirical evidence supporting the Bennett hypothesis. They are also consistent with anecdotal evidence indicating a general dissatisfaction among students concerning the tuition increases in high-quality private colleges.[27] Third, the average tuition trends of low-quality four-year colleges are not statistically different from zero, supporting the absence of spillover effects. However, this result must be taken with a grain of salt as most of the point estimates are positive after the program's launch (see Figure B.1b). This pattern could suggest that there could have been spillover ef-

[26] The tuition gap is expressed in logs and normalized with respect to the observed gap in 2013.

[27] Students from various elite colleges protested against substantial tuition hikes in 2016 and 2017 (Vargas, 2017). Staff from some of these colleges provided details on the increases in tuition after student discontent gained media attention (Rojas, 2017).

fects on the tuition of untargeted colleges, but we do not have enough power to disentangle them.

Fourth, these results are robust to various specifications and sample restrictions. In particular, compared to the baseline benchmark that controls for college and year fixed effects, our conclusions hold after we control for specific tuition trends in different education markets (i.e., departments). In addition, we run our analysis at the program level, as programs could have different tuition within a given college. For this sample, we consider additional specifications where we exclude colleges that received high-quality accreditation after 2014 and exclude each college and field of study at a time.[28] Our conclusions remain unchanged to these restrictions.

Table 1 presents standard difference-in-differences estimates, summarizing the results of our event-study specification. On average, the *direct effect* of financial aid on average tuition at high-quality colleges ranges between 6.7 to 6.9 percent. These estimates are similar in magnitude to the impact of subsidized loans on tuition prices found in Brazil and Chile (Espinoza, 2017; de Mello and Duarte, 2020; Dobbin, Barahona and Otero, 2022). Moreover, as the programs could have different tuition within a given college, we also examine the effects on different tuition quartiles in Panels 4-6. The results indicate that tuition increases the most (least) for programs that had the lowest (highest) pre-program tuition. High-quality colleges increased tuition at the lowest quartile by 9.6 percent, in the median by 6 percent, and in the highest quartile by 5.5 percent. We do not observe *spillover effects* on average nor quartile tuition at colleges where financial aid recipients were not allowed to enroll. The coefficients associated with low-quality colleges are not significant but also small in magnitude, ranging from -0.2 to 2.7 percent.

Why does tuition increase? **–** As we highlight in our conceptual framework, financial aid programs can induce an increase in the demand for higher education. The increase can be more pronounced if the target population of these programs is low-income, high-achieving students; especially if they receive direct and clear communication about the aid package (Dynarski et al., 2021). Now, if colleges have difficulties to expand their supply in the short

[28] Appendix Figure B.1 presents the results excluding colleges granted high-quality status after 2014. Figures B.2 and B.3 exclude one college and one field of study at a time.

run or preferences for not doing so, a simple economic model predicts an increase in tuition prices. Guided by this framework, we explore whether high-quality colleges in Colombia might exhibit binding capacity constraints that could help to rationalize the observed increase in tuition.

We begin by analyzing if the admission rates at high-quality colleges changed after the introduction of *Ser Pilo Paga*. Figure 6 presents the results of estimating equation (2) on the ratio of the number of students who are offered admission to the number of applicants during the Fall and the Spring semesters. We run separate regressions for each semester, considering that the number and characteristics of the students who apply to college in both terms vary substantially. Although post-treatment coefficients suggest a reduction of the admission rate of around 5 percentage points, only the coefficient for 2016 is marginally significant (see Figure 6a). This pattern is observed not only during the Spring semester—when loan recipients enroll—but also in the Fall. In Figures 6b and 6c we present estimates for the number of applicants and admissions separately. The effect on the number of applicants exhibits a similar pattern to that of the number of loans intended to be granted by the government each year.[29] The effect on the number of admissions appears to follow a similar trend but with much smaller magnitudes and, in some cases, not statistically significant from zero.

This evidence suggests that although there was a slight decline in the admissions rate of high-quality colleges—indicating that their supply is somewhat inelastic—these colleges are still willing to expand their admissions amidst the application hike. To understand this response, it is worth recalling some program features. First, the median ratio of beneficiaries to entering private institutions' cohorts is more than 15 percent. Second, private, high-quality colleges rely heavily on tuition as a source of revenue. Last, the government was willing to pay for any tuition level at these institutions as long as they had high-quality accreditation. Therefore, it seems plausible that high-quality colleges were still willing to expand their admissions as this stimulus represented an opportunity to increase revenue—

[29] From 2015 to 2018, the annual number of loan recipients was, respectively: 10,142 (in 2015), 12,751 (in 2016), 9,086 (in 2017), and 7,384 (in 2018). Appendix Figure A.5 presents the number of recipients who enrolled in private and public colleges each year.

and probably the average ability of their student body. We will see later that this result is still compatible with a story where high-quality colleges care about the quality of their education.

In Figure 7, we show that the number of first-year students (the flow) enrolling in high-quality colleges remained unchanged during the post-treatment period (see Figure 7a). In other words, the policy does not seem to have a significant effect in increasing the average size of the entering cohorts.[30] This contrasts with the effect on the number of enrollees (the stock), which increased after the aid program was put in place (see Figure 7b). By 2018, the number of students enrolled in a high-quality college had increased by 14 percent compared to the average number of enrollees in 2013. There are three possible explanations for these seemingly contradictory results. First, during the post-treatment period, students may take longer to graduate from high-quality colleges compared to previous cohorts. This would translate into an increase in the stock of enrollees over time. We rule out this explanation by estimating the effect of financial aid on the number of graduates.[31] The second explanation has to do with the effect that financial aid can have on the dropout rates among the cohorts that enrolled after 2014. Unfortunately, information on the number of dropouts is unavailable. Yet, we know from the literature that dropout rates among loan recipients are lower than among their peers in high-quality colleges, even when their academic performance can be lower.[32] This effect on dropout rates is likely explained by the strong incentives of the program to deter loan recipients from dropping out. Notably, program beneficiaries who do not enroll during two consecutive semesters must repay their education debt.[33] The final explanation might be that, as we explained in the previous section, our control groups could have also increased their entering cohort because of the program. Figure 3 shows that the

[30] Although the post-treatment coefficients are not statistically significant from zero, they are positive. However, we see that this trend is not different from that of the pre-treatment period. Moreover, the cumulative effect of the effect on the number of freshmen can only explain 43% of the increase observed in the stock of students based on DiD coefficients.

[31] See Appendix Figure D.1.

[32] Meisel and Granger (2022) use data from the private college that enrolled that largest share of loan recipients and find that the dropout rate of aid recipients is 15 percentage points lower than that of their peers. On the other hand, Londoño-Vélez et al. (2023) exploit the discontinuity in aid eligibility to estimate that loan recipients are 66 percent (or 27 percentage points) more likely to take the college exit exam within seven years of enrolling in college.

[33] Dropouts are identified by the Colombian Ministry of Education using this definition of failing to enroll during two consecutive terms.

average number of applicants in those institutions remains virtually unchanged. However, our estimates could still be a lower bound if the ability and preferences of the pool of applicants changed and, as a response, two-year colleges accepted more students. In that case, the variation we are exploiting could not be enough to identify an increase in the flow of students.

Table 2 presents static difference-in-differences estimates summarizing the effects of financial aid on admission rates, applicants, admissions, and freshmen at all four-year college segments, including private and public sectors.[34] For the low-quality private sector, we do not see significant effects in any of the outcomes, except for an increase in enrollment for some years at the beginning of the program. Consistent with a story where there is not an important displacement, the number of applicants does not increase nearly as much as in the case of the high-quality universities, despite the private low-quality system having significantly more students. All these patterns are consistent with the observation that there is no significant effect on real tuition for this sector.

For the public sector, we observe a significant increase of 1,050 additional applicants for high-quality colleges in the Spring semester, representing a 16 percent increase relative to the level observed in the pre-treatment period. However, the number of admissions does not keep pace with the number of additional applicants, and although the effect is positive, it is not statistically significant. This result is also supported by a negative admission rate, which becomes statistically significant for the final periods of the program. For low-quality public colleges, we observe a negative admission rate mainly driven by a noisy but positive rise in the number of applicants amidst a small and insignificant effect in the number of additional admissions. For both sectors, the number of freshmen exhibits a null effect while the number of enrollees increases. However, enrollment in public high-quality colleges increased only by 5 percent in 2018 relative to the mean level observed in 2013. These patterns in the number of freshmen and enrollees are consistent with those observed for the private sector.

[34]In Appendix Figures C.1 and C.2, we show the estimates of the effect of financial aid on admission rates, freshmen, and enrollment at low-quality private colleges. The equivalent results for four-year public colleges are shown in Appendix Figures C.3, C.4, and C.5.

Our estimates of the impact on the number of first-year students across all types of colleges could suggest that *Ser Pilo Paga* did not have a general equilibrium effect on college access for the cohorts entering college between 2015 and 2018. However, the positive effect observed in the number of enrollees at low-quality public colleges could suggest that the program increased overall persistence in the four-year college system. This explanation would be possible if students were more motivated and prepared for college because of the program. Previous research documents spillover effects on middle-school students' test scores and fertility rates among young women, aligning with such hypothesis (Laajaj, Moya and Sánchez, 2022; Bloem and Villero, 2021). Moreover, although we observe increases in the applications and, in some cases, admissions, this does not necessarily mean that more students are entering the market. Several applications and admissions can be associated with only one student. Therefore, the results could also suggest that the program introduced more incentives for competing for high-quality seats—in in part, by removing credit constraints affecting high-ability students.

These findings suggest that high-quality private colleges are willing to increase their number of admissions, but they do not increase their seats as much as the demand expands. While the supply curve may be inelastic, colleges do have the ability to accommodate more students as the number of enrollees increases. Therefore, the empirical evidence supports a story where capacity constraints are not binding and although inelastic supply might still play a role in the tuition increase, it could also result from higher markups since loan recipients in our context are completely price-inelastic (Dobbin, Barahona and Otero, 2022).

VI.2. Beyond the Bennett Hypothesis

***Effect of Financial Aid on College Resources* –** To complement our analysis of how colleges respond to financial aid, we investigate if other outcomes, such as the resources that students find in schools, can also be affected after the implementation of an aid program.

We begin by checking if colleges hired additional faculty members as a result of *Ser Pilo Paga*. Figure 8 displays the estimates of this analysis by type of contract and education of the faculty working in high-quality colleges. Positive effects are observed for all types of faculty: faculty working full-time and part-time, and faculty with and without a PhD degree. Larger effects are concentrated among part-time faculty and faculty without a PhD. One potential explanation for these effects is the concern of colleges for the resources available to students. We previously showed how high-quality colleges experienced an increase in the stock of students due to the effect that *Ser Pilo Paga* had on dropout rates. The increase in enrollment can imply that fewer resources are available to students, which may lead colleges to hire additional teaching personnel. Our estimates show that by the end of 2018, high-quality colleges had, on average, an additional 160 part-time faculty (or a 33% increase compared to the mean for 2013), 65 full-time faculty (or 32%), 76 PhD faculty (or 135%), and 155 Non-PhD faculty (or 25%). These findings align with the trend followed by higher education institutions in the US, where the share of part-time and adjunct professors increased dramatically since the late 1980s in response to the growing demand for college education and to reduce educational expenses (Bettinger and Long, 2010; Figlio, Schapiro and Soter, 2015).

To determine if colleges are concerned about the teaching resources available to students, we investigate the effect on the student-to-faculty ratio. Figure 9 displays the estimates of our event-study strategy. Remarkably, we observed a null impact on both the pre-treatment and post-treatment periods (see Figure 9a). This finding suggests that high-quality colleges closely monitor the resources available to their students. Consequently, in response to an increase in enrollment (see Figure 9b), colleges hire additional faculty (see Figure 9c) to maintain a constant student-to-faculty ratio over time. This is important for students since teaching resources can have a direct impact on degree attainment (Bound, Lovenheim and Turner, 2010), as well as other future outcomes.

Given that colleges provide other services such as academic advice and career counseling, we also examine the impact of financial aid on hiring decisions regarding staff personnel. The Ministry of Education classifies college staff in Colombia into: *i)* heads or directors, *ii)* professionals, and *iii)* auxiliary staff. Our results suggest that high-quality colleges did not hire additional personnel for any of these job types. Consequently, the student-to-staff ratio increased during the post-treatment period.[35]

***Effect of Financial Aid on the Supply of College Programs* –** Colleges may also hire additional faculty to introduce new undergraduate programs. Launching new programs can result from education expansion plans to attract financial aid recipients interested in fields where colleges don't currently offer a major. Figure 10 shows the estimated impact of equation (2) on the number of available programs at high-quality colleges over time. By 2018, when the last cohort of the program beneficiaries entered college, high-quality colleges had introduced an average of two additional programs. The significant impact observed only after several years is reasonable, considering the extensive planning and bureaucratic efforts needed to launch a new program in Colombia. Note that the increase in full-time instructors, alongside this trend, implies that financial aid policies may prompt colleges to expand their education supply in the medium term. Therefore, while high-quality colleges do not significantly expand the size of entering cohorts while preserving quality—as measured by a stable student-to-faculty ratio—they could be interested in absorbing excess demand by launching new programs.

VII. Conclusion

This paper examines the impact of college financial aid on tuition, leveraging Colombian data and the exogenous variation from a large-scale government financial aid program's introduction. To identify the effect of the policy, we use a difference-in-differences strategy, in which our control group is the set of two-year colleges where loan recipients do not enroll. Our findings suggest that tuition at high-quality colleges increased by about 6.9 percent as a result of the introduction of the program. We do not find evidence of spillover effects on tuition at non-eligible four-year colleges (i.e., colleges offering similar programs as schools with high-quality accreditation). Additionally, we provide suggestive evidence showing that high-quality colleges—which increased tuition—are willing to expand to receive more students as they increase the number of admissions. Still, these institutions seem to have

[35]See Appendix Figures D.2 and D.3.

an inelastic supply since the increase in admissions does not increase at the same pace as applications.

We find total enrollment in all four-year college colleges increases in response to the program. In response to this increase, high-quality private colleges—our main focus of interest, as they received most program beneficiaries—hire more part-time and full-time instructors to accommodate the higher student population. This effort ensures that the student-to-faculty ratio remains unchanged despite the fact that the stock of students in a program increased by 14 percent. Furthermore, all types of faculty, including those with and without PhD degrees, experience an increase in hiring. Finally, we provide evidence that financial aid may lead high-quality colleges to open new undergraduate programs. These trends suggest that high-quality colleges use the additional revenues obtained from the rise in tuition to expand their educational offerings while maintaining the quality of education they provide. This evidence supports a narrative where high-quality private colleges prioritize their reputation, opting for gradual expansion without compromising quality.

Finally, we close our discussion, emphasizing that financial aid might have indirectly affected our control group, although that scenario has a low probability—at least relative to other market segments. This paper presents evidence supporting that our control group does not receive fewer applications nor enroll fewer students after the program. These patterns might indicate that if our estimates are biased, they would be downward biased. Consequently, our results, especially those with small or no effects, need to be interpreted cautiously.

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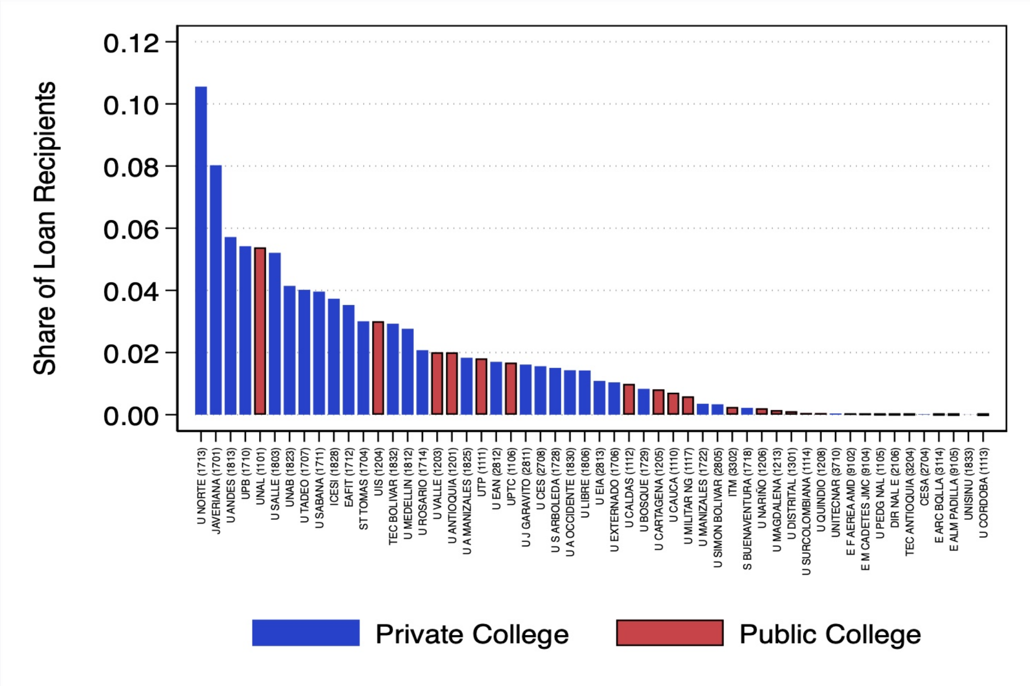
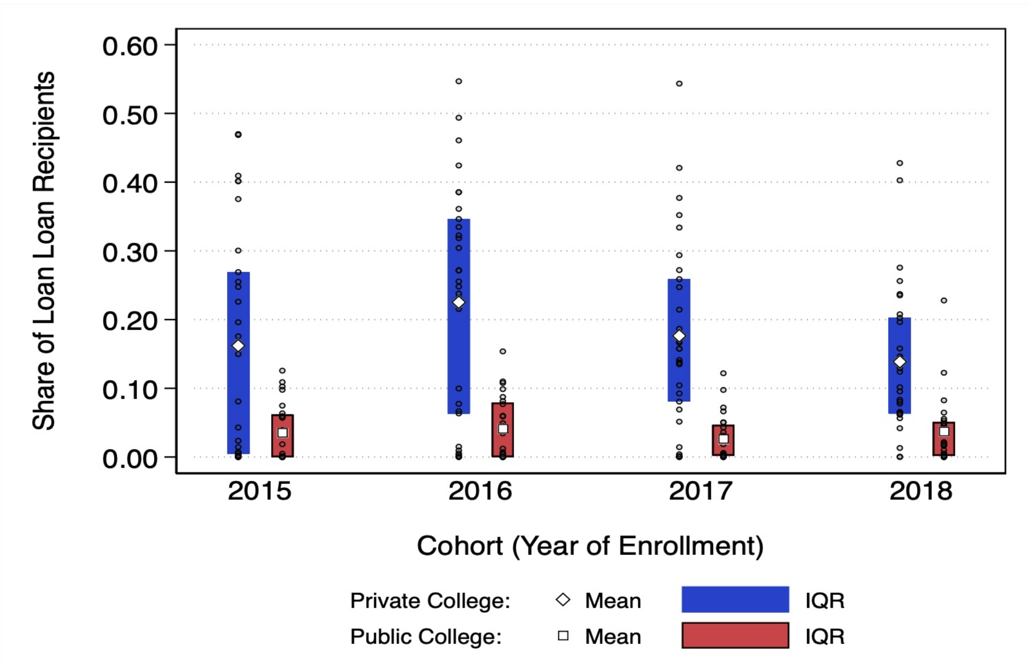
Figures and Tables

Figure 1: Financial Aid Recipients Across and Within Colleges, 2015-2018

(a) Share of Recipients Across Colleges

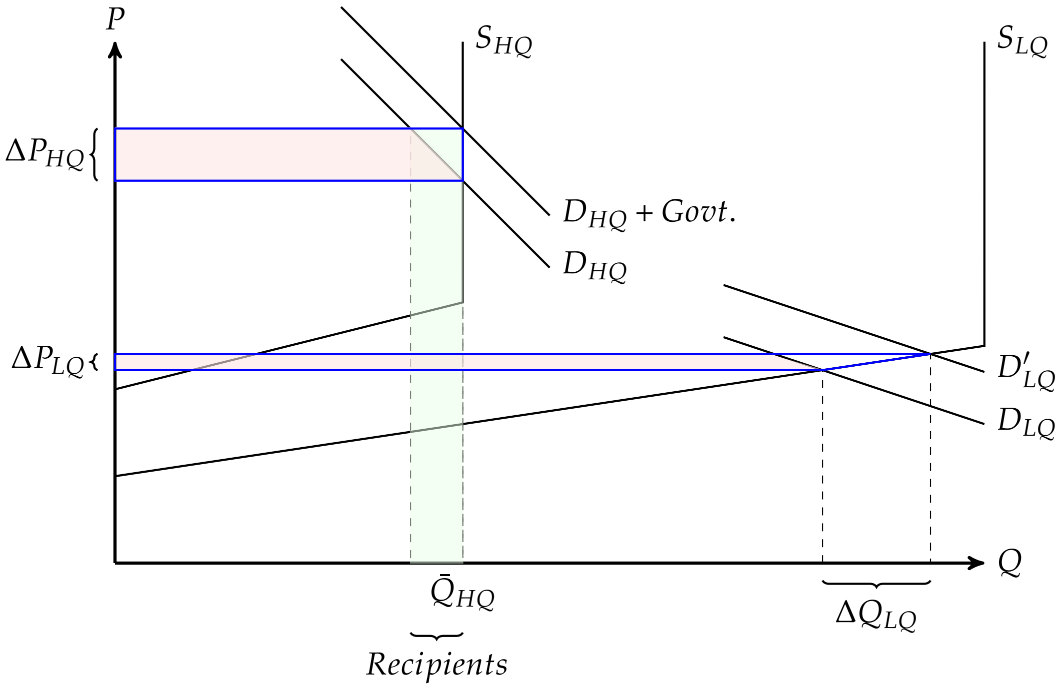


(b) Share of Recipients Among Freshmen



Notes. Panel (a) plots the share of *Ser Pilo Paga* loan recipients enrolled in different high-quality colleges from 2015 to 2018. Panel (b) plots the share of loan recipients within cohorts of first-year students. Each plotted dot represents the share of newly enrolled students in college who are loan recipients. Boxes represent the interquartile range (1st and 3rd quartiles) across college-cohorts. Rhombus and square markers correspond to the average share of recipients across college-cohorts.

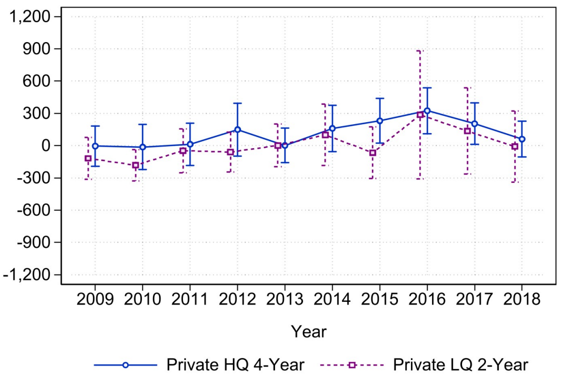
Figure 2: Conceptual Framework Relating College Financial Aid and Tuition Prices



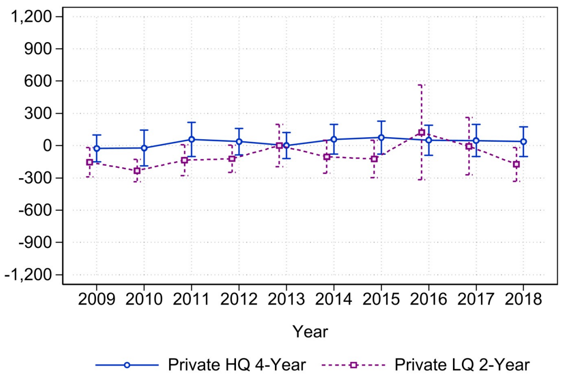
Notes. This graph serves as a visual representation of the conceptual framework employed to support the main hypotheses investigated in this study. It depicts the bachelor's degree market in Colombia, distinguishing between two segments: universities with high-quality accreditation (represented as *HQ*) and universities lacking such accreditation (represented as *LQ*). It is important to note that this graph assumes a constant price elasticity of demand for the purpose of simplification. However, in section **??**, we elaborate on the reasons why the price elasticity of demand may have undergone changes as well.

Figure 3: Average Freshmen and Applicants Across Type of Colleges

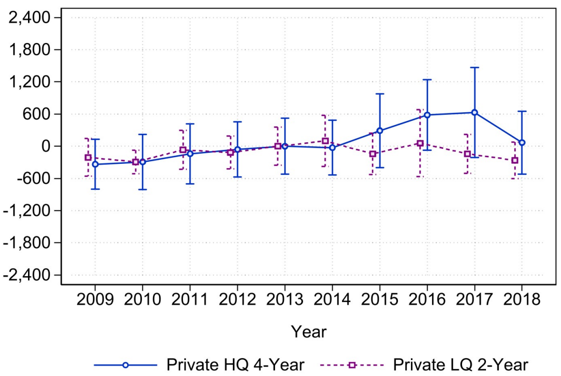
(a) Number of Freshmen, Spring



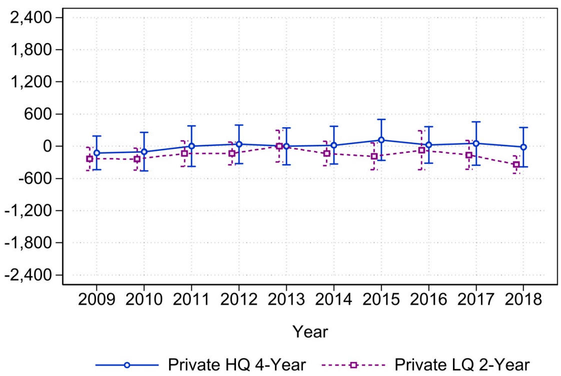
(b) Number of Freshmen, Fall



(c) Number of Applicants, Spring



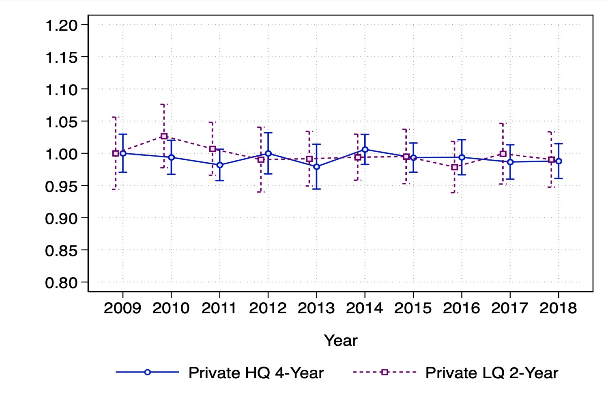
(d) Number of Applicants, Fall



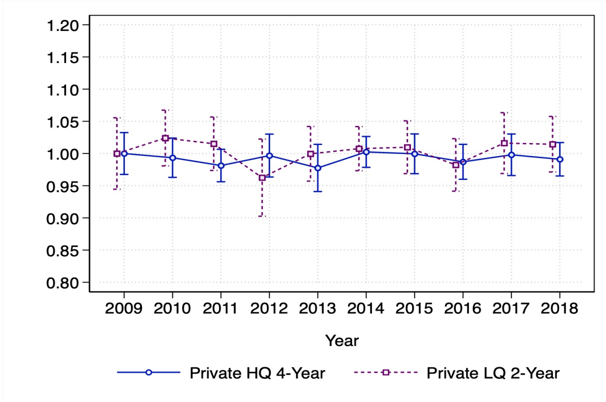
Notes. These figures display the average of the number of freshmen and applicants across college types (i.e., high-quality four-year and low-quality two-year colleges). Means are normalized to the base value of 2013. 95% confidence intervals are displayed around sample means.

Figure 4: Average Student Characteristics Across Type of Colleges

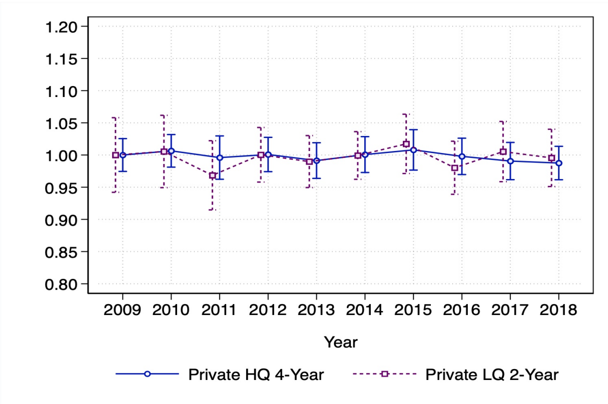
(a) Share of Female Applicants



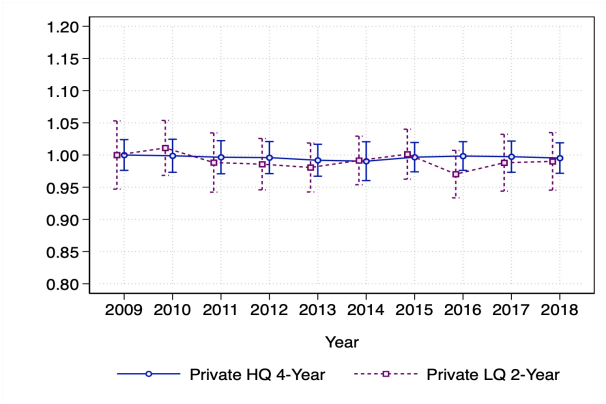
(b) Share of Females Offered Admission



(c) Share of First-Year Female Students



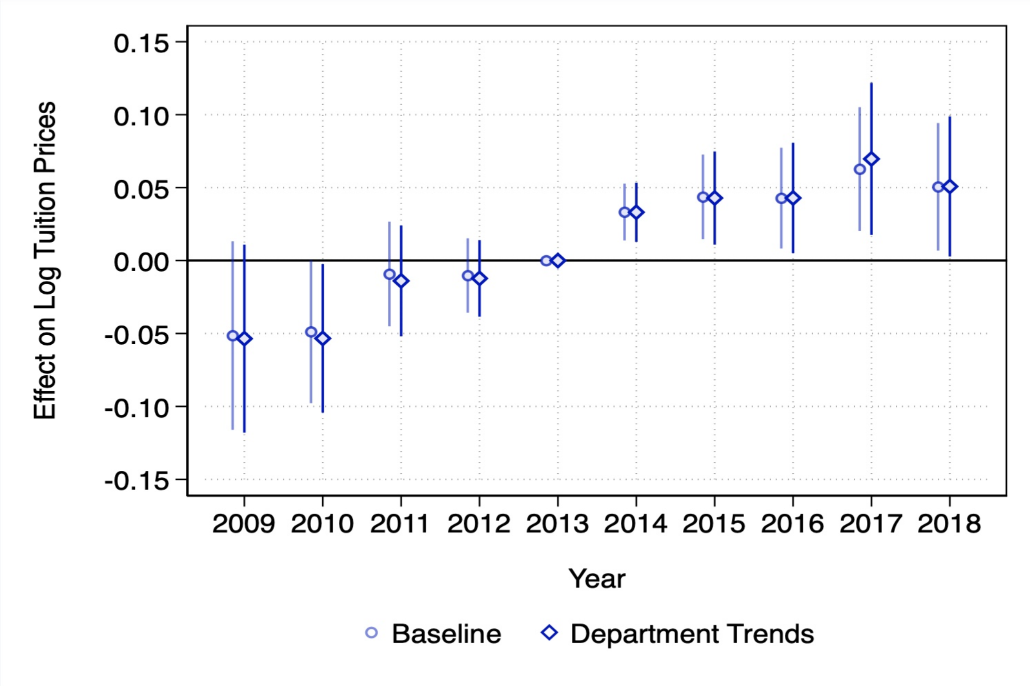
(d) Share of Female Students Enrolled



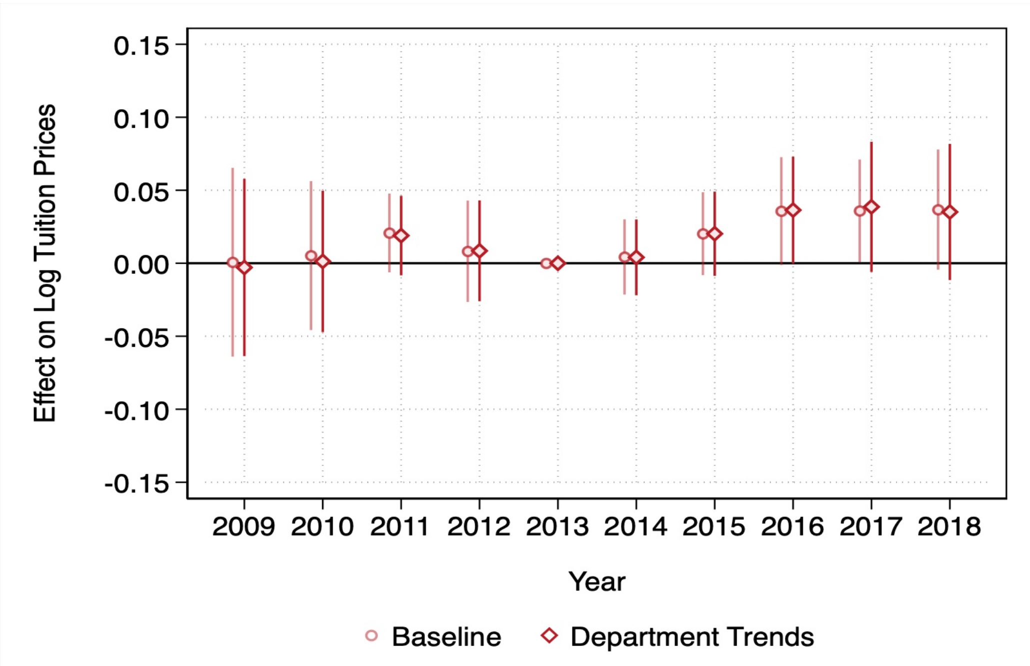
Notes. These figures display the average of the share of females across college types (i.e., high-quality four-year and low-quality two-year colleges) for different outcomes. Means are normalized to the base value of 2009. 95% confidence intervals are displayed around sample means.

Figure 5: Effect of Financial Aid on College Tuition Prices

(a) *Direct Effect*: High-Quality Four-Year Colleges



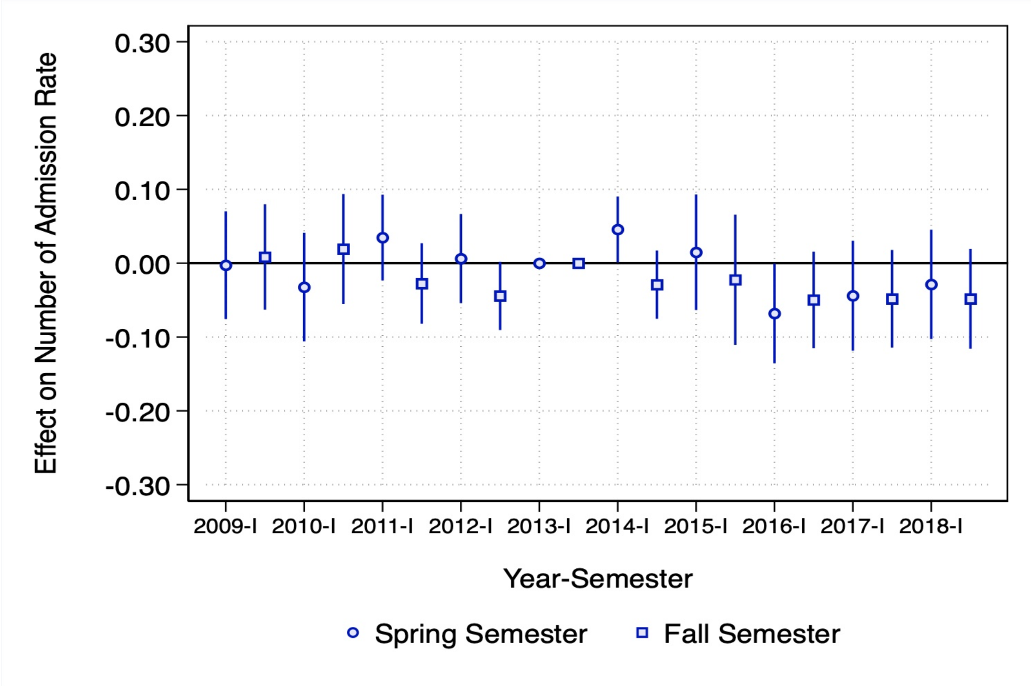
(b) *Spillover Effect*: Low-Quality Four-Year Colleges



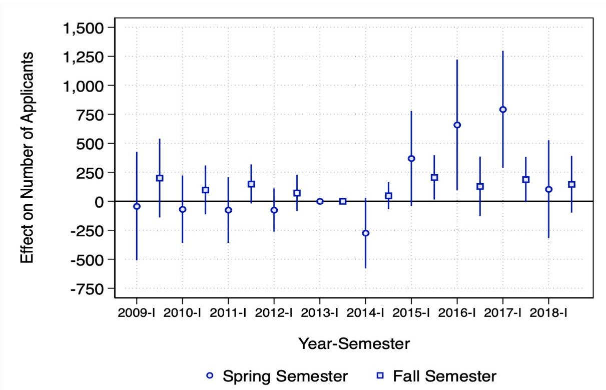
Notes. Ordinary least squares (OLS) estimates of Equation (1). Tuition for all college programs is expressed in prices of 2009 to account for inflation. The outcome variable is the logarithm of mean tuition in each college. Panel (a) displays the estimates of δ_τ, with $\tau \in \{2009, ..., 2018\}$, representing the (*direct*) effect on tuition at high-quality four-year colleges after the government introduced the financial aid program *Ser Pilo Paga*. Panel (b) displays the estimates of β_τ, corresponding to the (*spillover*) effect on tuition at low-quality four-year colleges. Circle markers represent the estimates from a baseline specification that controls for college and year fixed effects. Rhombus markers represent the full specification, including linear and department linear trends. Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Figure 6: Direct Effect of Financial Aid on College Admission Rates

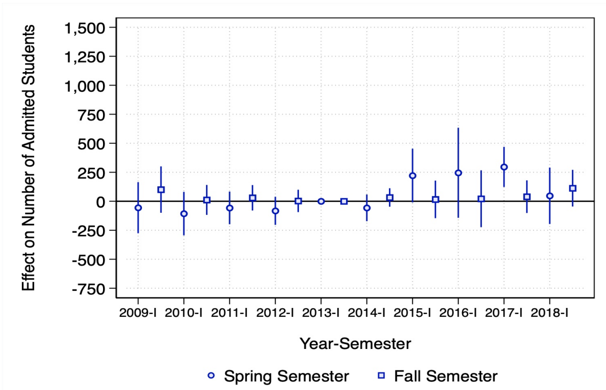
(a) Admission Rate



(b) Number of Applicants



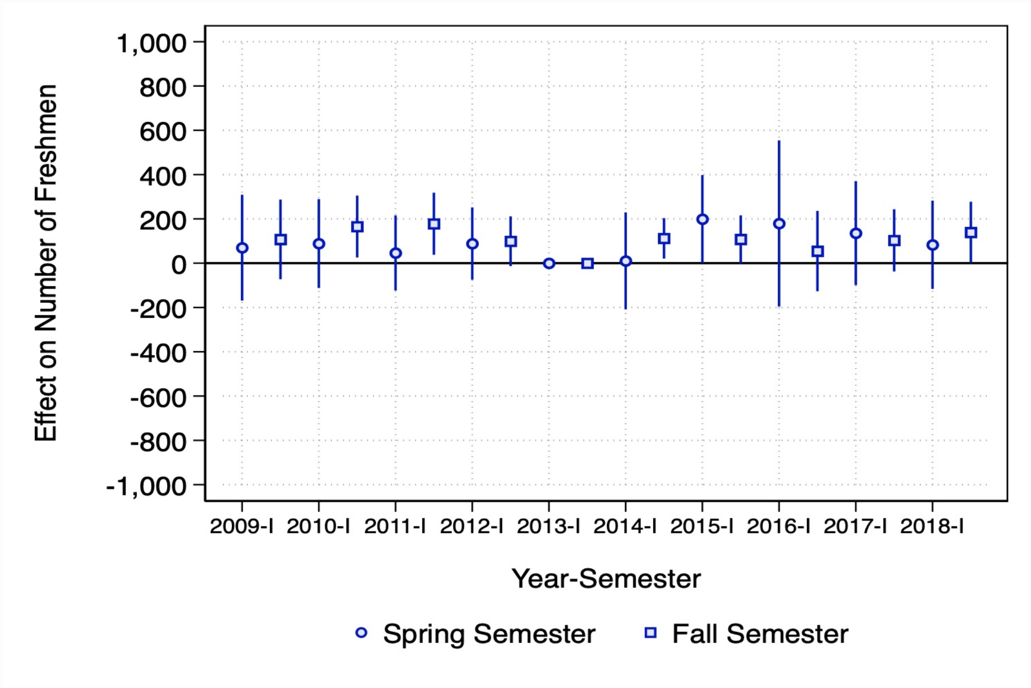
(c) Number of Admissions



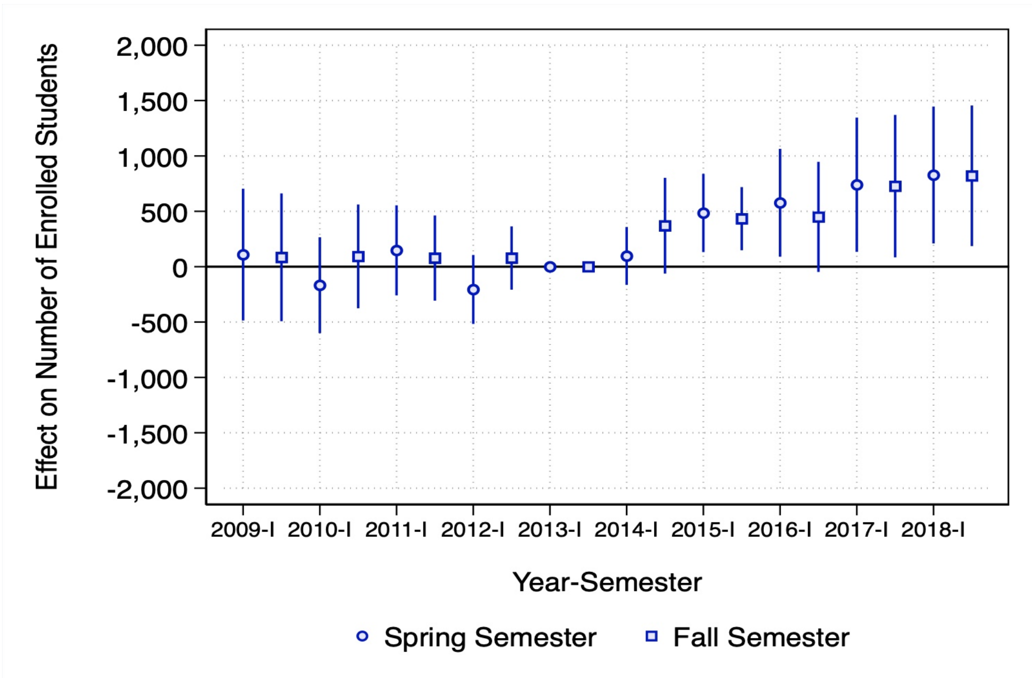
Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable in Panel (a) is the admission rate of college programs, computed as the fraction of students offered admission among the total number of applicants to a program. In panels (b) and (c), the outcome variables are the number of applicants and the number of admissions offered, respectively. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Figure 7: Direct Effect of Financial Aid on College Enrollment

(a) Number of Freshmen (Flow)

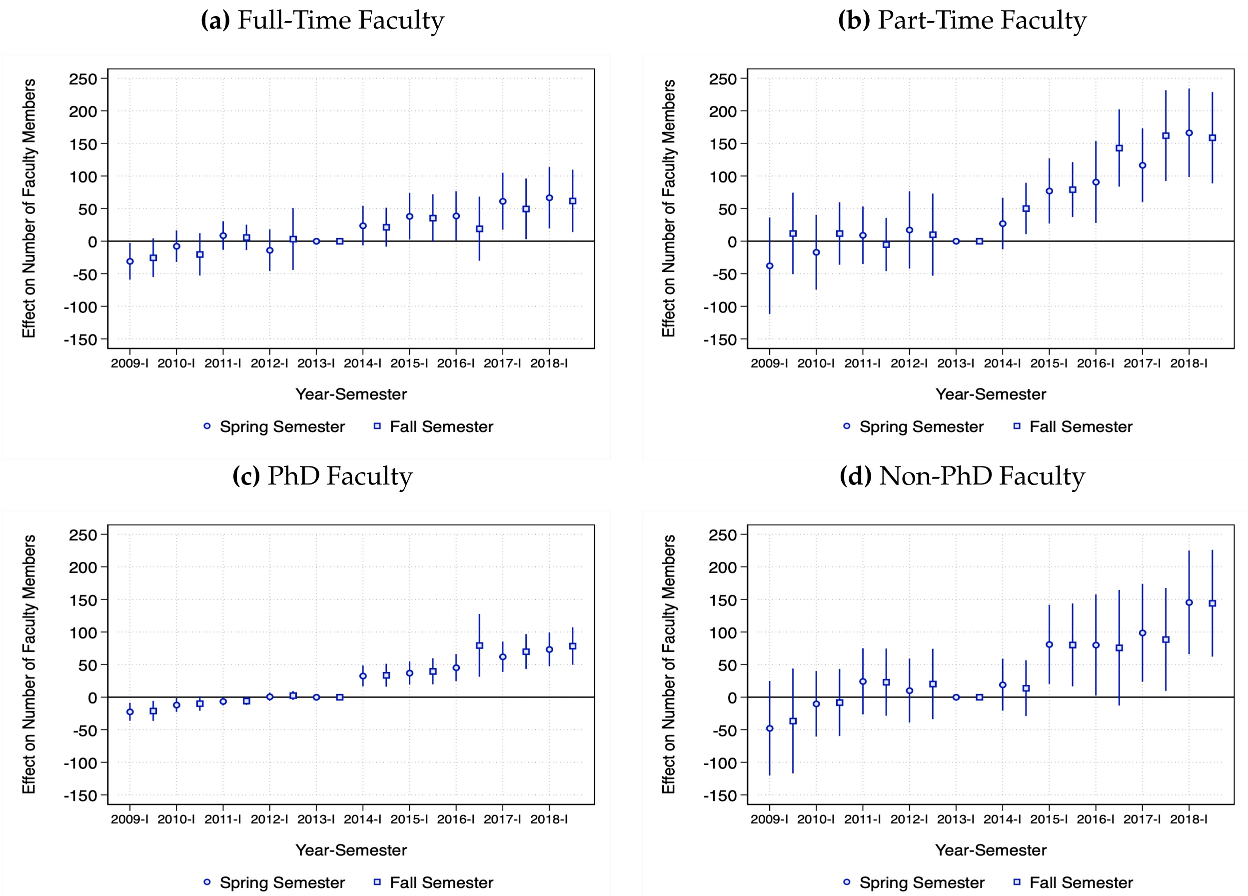


(b) Number of Enrolled Students (Stock)



Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. In panels (a) and (b), the outcome variables are the number of first-year students (freshmen) in a college program and the number of all enrolled students, respectively. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

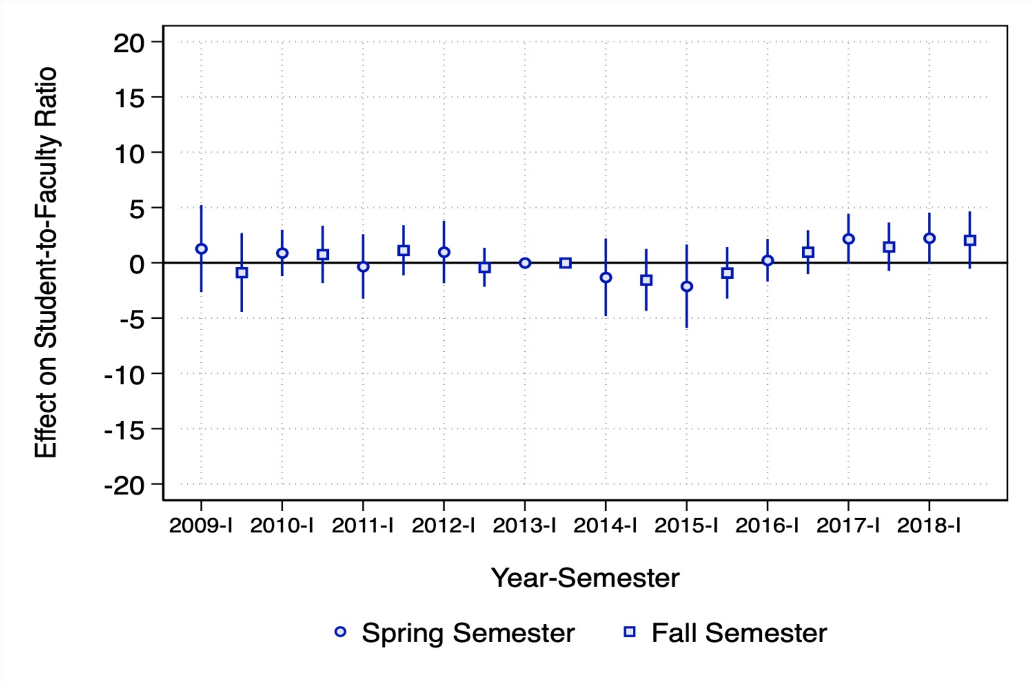
Figure 8: Direct Effects of Financial Aid on Faculty Hiring



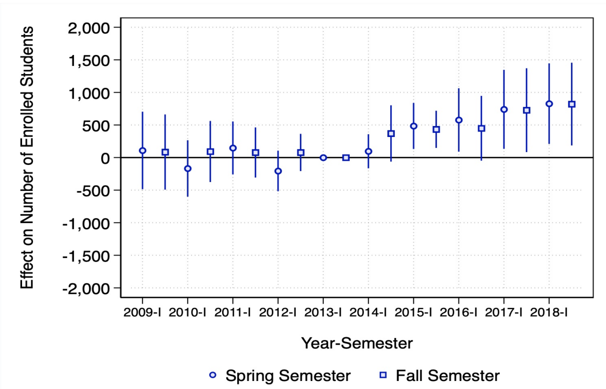
Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. In panels (a) and (b), the outcome variables are the number of faculty members working under a full-time contract in a college and the number working part-time. In panels (b) and (c), the outcome variables are, respectively, the number of faculty members in a college who hold a PhD degree and the number holding a Master's or a Bachelor's degree. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, and department linear trends. Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Figure 9: Direct Effect of Financial Aid on the Student-to-Faculty Ratio

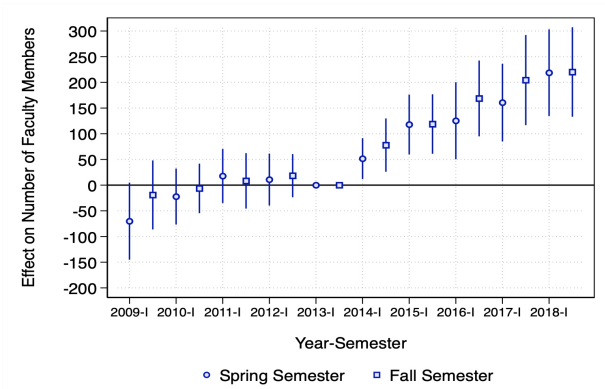
(a) Student-to-Faculty Ratio



(b) Number of Enrolled Students

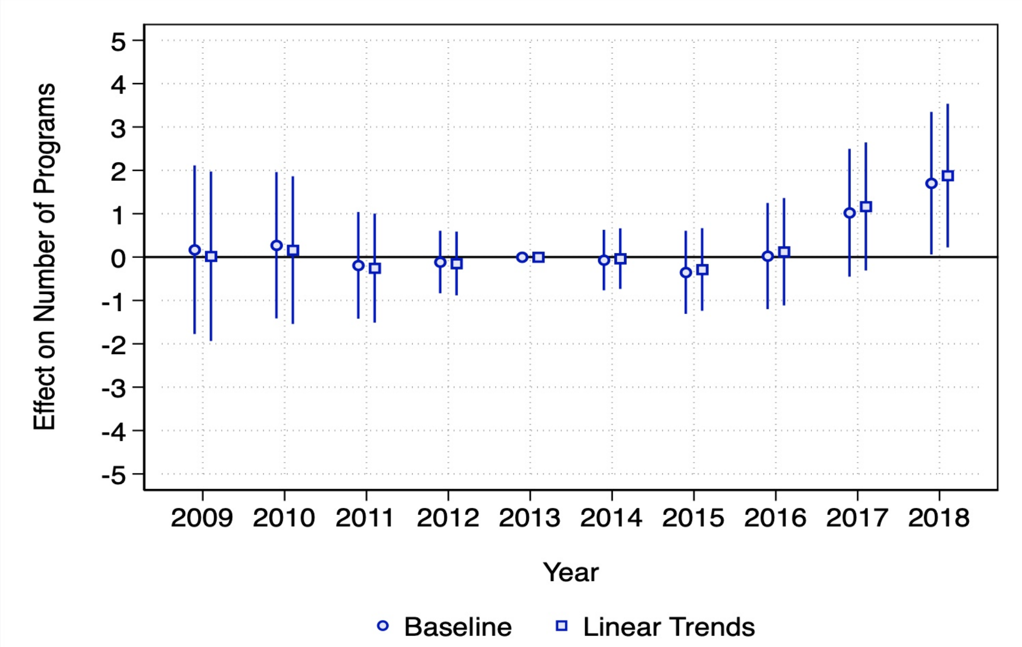


(c) Number of Faculty Members



Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable in Panel (a) is the student-to-faculty ratio in each college. In panels (b) and (c), the outcome variables are the number of students enrolled in a college and the total number of faculty members, respectively. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, and department linear trends. Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Figure 10: Direct Effect of Financial Aid on the Number of Undergraduate Programs



Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable is the number of undergraduate programs offered in each college. Circle markers represent the estimates from a baseline specification that controls for college and year fixed effects. Square markers additionally control for department linear trends. Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Table 1: Effect of Financial Aid on College Tuition Prices

	Dependent Variable : log(Tuition)					
	Average Tuition			1st Quartile	Median	3rd Quartile
	(1)	(2)	(3)	(4)	(5)	(6)
Private HQ 4-Y × Post	0.068***	0.067***	0.069***	0.096***	0.060**	0.055***
	[0.017]	[0.017]	[0.019]	[0.025]	[0.028]	[0.020]
Private LQ 4-Y × Post	0.020	0.017	0.018	–0.002	0.009	0.027
	[0.017]	[0.017]	[0.017]	[0.021]	[0.024]	[0.017]
Observations	1,190	1,190	1,190	1,190	1,190	1,190
R-squared	0.975	0.979	0.980	0.949	0.968	0.973
College FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE		Yes	Yes	Yes	Yes	Yes
Department Trends			Yes	Yes	Yes	Yes

Notes. Ordinary-least-squares estimates of the effect of a financial aid policy on college tuition prices, based on the following equation: $Y_{i(c),\,t} = \mu_c + \mu_t + \delta$ (HQ 4-Year$_c$ × Post) + β (LQ 4-Year$_c$ × Post) + $X'_{it}\gamma + \varepsilon_{i(c),\,t}$. HQ 4-Year$_c$ is an indicator equal to 1 if c is a four-year college holding high-quality accreditation. LQ 4-Year$_c$ is an indicator equal to 1 if c is an non-accredited four-year college. Post is an indicator equal to 1 for the post-treatment period 2014-2018. μ_c and μ_t represent college and year fixed effects. X_{it} is a set of controls that include field of study fixed effects, study area time-trends, and department time-trends. The outcome variable is the log of tuition prices charged at private colleges to students enrolled in each undergraduate program. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. Standard errors in square brackets are clustered at the college level. * p<0.10, ** p<0.05, *** p<0.01.

Table 2: Effect of Financial Aid on College Admission Rates

	Dependent Variable :							
	Admission Rate		Applicants		Admissions		Freshmen	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Spring								
Private HQ 4-Y × Post	–0.025	–0.013	443.726***	338.390	195.753**	205.774**	51.109	60.686
	[0.027]	[0.027]	[162.867]	[210.841]	[92.226]	[91.872]	[75.176]	[74.854]
Private LQ 4-Y × Post	–0.039	–0.043	162.388	89.243	74.546	70.168	6.476	6.246
	[0.025]	[0.026]	[114.509]	[156.967]	[92.531]	[95.728]	[75.819]	[78.727]
Public HQ 4-Y × Post	–0.049	–0.039	1,142.479**	1,050.873***	115.435	156.492	22.562	38.760
	[0.031]	[0.035]	[502.715]	[370.415]	[104.215]	[109.841]	[84.224]	[87.267]
Public LQ 4-Y × Post	–0.080***	–0.056*	1,041.251	1,170.908	23.846	45.311	4.345	21.999
	[0.028]	[0.029]	[681.137]	[857.099]	[93.430]	[87.758]	[89.503]	[85.103]
R-squared	0.786	0.791	0.916	0.923	0.897	0.899	0.859	0.863
Panel B: Fall								
Private HQ 4-Y × Post	–0.034	–0.028	135.592*	36.702	24.993	17.707	5.472	–1.544
	[0.027]	[0.028]	[74.760]	[98.045]	[61.057]	[63.801]	[50.399]	[51.508]
Private LQ 4-Y × Post	–0.061**	–0.068**	155.292**	99.399	57.654	47.815	–3.477	–1.449
	[0.028]	[0.028]	[63.708]	[80.595]	[61.318]	[64.617]	[46.016]	[47.832]
Public HQ 4-Y × Post	–0.048	–0.051	223.199	89.037	–37.825	–50.295	37.866	36.609
	[0.035]	[0.038]	[323.874]	[264.609]	[65.899]	[70.588]	[64.321]	[66.615]
Public LQ 4-Y × Post	–0.106***	–0.080**	529.344**	468.989*	37.277	22.323	66.815	45.861
	[0.034]	[0.033]	[242.613]	[262.155]	[62.477]	[61.400]	[60.486]	[55.983]
R-squared	0.757	0.765	0.937	0.942	0.905	0.906	0.876	0.878
Observations	2,134	2,134	2,134	2,134	2,134	2,134	2,134	2,134
College FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department Trends		Yes		Yes		Yes		Yes

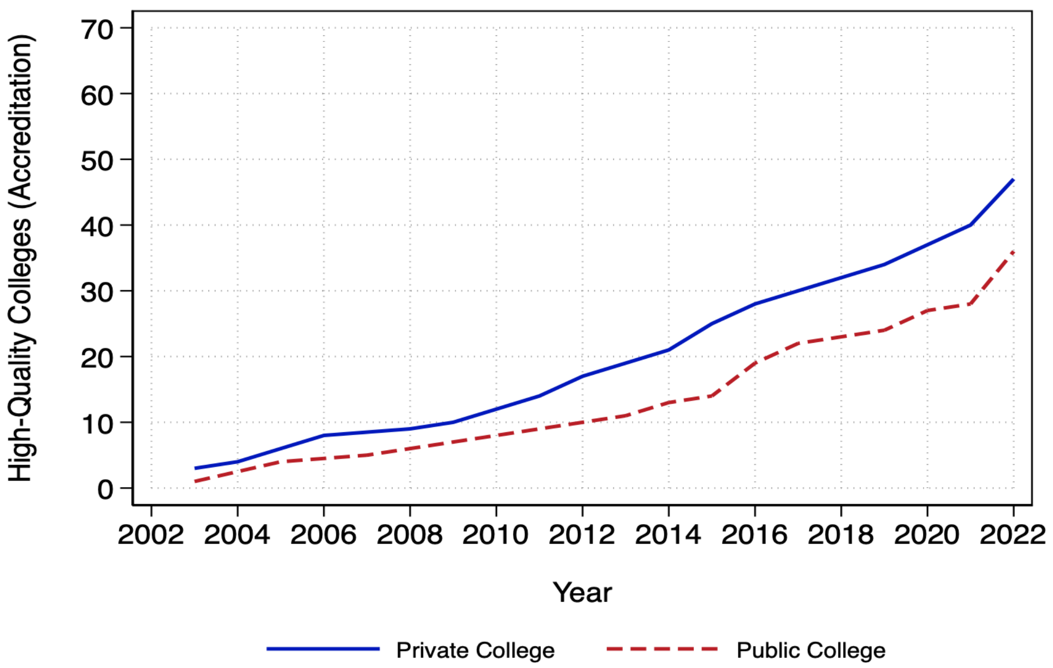
Notes. Ordinary-least-squares estimates of the effect of a financial aid policy on college tuition prices, based on the following equation: $Y_{i(c),\,t} = \mu_c + \mu_t + \delta\,(\text{HQ 4-Year}_c \times \text{Post}) + \beta\,(\text{LQ 4-Year}_c \times \text{Post}) + X'_{it}\gamma + \varepsilon_{i(c),\,t}$. HQ 4-Year$_c$ is an indicator equal to 1 if c is a four-year college holding high-quality accreditation. LQ 4-Year$_c$ is an indicator equal to 1 if c is an non-accredited four-year college. Post is an indicator equal to 1 for the post-treatment period 2014-2018. μ_c and μ_t represent college and year fixed effects. In columns (1) to (3) the outcome variable is the admission rate at each college program, computed as the fraction of students offered admission among the total number of applicants to a program (or major). The outcome variable in columns (4) to (6) is the number of applicants to a program, whereas the outcome in columns (4) to (6) is the number of students who are offered admission. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. Standard errors in square brackets are clustered at the college level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Appendices

A.. Institutional Setting Details

A.1. High Quality Accreditation

Appendix Figure A.1: Number of Colleges with High-Quality Accreditation.



Notes. This figure displays the number of colleges with high-quality accreditation over time. The solid blue line represents private colleges, while the red dashed line represents public colleges.

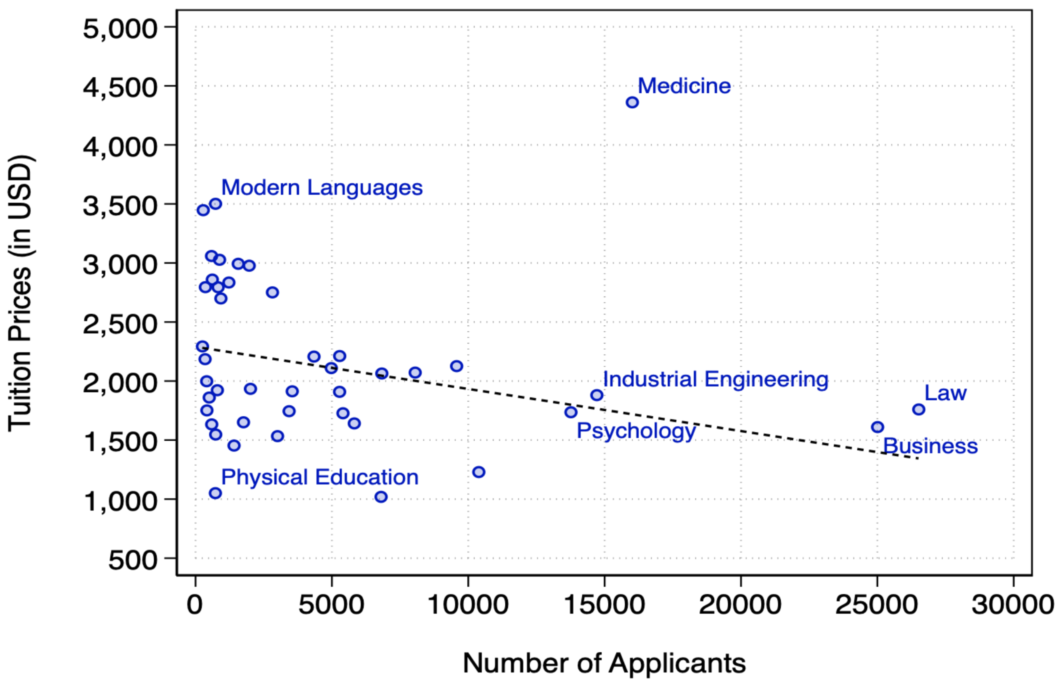
Appendix Table A.1: Number of Colleges and Programs, 2009-2018 (Pool)

	Four-Year		Two-Year	
	High-Quality	Low-Quality	High-Quality	Low-Quality
	Panel A: Private Colleges			
Colleges by Type				
Technical Institute	-	-	-	14
Technological Institute	-	-	1	26
University	44	32	-	1
University Institute	2	60	-	18
Total	46	92	1	59
Programs by Study Area				
Agronomy	4	33	-	4
Arts	47	80	-	102
Economics & Business	171	344	8	277
Education	44	72	-	5
Engineering	229	333	11	172
Health	63	149	1	13
Math & Natural Sc.	31	13	-	-
Social Sciences	177	207	2	38
Total	766	1231	22	611
	Panel B: Public Colleges			
Colleges by Type				
Technical Institute	-	-	-	7
Technological Institute	-	-	2	8
University	29	17	-	-
University Institute	1	12	3	9
Total	30	29	5	24
Programs by Study Area				
Agronomy	22	19	1	5
Arts	39	16	2	12
Economics & Business	106	81	12	68
Education	163	72	5	3
Engineering	217	133	25	97
Health	53	27	3	1
Math & Natural Sc.	79	24	1	1
Social Sciences	126	44	6	14
Total	805	416	55	201

Notes. This table presents the number of colleges by type and the number of in-person undergraduate programs by area of study. Counts for private colleges are displayed in Panel A, while counts for public are displayed in Panel B. Two-year colleges are defined as colleges where more than 50 percent of students are enrolled in two-year programs.

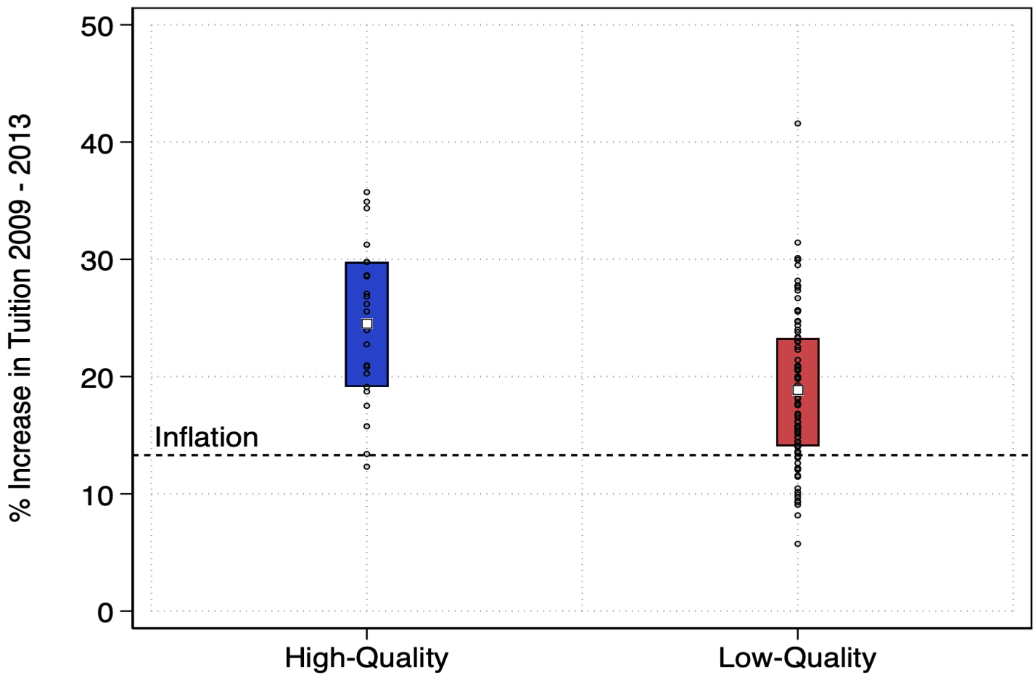
A.2. Tuition Regulation for Colleges in Colombia

Appendix Figure A.2: Tuition Prices and College Applicants by Field of Study



Notes. This figure shows the relationship between college tuition prices and the number of applicants to programs in different fields of study. The Ministry of Education classifies college programs into 56 fields. Only tuition prices from four-year programs at private colleges are considered. Fields where less than two colleges offer undergraduate programs are omitted.

Appendix Figure A.3: Increase in Tuition Prices by College Quality, 2009-2013



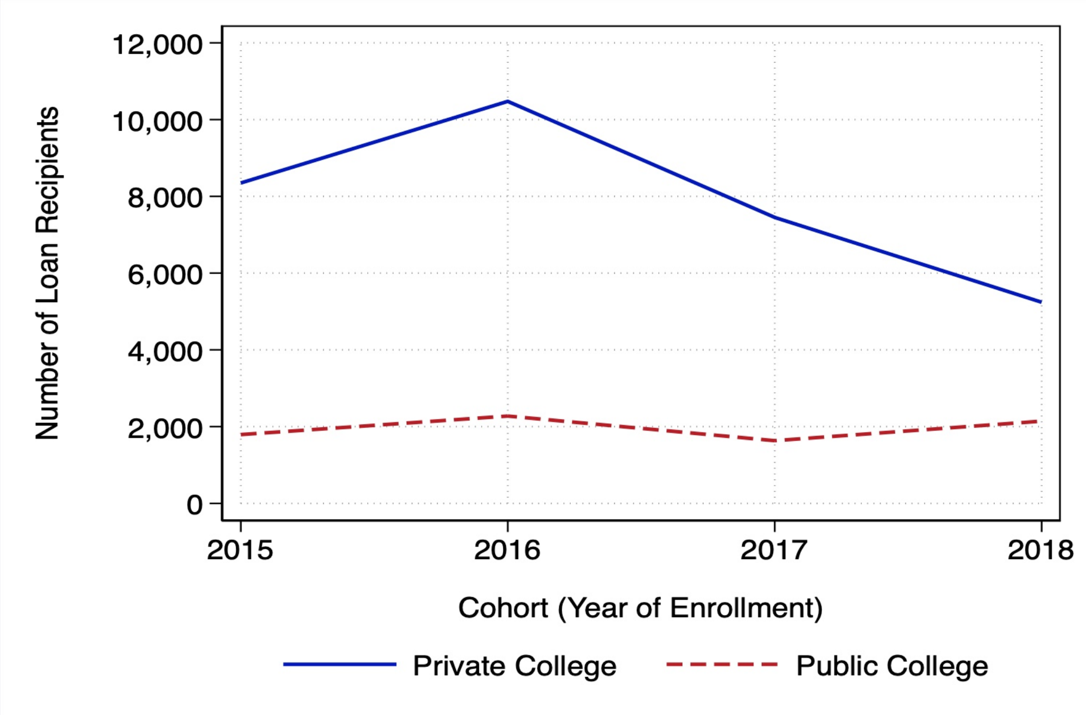
Notes. This figure displays the relationship between inflation and tuition increase across private colleges. Plotted dots represent the average tuition increase of private colleges' programs, measured between 2009 and 2013. Square markers represent the mean of tuition increases across schools. The horizontal dashed line represents the 2009-2013 inflation rate.

A.3. *Ser Pilo Paga* Financial Aid and Loan Recipients Sorting

Appendix Figure A.4: Eligibility Announcement for the Financial Aid Program *Ser Pilo Paga*

Notes. This figure displays the message that high school seniors received after logging in to check their performance in the *Saber 11* exit exam. In English, it reads: "Your score is equal to or above 310. You may be eligible for one of 10,000 scholarships to pursue higher education."

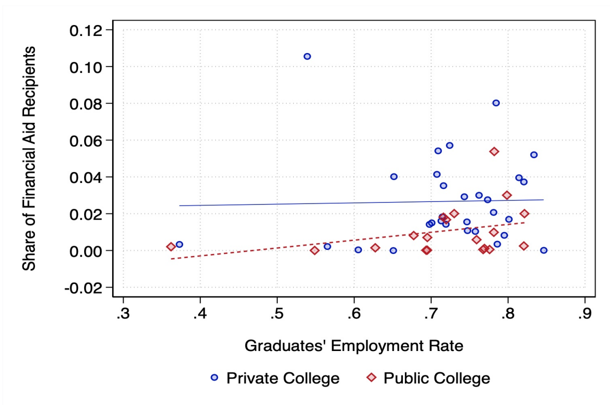
Appendix Figure A.5: Financial Aid Recipients by Cohort of Enrollment



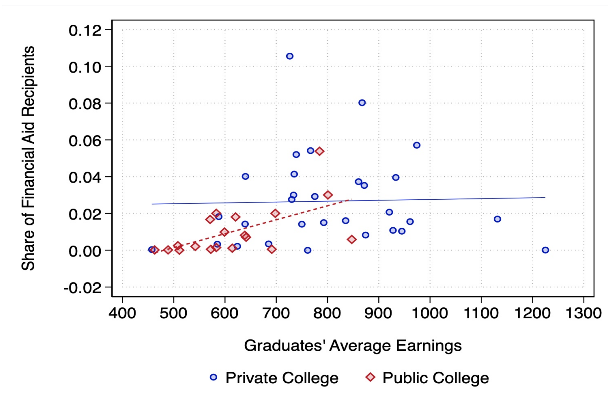
Notes. This figure displays the number of loan recipients of the financial aid program *Ser Pilo Paga* by year of enrollment. The solid blue line represents the number of recipients who enrolled in any private college, whereas the red dashed line represents the number who enrolled in public colleges.

Appendix Figure A.6: Relation between College Characteristics and Loan Recipients' Sorting

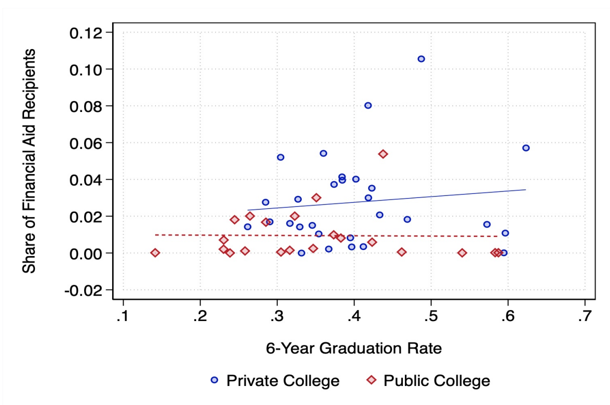
(a) Employment Rate



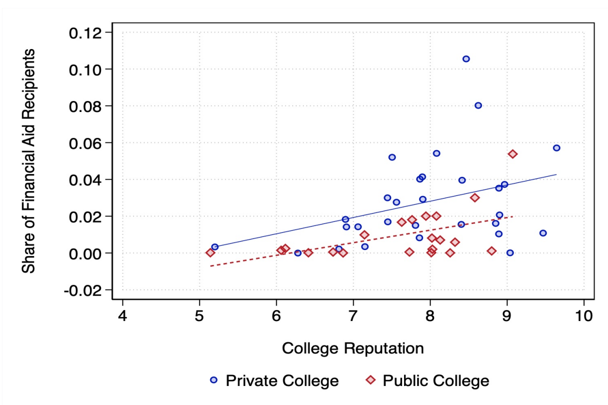
(b) Graduates' Earnings



(c) Six-Year Graduation Rates



(d) College Reputation



Notes. This Figure plots the relationship between the fraction of *Ser Pilo Paga* beneficiaries across colleges and different college outcomes measured by 2014. College reputation is computed as the average percentile in the high school exit exam (*Saber 11*) of each college's graduates between 2006 and 2014. For details about the college reputation measure see MacLeod et al. (2017). Six-year graduation rates are computed using the data of students who enrolled in bachelor's degree programs between 2000 and 2007. Employment rates correspond to the fraction of graduates employed in the formal sector one year after getting a college degree. Employment rates are computed by pooling all graduates between 2007 and 2013. Monthly earnings correspond to the average monthly earnings of graduates working in the formal sector one year after getting a college degree.

Appendix Table A.2: Relation between College Characteristics and Loan Recipients' Sorting

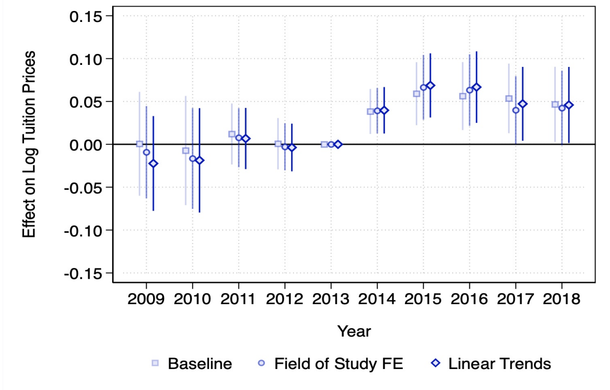
	Dependent Variable : Share of Loan Recipients						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Private	0.017***	0.016***	0.017***	0.015*	0.014***	0.023***	0.025***
	[0.006]	[0.006]	[0.006]	[0.008]	[0.005]	[0.007]	[0.009]
Graduation Rate		0.015				0.007	0.002
		[0.031]				[0.031]	[0.048]
Employment Rate			0.016			0.007	0.140**
			[0.039]			[0.039]	[0.067]
Graduates' Earnings				0.000		–0.000*	–0.000*
				[0.000]		[0.000]	[0.000]
College Reputation					0.008***	0.012***	0.014**
					[0.003]	[0.004]	[0.006]
Observations	48	48	48	48	48	48	48
R-squared	0.142	0.147	0.148	0.147	0.275	0.325	0.556
Department FE							Yes

Notes. Ordinary-least-squares estimates. The dependent variable is the share of all loan recipients that enroll in each college between 2015 and 2018. College reputation is computed as the average percentile in the high school exit exam (*Saber 11*) of each college's graduates between 2006 and 2014. For details about the college reputation measure see MacLeod et al. (2017). Six-year graduation rates are computed using the data of students who enrolled in bachelor's degree programs between 2000 and 2007. Employment rates correspond to the fraction of graduates employed in the formal sector one year after getting a college degree. Employment rates are computed by pooling all graduates between 2007 and 2013. Monthly earnings correspond to the average monthly earnings of graduates working in the formal sector one year after getting a college degree. Robust standard errors are displayed in square brackets. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

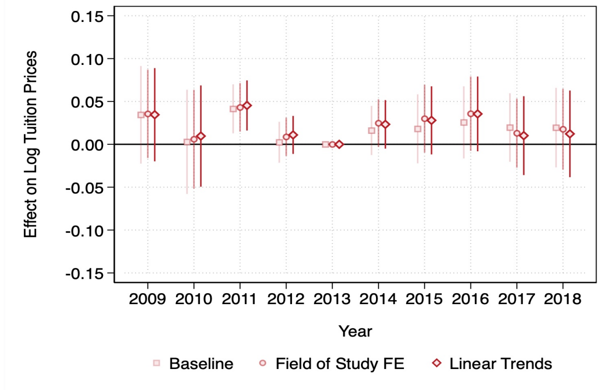
B.. Additional Robustness Checks for the Main Results

Appendix Figure B.1: Robustness of the Effect of Financial Aid on Tuition at Program Level

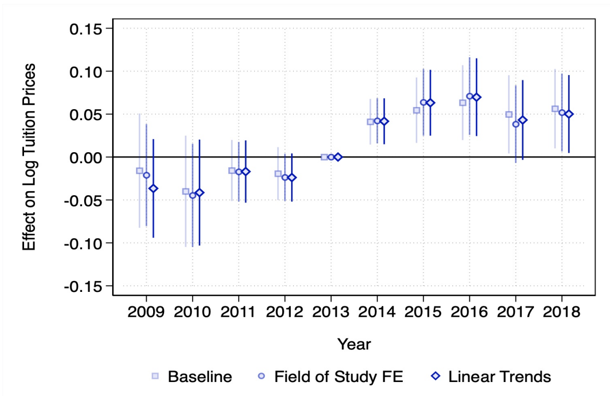
(a) High-Quality Four-Year Colleges



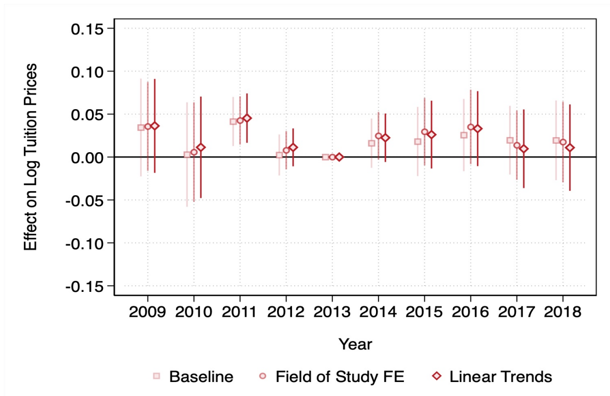
(b) Low-Quality Four-Year Colleges



(c) High-Quality Four-Year Colleges, Restricted



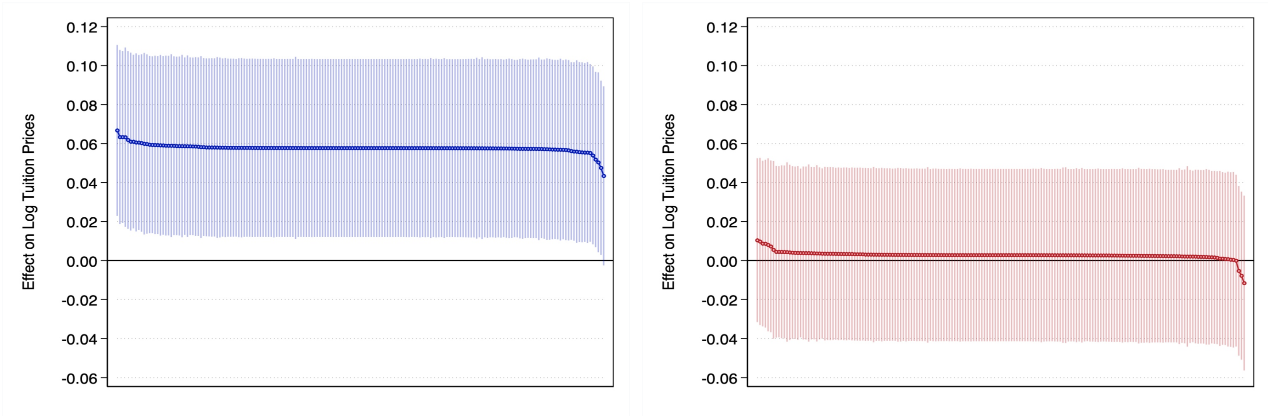
(d) Low-Quality Four-Year Colleges, Restricted



Notes. Ordinary least squares (OLS) estimates of Equation (1). The outcome variable is the logarithm of tuition prices. Tuition for all college programs is expressed in prices of 2009 to account for inflation. Panels (a) and (c) display the estimates of δ_τ, with $\tau \in \{2009, ..., 2018\}$, representing the (*direct*) effect on tuition at high-quality four-year colleges after the government introduced the financial aid program *Ser Pilo Paga*. Panels (b) and (d) display the estimates of β_τ, corresponding to the (*spillover*) effect on tuition at low-quality four-year colleges. Square markers represent the estimates from a baseline specification that controls for college and year fixed effects. Circle markers additionally control for field of study fixed effects. Rhombus markers represent the full specification, which includes study area linear trends and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients. Panels (a) and (b) use the unrestricted sample, where all colleges that received high-quality accreditation during the sample are classified as high-quality. Panels (c) and (d) exclude from the sample colleges that obtained high-quality accreditation post-treatment.

Appendix Figure B.2: Robustness of the Effect of Financial Aid on Tuition - Excluding Colleges

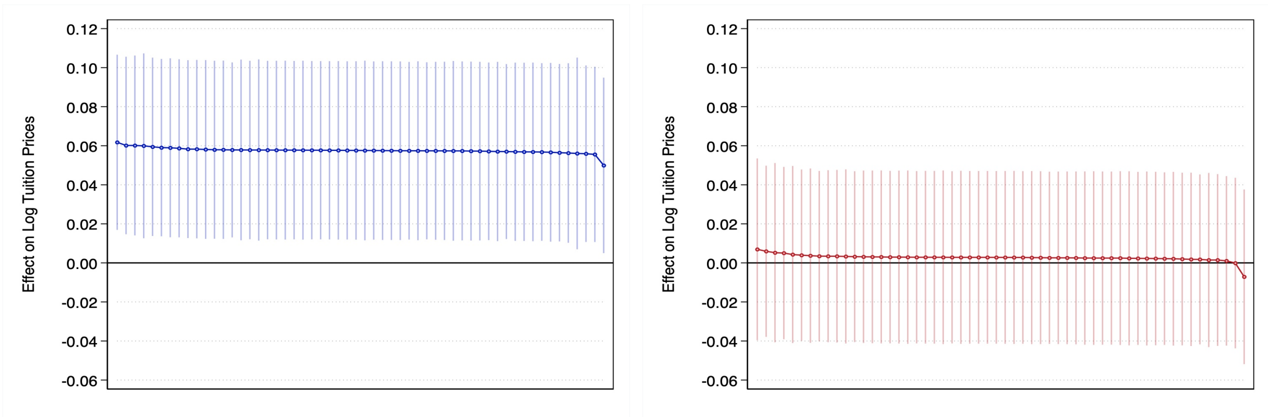
(a) *Direct Effect*: HQ Four-Year Colleges **(b)** *Spillover Effect*: LQ Four-Year Colleges



Notes. Each plotted dot represents the estimated effect of financial aid on tuition prices dropping from the sample one college at a time. Estimates are based on the following equation: $Y_{i(c),\,t} = \mu_c + \mu_t + \delta$ (HQ 4-Year$_c$ $\times$ Post) + β (LQ 4-Year$_c$ $\times$ Post) + $X'_{it}\gamma + \varepsilon_{i(c),\,t}$. HQ 4-Year$_c$ is an indicator equal to 1 if c is a four-year college holding high-quality accreditation. LQ 4-Year$_c$ is an indicator equal to 1 if c is an non-accredited four-year college. Post is an indicator equal to 1 for the post-treatment period 2014-2018. μ_c and μ_t represent college and year fixed effects. X_{it} is a set of controls that include field of study fixed effects, study area time-trends, and department time-trends. The outcome variable is the log of tuition prices charged at private colleges to students enrolled in each undergraduate program. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. Standard errors in square brackets are clustered at the college level. * p<0.10, ** p<0.05, *** p<0.01.

Appendix Figure B.3: Robustness of the Effect of Financial Aid on Tuition - Excluding Fields

(a) *Direct Effect*: HQ Four-Year Colleges **(b)** *Spillover Effect*: LQ Four-Year Colleges



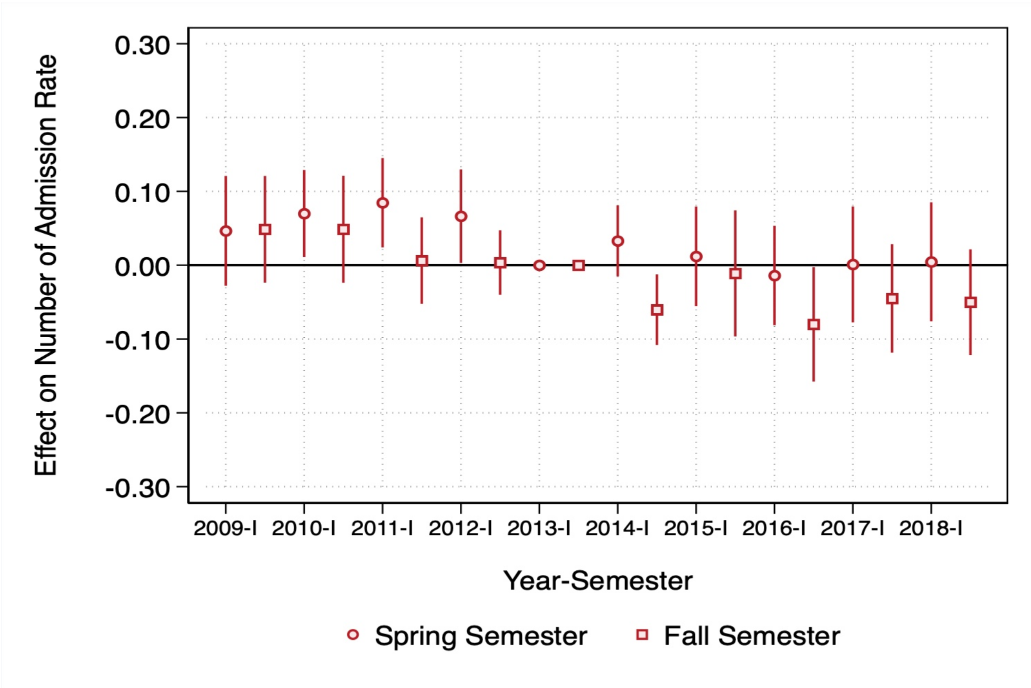
Notes. Each plotted dot represents the estimated effect of financial aid on tuition prices, with all programs in a field of study being dropped at a time. Estimates are based on the following equation: $Y_{i(c),\,t} = \mu_c + \mu_t + \delta$ (HQ 4-Year$_c$ $\times$ Post) + β (LQ 4-Year$_c$ $\times$ Post) + $X'_{it}\gamma + \varepsilon_{i(c),\,t}$. HQ 4-Year$_c$ is an indicator equal to 1 if c is a four-year college holding high-quality accreditation. LQ 4-Year$_c$ is an indicator equal to 1 if c is an non-accredited four-year college. Post is an indicator equal to 1 for the post-treatment period 2014-2018. μ_c and μ_t represent college and year fixed effects. X_{it} is a set of controls that include field of study fixed effects, study area time-trends, and department time-trends. The outcome variable is the log of tuition prices charged at private colleges to students enrolled in each undergraduate program. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. Standard errors in square brackets are clustered at the college level. * p<0.10, ** p<0.05, *** p<0.01.

C.. Spillover Effects of *Ser Pilo Paga* Financial Aid

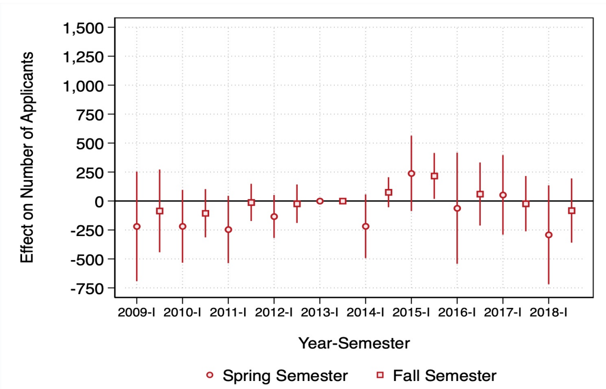
C.1. Spillovers on Low-Quality Private Colleges

Appendix Figure C.1: Spillover Effect of Financial Aid on College Admission Rates

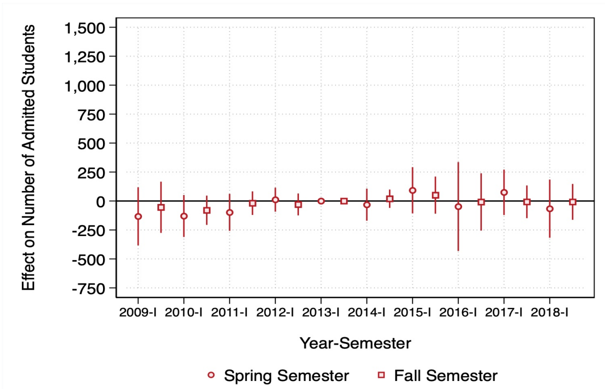
(a) Admission Rate



(b) Number of Applicants



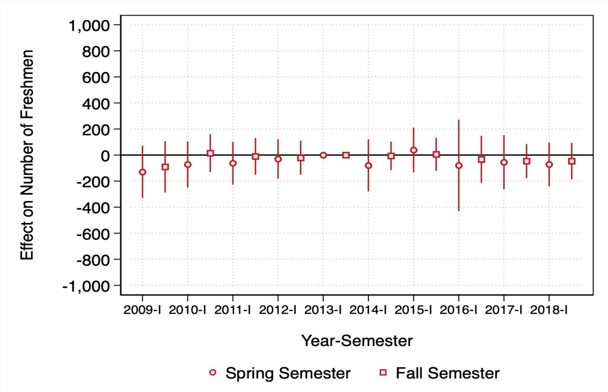
(c) Number of Admissions



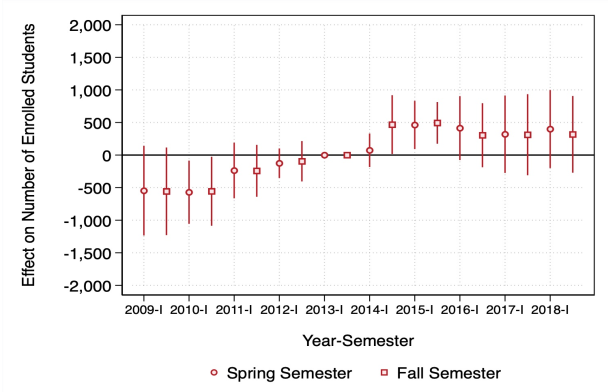
Notes. Ordinary least squares (OLS) estimates of the β_τ coefficients in Equation (1), corresponding to the (*spillover*) effect on low-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable in Panel (a) is the admission rate of college programs, computed as the fraction of students offered admission among the total number of applicants to a program. In panels (b) and (c), the outcome variables are the number of applicants and the number of admissions offered, respectively. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Appendix Figure C.2: Spillover Effect of Financial Aid on College Enrollment

(a) Number of Freshmen



(b) Number of Enrollees

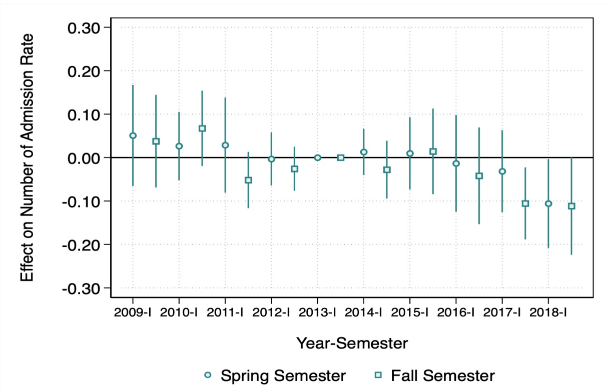


Notes. Ordinary least squares (OLS) estimates of the β_τ coefficients in Equation (1), corresponding to the (*spillover*) effect on low-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. In panels (a) and (b), the outcome variables are the number of first-year students (freshmen) in a college program and the number of all enrolled students, respectively. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

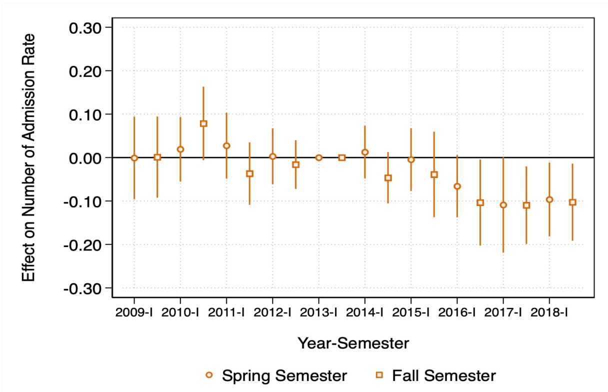
C.2. Spillovers on Public Colleges

Appendix Figure C.3: Effect of Financial Aid on Admission Rates at Public Colleges

(a) High-Quality 4-Year Public Colleges



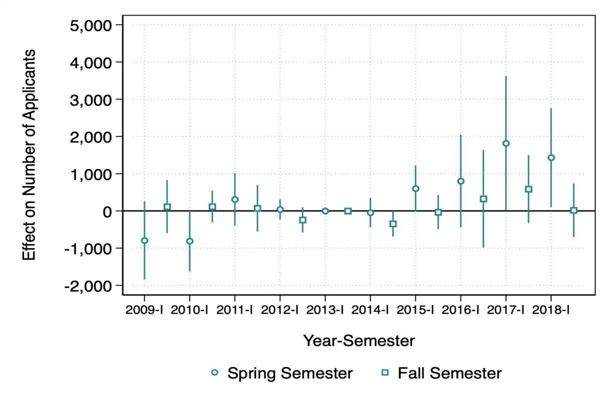
(b) Low-Quality 4-Year Public Colleges



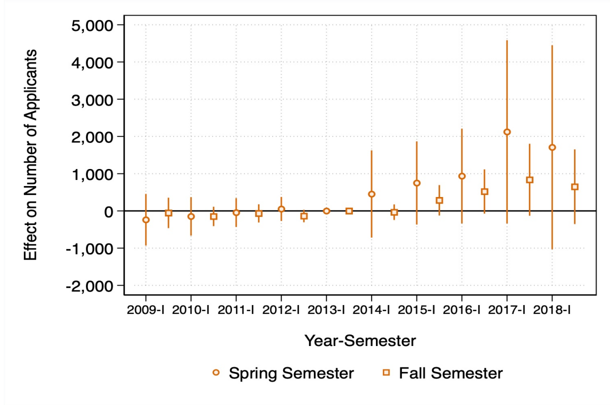
Notes. Ordinary least squares (OLS) estimates of Equation (1). Panel (a) displays the estimates of coefficients δ_τ, corresponding to the effect on high-quality four-year public colleges. Panel (b) displays the estimates of coefficients β_τ, corresponding to the effect on low-quality four-year public colleges. The control group is low-quality two-year private colleges. The outcome variable is the admission rate of college programs, computed as the fraction of students who are offered admission among the total number of applicants to a program. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Appendix Figure C.4: Effect of Financial Aid on Applicants and Admissions at Public Colleges

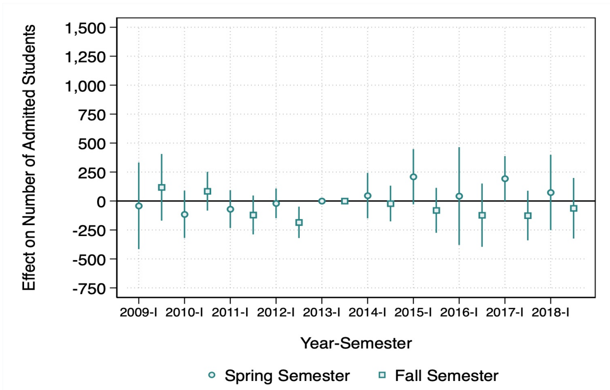
(a) High-Quality 4-Year: Applicants



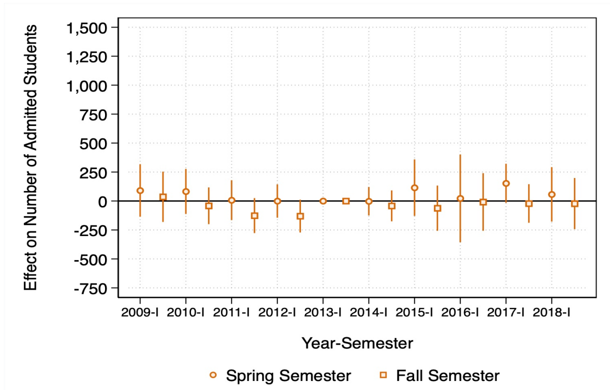
(b) Low-Quality 4-Year: Applicants



(c) High-Quality 4-Year: Admissions



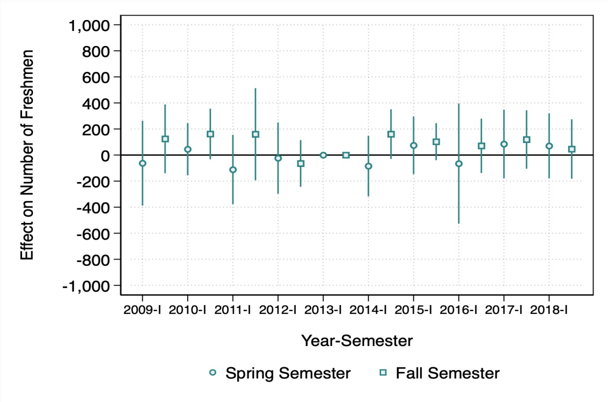
(d) Low-Quality 4-Year: Admissions



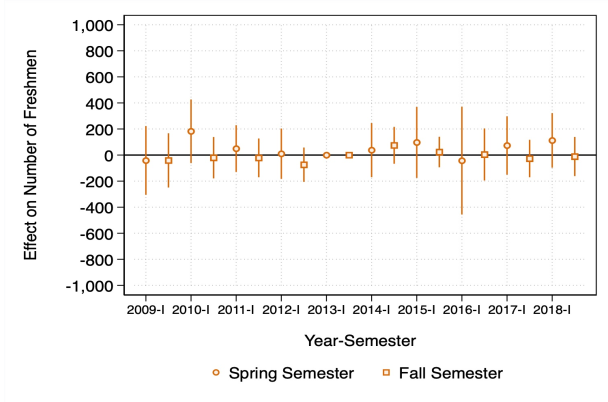
Notes. Ordinary least squares (OLS) estimates of Equation (1). Panels (a) and (c) display the estimates of coefficients δ_τ, corresponding to the effect on high-quality four-year public colleges. Panels (b) and (d) display the estimates of coefficients β_τ, corresponding to the effect on low-quality four-year public colleges. The control group is low-quality two-year private colleges. In Panels (a) and (b) the outcome variable is the number of applicants in the Spring and Fall semesters. In Panels (c) and (d) the outcome variable is the number of students who are offered admission in the Spring and Fall semesters. Separate regressions are run for outcomes measured in each semester. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Appendix Figure C.5: Effect of Financial Aid on Freshmen and Enrollment at Public Colleges

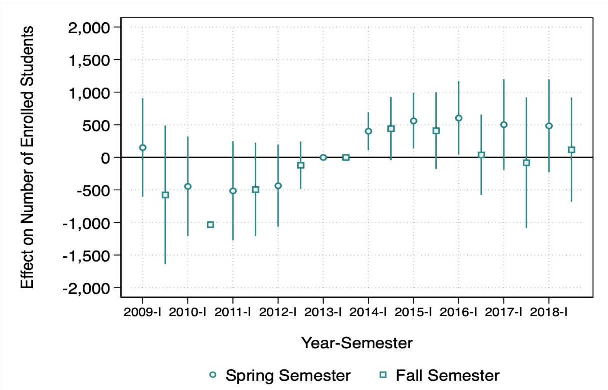
(a) High-Quality 4-Year: Freshmen



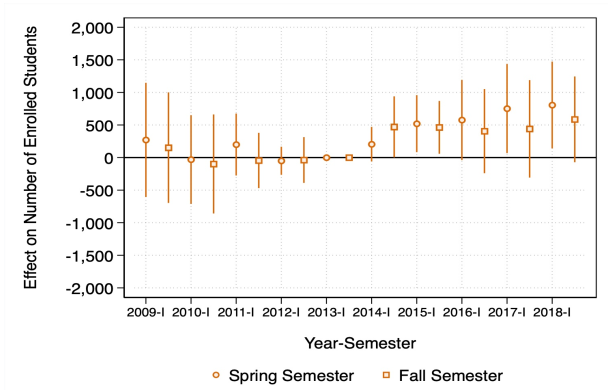
(b) Low-Quality 4-Year: Freshmen



(c) High-Quality 4-Year: Enrollees



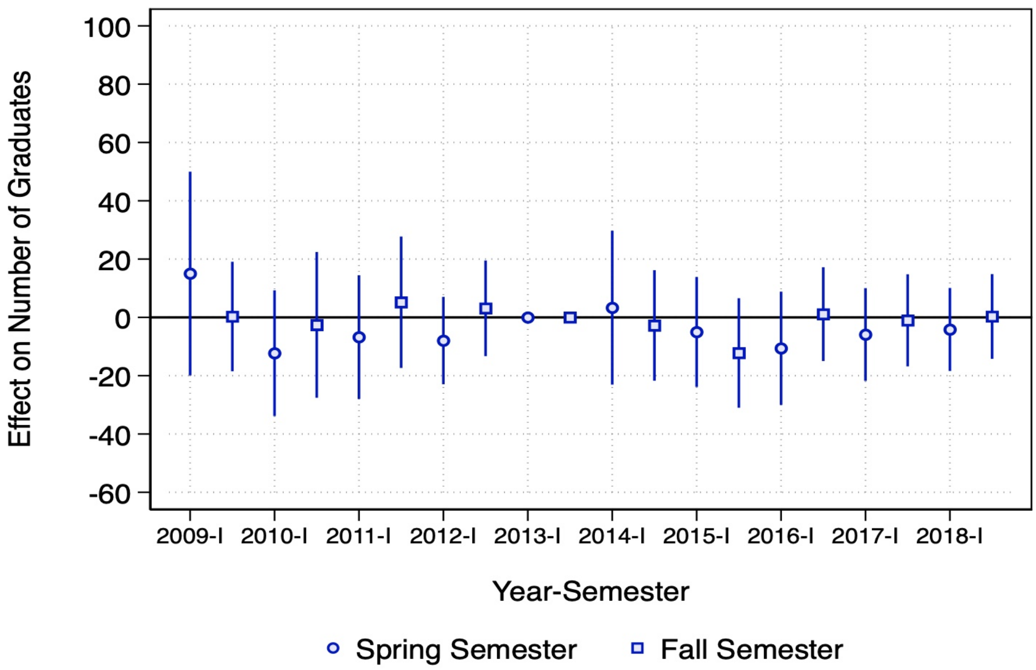
(d) Low-Quality 4-Year: Enrollees



Notes. Ordinary least squares (OLS) estimates of Equation (1). Panels (a) and (c) display the estimates of coefficients δ_τ, corresponding to the effect on high-quality four-year public colleges. Panels (b) and (d) display the estimates of coefficients β_τ, corresponding to the effect on low-quality four-year public colleges. The control group is low-quality two-year private colleges. In Panels (a) and (b) the outcome variable is the number of first-year students (freshmen) in the Spring and Fall semesters. In Panels (c) and (d) the outcome variable is the number of all the students enrolled in a program each semester. Separate regressions are run for outcomes measured in both semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

D.. Additional Results

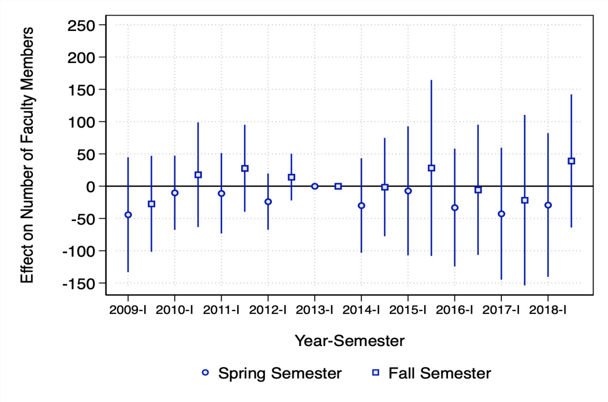
Appendix Figure D.1: Direct Effect of Financial Aid on College Graduates



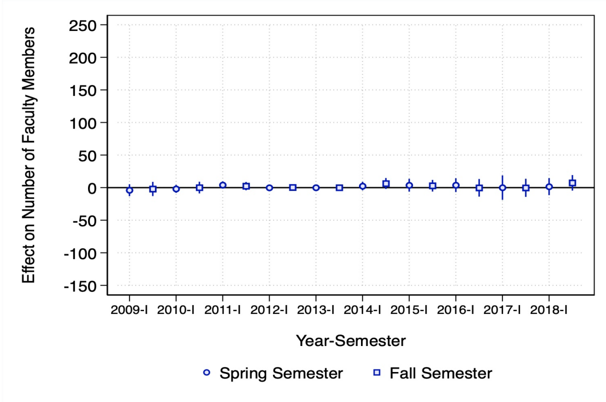
Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable is the number of students who graduate from any program at a private college. Separate regressions are run for the number of graduates in the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, field of study fixed effects, study area linear trends, and department linear trends. College programs are classified by the Ministry of Education into 56 fields of study and 8 study areas (Agronomy, Arts, Business and Economics, Education, Engineering, Health, Math and Natural Sciences, and Social Sciences). Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Appendix Figure D.2: Direct Effects of Financial Aid on Staff Hiring

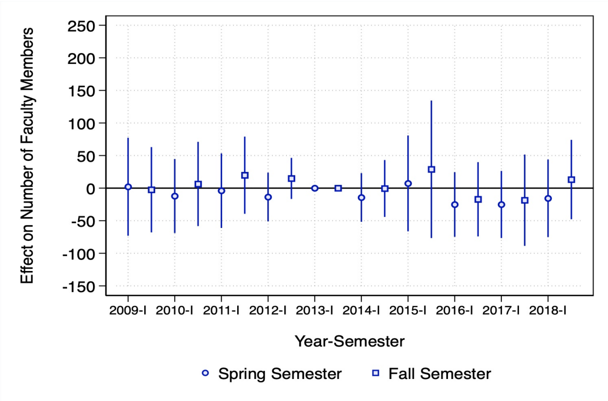
(a) All Staff



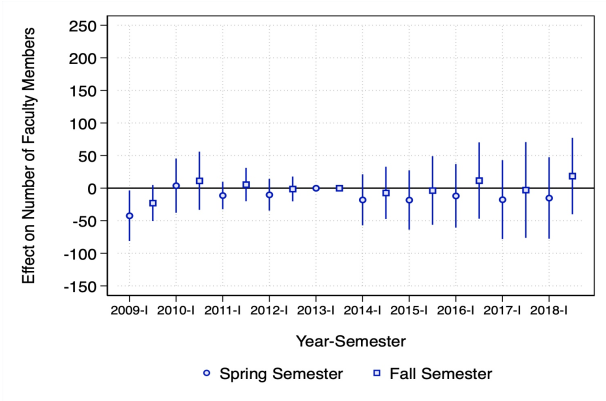
(b) Heads and Directors



(c) Professional Services

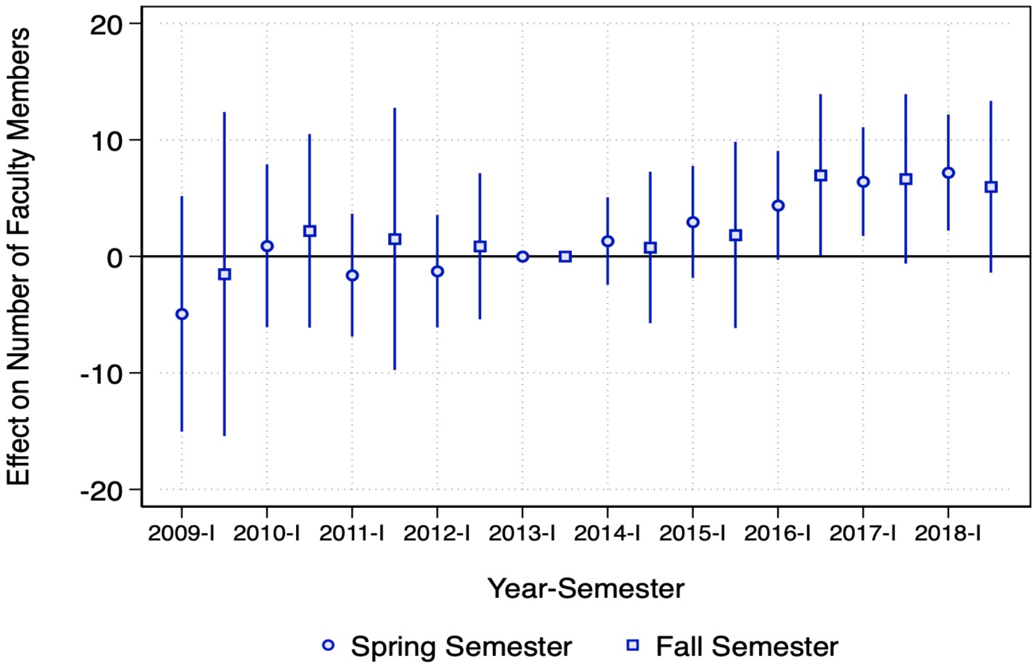


(d) Auxiliary Services



Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable in panel (a) is the number of all administrative staff working in a private college. In panels (b), (c), and (d) the outcome variables are, respectively, the number of staff members who are heads or directors, the staff who provide professional services, and the staff who provide general services. Separate regressions are run for outcomes measured during the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college fixed effects, year fixed effects, and department linear trends. Colombia is divided into 32 administrative regions known as departments. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.

Appendix Figure D.3: Direct Effect of Financial Aid on the Student-to-Staff Ratio



Notes. Ordinary least squares (OLS) estimates of the δ_τ coefficients in Equation (1), corresponding to the (*direct*) effect on high-quality four-year colleges after introducing the financial aid program *Ser Pilo Paga*. The outcome variable is the student-to-faculty ratio in each college. Separate regressions are run for the Spring and Fall semesters. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. Estimates for the Spring semester are displayed using circle markers, while square markers are used for estimates corresponding to the Fall semester. All regressions control for college and year fixed effects. 95% confidence intervals, based on standard errors clustered at the college level, are displayed around plotted coefficients.