Changes in the Cost Structure and Productivity of U.S. Tertiary Education

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Abstract

This paper decomposes instruction-related expenditures at colleges and universities in the United States from 2004 to 2015 and analyzes the changes in the cost structure and productivity of the higher education sector. Specifically, I decompose spending on instruction into the number of students (quantity), credit hours per student (demand intensity), faculty course load (service intensity) and cost of instruction per instructional staff (input cost). Taking logs and differencing, changes in spending are summarized into the sum of enrollment (demand at the extensive margin) changes, changes in demand at the intensive margin, service intensity (productivity) and changes in input cost. I use the Integrated Postsecondary Education Data System to decompose the above changes in six types of institutions: public 2-years, private 2-years, public bachelors and master's, non-profit bachelors and master's, doctoral research, and for-profit 4-year institutions.

Results indicate that increases in aggregate spending on instruction at post-secondary educational institutions are foremost driven by the increase in unit cost (expenditures per instructional staff), particularly at public colleges and universities, which account for more than two-thirds of student enrollment. Demand intensity, as measured by credit hours per student, stays flat mostly due to institutional reasons, while the productivity of educational services measured by credit hours taught per instructional staff respond strongly to changes in student enrollment, possibly reflecting production technology of education services. Looking at the composition of instruction-related expenditures, I find that the share of the cost of academic and institutional support services increases while the direct instruction cost grows more slowly at public institutions, while expenditures related to student services increase most rapidly among public 2-year and for-profit institutions.

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A rise in college tuition has been a recurrent issue in the popular press. There has been talk of a college bubble, claiming that the amount of student loans required to finance college education will not be sustainable as new graduates often fail to earn enough to pay the debts in a timely manner. Although the student enrollment in post-secondary education has declined in recent years, households keep borrowing in student loans and the amount outstanding that households owe reached almost $1.5 trillion at the end of 2017. The growing student debt is linked to declining first-time homeownership (Chakrabarti, Gorton, and van der Klaauw 2017), delay in marriage and fertility decisions (Bozik and Estacion 2014), and higher incidence of mental health issues (Walsemann, Gee, and Gentile 2014). Despite issues associated with student debt, research shows return on college education is higher now than any time in recent years and college is still a good investment, for most people, in net present value after taking loan service into account (Avery and Turner, 2012).

In the U.S. National Income and Product Accounts (NIPAs), the share of personal consumption expenditures (PCE) spent on higher education has been increasing steadily and hit the highest level at 1.5 percent in 2013. Panel (a) of figure 1 presents share of higher education compared to that of nursery, primary and secondary education in PCE. While small in aggregate, American households spent $187 billion in 2016, accounting for about 1.4% of total PCE. In contrast, the share of PCE spent on nursery, primary, and secondary education has stayed relatively constant at less than 0.4 percent since 1977. The increasing share of higher education in household expenditures is consistent with the notion that higher education is a luxury good. In contrast, the share of higher education in government current expenditures has stayed relatively constant at just below 3% since the 1980s while the share of primary and secondary education

has declined in recent years. In 2016, the federal, state and local governments expended $179 billion in current expenditures on higher education.

Despite the increasing importance of higher education in a typical American's life, there is little discussion on productivity of the sector. The large majority of education services is provided by the government and non-profit institutions (NPIs) whose output is measured by the cost of direct inputs. Consequently, productivity of the education sector is not well defined as inputs are the same as output. By measuring the output of the sector by the cost of inputs and by confusing *output* and *outcomes* (e.g., learning, skills, earnings, and eventually, health outcomes), one may erroneously believe that we are producing better educated citizenry just because we spend more money on schools. Hanushek (1996, 2003) and Hanushek and Rivkin (1997) convincingly illustrate how increased school spending has failed to improve educational outcomes.

There have been a handful of studies that attempt to measure productivity of the educational sector. Powers (2016), using two surveys from the National Center for Education Statistics (NCES) covering public and private schools, estimates the attendance-adjusted number of students at primary and secondary education institutions to measure output. To derive labor productivity, the output measure is divided by the number of full-time equivalent (FTE) employees, which includes not only teachers but also other school employees. O'Mahony and Stevens (2009) use CPS and expand the coverage to include the post-secondary level and measure output by earnings-weighted enrollment and input by the number of hours worked. In an international context, Gu and Wu (2015) estimate productivity growth for the entire education sector in Canada. They measure output by earnings- and cost-weighted enrollment numbers and input by the labor input.

The above studies illustrated mixed results for labor productivity growth of the education sector. Taking 1989 as the base year, Powers (2016) shows an improvement of labor productivity in the 1990 and a prolonged decline thereafter. Private schools' labor productivity in 2012 is about 30 percent lower than in 1993. In O'Mahony and Stevens, the US labor productivity of the education sector shows consistent decline between 1979 and 2002. Gu and Wong find that the labor productivity of the education sector in Canada declines from 1976 to the mid-1990s and then slowly improves. Nonetheless, the labor productivity in 2004 is still lower than that in 1976. Many studies thus find productivity of the education sector declining as the output is influenced by overall population growth and demographics while the labor input increases to add more staff to the education sector.

This paper takes a similar approach and measures output by student enrollment and credit hours taken by students and inputs by the number of FTE instructional staff and the cost per instructional staff. Labor productivity in this paper is measured by faculty course load, i.e., the number of credit hours taught by instructional staff. In addition, I decompose total instruction-related expenditures to different components of the education service production process and relate the growth of instruction expenditures to demand changes and productivity changes. This approach is similar to Hanushek and Rivkin (1997) for primary and secondary education. By linking the growth in expenditures on instruction to student enrollment, labor productivity, and unit input cost, I show how productivity changes are related to enrollment changes given the technology of post-secondary education production. To the best of my knowledge, this paper is the first attempt to extend Hanushek and Rivkin's methodology to post-secondary education with more detailed data on inputs.

The paper is organized as follows. The next section describes the data set. Section II presents a model of decomposition, its interpretation, and discussion of operationalizing the decomposition model with the data. Section III presents the results of decomposition and section IV then examines changes in the composition of education-related expenditures. Section V concludes.

I. Integrated Postsecondary Education Data System

I use the longitudinal data from the Integrated Postsecondary Education Data System (IPEDS) collected by the National Center for Education Statistics of the U.S. Department of Education. The IPEDS is a longitudinal survey collecting data on institution, student enrollment and their demographics, and institution finances. Completing IPEDS surveys is required for all institutions that participate in federal financial assistance programs under Title IV of the Higher Education Act of 1965. Since the Economic Census, conducted every five years, and Service Annual Survey do not cover colleges and universities, the IPEDS is the most comprehensive data set available on most institutions in post-secondary education. I use the 2004-2015 longitudinal data compiled from IPEDS by the Delta Cost Project, a joint endeavor between the American Research Institute and the U.S. Department of Education, supplemented with other information obtained directly from the IPEDS as needed. I limit my sample to data from 2004 because the IPEDS collects the 12-month FTE student enrollment starting that year.[1]

In compiling national statistics, defining what constitutes post-secondary education presents its own challenges. In popular parlance in the United States, higher education, post-secondary education, and tertiary education are used interchangeably. An unaccredited non-

[1] Prior to 2004, IPEDS asked the number of full-time and part-time students at the beginning of the Fall term. To expand the time period beyond 2004 will be left for the future project.

degree-granting institution is free to call itself a “college” while institutions with similar names may provide totally different types of education. To complicate matters further, the variation in naming and differences in duration of programs make cross-sectional aggregation of education output at the post-secondary level extremely difficult. In the case of IPEDS, about 8,000 institutions report to the system, some of which may not fit into our concept of post-secondary education, as any institution that receives Federal Title IV financial aid is required to report to the data system. Many short-term vocational programs, some of which are operated by the local school districts, are included in the data.

An attempt to standardize classification of various educational systems is made by UNESCO’s Institute for Statistics through its International Standard Classification of Education System (ISCED). ISCED 2012, the most recent version, divides different stages of education from early-childhood to doctoral education into nine levels based on program orientation, complexity, duration, and entry requirements. The ISCED specifically distinguishes tertiary education from post-secondary education and defines the former as a subset of the latter. The ISCED Level 4 refers to post-secondary non-tertiary education, which provides vocational training aimed at direct labor market entry and offers programs that are shorter than two years. In the United States, examples of post-secondary non-tertiary institutions include beauty and cosmetology schools and schools for massage therapists and practical nurses.

The ISCED classifies post-secondary tertiary education into four levels: from Level 5 (short-cycle tertiary education) to Level 8 (doctoral level). In this paper, I focus on institutions corresponding to the ISCED’s levels 5 to 8. The levels correspond to community and junior colleges (Level 5), four-year colleges (Level 6), and graduate programs (Levels 7 and 8)

including courses with strong academic orientation as well as professional programs such as law, medical, and business schools.

The ISCED classifications do not necessarily translate well for the analysis of the U.S. tertiary education system. More so than any other country, three main types of institutional control and ownership coexist in the United States: government-owned public entities, private not-for-profit institutions, and private for-profit institutions, with a substantially larger presence of the for-profit sector than other countries. Each type of institution would presumably behave differently and react to incentives and market conditions differently. To limit institutions to more comparable groups, I rely on Carnegie Classification of Institutions of Higher Education and exclude from my sample institutions that do not have Carnegie Classifications. Carnegie Classification is a framework for classifying colleges and universities by identifying groups of roughly comparable institutions. The classification includes all accredited degree-granting colleges and universities that are included in the IPEDS. I also exclude religious seminaries and schools for rabbis and priests as their strategies for recruitment and retention, and their production technologies of education services may differ from those of traditional colleges and universities.

Table 1 presents the number of institutions in my sample by control and instruction level. Private non-profit institutions account for much of four-year colleges and universities while public institutions make up the majority among community colleges. The number of public and private not-for-profit institutions stay relatively constant throughout the period.[2] On the other hand, private for-profit institutions have grown substantially from 16.8% of all tertiary

[2] Note that some two-year institutions convert to four-year schools and concurrently offer four-year degrees in selected programs while keeping the two-year degree options. Such institutions are re-classified from two-year to four-year institutions in the IPEDS. Hence the decrease of two-year institutions in recent years does not necessarily mean that they exit the industry.

institutions in 2004 to 26.4% in 2012 and declining to 23.5% in 2015. The growth seems particularly pronounced after 2009 when the total number of for-profit 2- and 4-year institutions increased from 754 to 957 in 2010, a 26.9% growth rate in one year.[3] This growth comes from many institutions lengthening their program durations (e.g., from less-than-two-years to two-year, and from two-year to four-year). Curiously, the lengthening of program durations at for-profit institutions seems to have taken place as the U.S. Department of Education has intensified scrutiny of for-profit institutions and required disclosures of gainful employment statistics.

Expansion of for-profit post-secondary education is studied extensively in recent years. Deming et al. (2012) analyze the growth of for-profit institutions over a longer period considering how they are organized and what types of students they attract. They document that for-profit colleges focus on career-oriented fields such as business, accounting, and nursing and enroll a far greater number of minorities and first-time college students. Cellini (2009, 2010) attributes part of this growth to public-sector funding constraints and wider availability and more generous provision of federal and state financial aid. Gilpin et al. (2015) show for-profit two-year institutions are more responsive to changes in local labor market conditions while public two-year institutions remain unresponsive to employment growth and wage changes in related occupations.

Figure 2 represents the recent trends in student enrollment at different types of colleges and universities. While public 4-year institutions are fewer in number, they educate most students, accounting for 42.2% of all FTE students enrolled in tertiary institutions in 2015. Together with public 2-year institutions, 70% of students attend public institutions. While higher in terms of the number of institutions, non-profit 4-year institutions are a distant third in terms of

[3] The growth may also reflect entry of small, for-profit schools that have previously not received federal financial aid but done so after 2009 when the Federal government expanded the resources available for Pell grants.

student enrollment, educating 21.9% of enrolled students. Both in terms of the number of schools and the number students, not-for-profit 2-year institutions account for a very small fraction of the sector.[4]

II. Decomposition of Instruction Costs

I focus on the production process of education services applied to the higher education sector. Total cost of production increases because the quantity demanded increases, the unit cost of inputs increases, or production technology changes and require more inputs to produce the same amount of goods and services (i.e., productivity decline). Considering what constitutes production of education services, I connect the total expenditures on instruction to the number of students educated, the number of faculty inputs used, and the cost of instruction per instructional staff in the following identity. Following Hanushek and Rivkin (1997), instruction-related expenditures can be related to input measures by the following identity:

$$\text{Expenditures on Instruction} \equiv \text{No. of Students} \times \frac{\text{Credit Hours}}{\text{No. of Students}} \times \frac{\text{No. of Instructional Staff}}{\text{Credit Hours}} \times \frac{\text{Cost of Instruction}}{\text{No. of Instructional Staff}}$$

This decomposition is understood as the cost of producing instruction services decomposed into the number of students, credit hours per student, faculty course load and cost of instruction per instructional staff. Taking logs of the above identity and differencing, we obtain:

$$\Delta ln(\text{Expenditures}) = \Delta ln(\text{Enrollment}) + \Delta ln(\text{Student Credit Load}) - \Delta ln(\text{Faculty Course Load}) + \Delta ln(\text{cost per instructional staff})$$

This equation is interpreted as follows: Instruction-related expenditures change is the sum of enrollment change (demand change at the external margin), per-student credit load (change in demand intensity, or demand change at the intensive margin), the inverse of credit hours taught

[4] This is because many of them are vocational programs and religious institutions that are not classified by the Carnegie Classification and are thus excluded from my sample.

by instructional staff (change in service intensity), and change in input cost per instructional staff.

The inverse of the third term, the faculty course load, can be interpreted as labor productivity of instructional staff. In this productivity measure, both output (credit hours) and labor inputs (the number of FTE instructional staff) are measured by physical units and are thus unaffected by price changes.

To put this identity into operation with the data from the IPEDS, there are a few technical details that warrant explanation. First, the number of FTE students for the 12-month period is reported directly by institutions in the IPEDS since 2004 and I use the reported figures. Second, various institutions use different calendar systems to calculate credit hours. Total credit hours differ by the calendar system adopted by schools and I need to convert them to comparable units. To make different ways of calculating credit hours across institutions as comparable as possible, I convert reported credit hours to semester-equivalent units. Concretely, one quarter credit hour is equivalent to two-thirds of a semester credit hour. When an institution uses more than one calendar system, I convert reported credit hours by multiplying 4/5 to arrive at the semester-equivalent credit hours. To convert contact hours to semester-equivalent, I divide reported contact hours by 37.5.[5] Third, the number of FTE instructional staff is calculated as the sum of full-time instructional staff, three-quarters of part-time faculty and one half of instructional assistant headcounts.

Finally, colleges and universities are multi-product firms that not only produce education services but also provide research and public services and separating the costs of producing

[5] One semester credit hour is defined as three times a week of 50-minutes of instruction for 15 weeks, i.e., 2,250 minutes, or 37.5 hours of instruction per semester. Contact hours is defined as the actual number of hours that an instructor has with students. Therefore, say, 120 contact hours translates into 3.2 semester credit (120 ÷ 37.5 = 3.2).

education services is a challenge. I define instruction-related expenditures as the sum of costs on instruction and student services, and the education share of the sum of academic support, institutional support services, and maintenance and operation expenses, which follows the definition used by the U.S. Department of Education. The education share is calculated as the share of instruction and student-service expenditures in the sum of instruction, student services, research, and public service expenditures.

III. Instruction-Related Expenditures, Student Enrollment, and Decomposition

As households pay more for higher education, colleges and universities also spend more on instruction. Figure 3 plots growth in instruction-related expenditures[6] in contrast to FTE student count, credit hours taken by students, and the number of instructional faculty. The increase in expenditures on instruction outpaced that of other variables by a factor of two in just over a ten-year period, indicating that colleges and universities spend twice as much per student on instruction in 2015 as they did in 2004. While instruction-related expenditures increase smoothly, the increases in student count and credit hours have noticeable humps. The figure confirms that the higher-education sector is counter-cyclical; the demand for higher education increases during a recession for the opportunity cost of attending school declines and young adults weather the recession in education rather than face the labor market. Credit hours taken by students follow the same trend as FTE student enrollment. As the economy recovers, the number of students and credit hours both decline from the peak in 2011. On the other hand, the number of instructional staff increases steadily during recessions and does not decrease during the expansion phase, even when the number of students enrolled declines.

[6] All financial-related figures in the IPEDS are deflated by CPI-U to the constant 2015 dollars.

Classification of the U.S. post-secondary educational institutions by ownership and instruction level as done in table 1 and figure 2 may mask important similarities and differences among institutions. To classify institutions into more comparable groups of schools, I again rely on Carnegie Classification of Institutions of Higher Education. Specifically, I collapse 33 categories of the Carnegie Classification into six types: public 2-year institutions, private (both not-for-profit and for-profit) 2-year institutions, public bachelors and master's institutions, private not-for-profit bachelors and master's, doctoral research (both public and private not-for-profit) institutions, and for-profit 4-year institutions. I combine non-profit and for-profit 2-year institutions into one group as non-profit 2-year institutions are small in number and these two types of schools offer similar programs. Furthermore, a previous study (Yamashita 2018) shows that non-profit 2-year institutions are market producers charging economically significant price, i.e., about 100% of production costs as tuition.

Figure 4 illustrates the same information as figure 3 by the six sectors. Several salient features are gleaned by looking at these figures. First, the growth and rapid decline of student enrollment are particularly pronounced in the for-profit sector. For profit institutions grew more than twice as fast as public and NPI schools, in terms of student enrollment, the number of instructional staff, and expenditures related to instruction. Particularly the increase in student enrollment after 2009 at private 2-year institutions is pronounced as the Federal government increased the provision of Pell grants to low-income households. Both student enrollment and instruction-related spending peak between 2009-2012 and decline quickly thereafter. The rapid decline of for-profit colleges' student enrollment coincides with intensified scrutiny by the U.S. Department of Education over for-profit institutions, which requires for-profit schools to meet the Gainful Employment Guidelines. Under the guidelines, for-profit institutions must meet

minimum repayment and student debt-to-income ratios and are required disclose such information to current and prospective students to be eligible to receive federal financial aid. Around the same time, United States Government Accountability Office issued a report (GAO 2010) that found a sample of for-profit colleges made deceptive or questionable statements to GAO's undercover applicants and some even encouraged to falsify their financial aid forms to qualify for federal aid.

Another notable fact is that, among public and non-profit institutions, only public 2-year institutions show a clear counter-cyclical surge in demand during the recession and bust during the recovery phase. This is reasonable as many community colleges offer vocational programs at low tuition, and workers who have lost a job would more likely attend low-cost, practical community colleges than expensive 4-year institutions which are known for longer degree programs for traditional students. During the surge in demand, however, public 2-year institutions do not increase the instructional staff while in the other sectors, the increase in instructional staff keeps pace with the increase of student enrollment.

I implement the decomposition proposed in Section II and present the results for the entire tertiary sector in figure 5. The results of the decomposition exercise reflect the patterns observed in figure 3. The instruction-related expenditures grow rapidly between 2004 and 2008 at around 10 %. The growth quickly decelerates as the economy enters the Great Recession and stays at around 5% even after the economy recovers. The growth rate of total spending on instruction stays always above the growth of student enrollment, except in 2010, as the cost per instructional staff grows faster than the student enrollment. This figure shows that a high fraction of the growth of instruction expenditures is accounted for by the increase in cost per instructional staff. Not surprisingly, the course load per student (credit hours per FTE student)

stays relatively constant, possibly reflecting the institutional nature of higher education services. Many universities limit the number of credits a student can take in one term, and for many students, taking more than 18 semester hours is often physically impossible due to overwhelming course load and time conflicts of courses.

The FTE student count and the inverse of the faculty load (FTE instructional staff per credit hour) follow the opposite movements from year-to-year. This implies that colleges and universities do not adjust the labor input quickly in response to a demand shock. Note that this gold broken line is an inverse of a labor productivity measure (credit hours taught per instructional staff). Hence, schools seem to handle a surge in demand by packing more students into a classroom, requiring instructional staff to teach more students per allocated instructional hour. As a result, the measured labor productivity of instructional staff rises as the number of students increases. When the economy improves and students leave schools, the productivity rapidly declines as the same number of faculty members teach fewer students.

Considering the production technology of higher education, this relationship between demand from students and labor productivity does not appear surprising. Most institutions of higher-education, which are dominated by public institutions, often have a fixed number of full-time faculty members in the short run. Recruitment for new hires is conducted several months before the new school year starts, well before schools find out the actual demand in the fall. Capital equipment for instructional services (e.g. classroom buildings, computers, labs) are also supplied in pre-determined, fixed quantity in the medium run and many universities and colleges seem to have excess capacity, a characteristic of monopolistically competitive producer. At the onset of a new term when true demand is revealed, schools initially fill out classrooms up to capacity. It is not uncommon that classrooms with maximum seating capacity of 50 have 30

students in normal times but suddenly get packed with 50 students when enrollment surges during the recession. Schools could also move the class to a bigger classroom so that one instructor could teach 100 students with the same input (except the unmeasured faculty time in grading and advising). Only when the existing faculty members cannot handle the unanticipated increase in demand, would schools hire part-time instructional staff to meet the demand. Conversely, when demand subsides as the economy recovers, as seen in 2011-2015, productivity rapidly declines as each instructional staff teaches fewer number of students per class. At public and non-profit institutions, the tenure system makes it difficult to reduce the number of full-time faculty members and other instructional staff also enjoy strong labor protection. Between 2012 and 2015, the credit hours per instructional staff declined at the tune of 5% per year.

The rise in cost per instructional staff could reflect Baumol's disease in an labor-intensive industry such as education. Baumol's disease refers to the phenomenon that wages of the labor-intensive sectors in which improvement in labor productivity is difficult, increase as the economy grows and becomes more productive. For example, the same number of musicians is required to play a string quartet today as it was in the 19th century, while many other industries use fewer workers to produce greater output thanks to technological improvement. Since wages of other sectors grow, wages of musicians must increase to compete with the other sectors while there are little productivity gains in the music sector. Service sectors in general, and the education sector in particular, are often considered examples of Baumol's cost disease, owing to Baumol and Bowen (1966).

Figure 6 presents the same decomposition by the six sectors. Different sectors exhibit diverse patterns of decomposition. For public 2-year institutions, the increase in cost per instructional staff matches closely that of total expenditures on instruction, implying that the

increase in cost is mostly driven by the increase in unit input cost and changes in the other factors of the decomposition sum to zero. In this sector, a 10% surge in student enrollment in 2011 is met with a 10% higher course load per instructional staff. For private 2-year sector, which is dominated by the for-profit institutions, instruction-related expenditures and student enrollment follow similar patterns, indicating that these institutions flexibly adjust instruction expenditures as more students are enrolled (but keeping per-student expenditure relatively constant). In this sector, the faculty course load stays relatively stable unaffected by changes in student enrollment. For public bachelors and master's institutions, the increase in student enrollment in the 2010-2012 period is modest while instruction-related expenditures quickly decelerate in 2009-2010 when many state governments cut budgets for education and endowments earn negative returns. This deceleration happens at the same time when student enrollment increases, demonstrating a decline in per-student instruction expenditures. The NPI bachelors and master's institutions follow similar patterns as their public-sector counterparts. One noticeable difference of this sector compared to the public sector is a rapid decline in labor productivity (an uptick in the gold broken line) in 2011-2012. For doctoral research institutions, the deceleration in 2010 is more modest while both student enrollment and course load per student increase in 2011 contributing to a quicker rise in instructional staff productivity compared to bachelors and master's institutions. The growth rate of expenditures per instructional staff (red broken line) always stays below the total instruction-related expenditures growth (black solid line) for all three of bachelor, master's and doctoral research institutions, implying at least part of spending increases is accounted for by increases in quantity demanded and productivity changes.

The decomposition of for-profit 4-year schools shows a different pattern from the other types of institutions. While starting from a very high growth rate (nearly 30%) between 2004 and 2005, the pace of deceleration of total instruction-related expenditure is much quicker than the other types of institutions. Total expenditures decline by about 10% in 2013 and again by 20% in 2014 as student enrollment rapidly declines. Unlike public and non-profit sectors in which the growth rates of expenditures per instructor never go to the negative territory, unit input cost per instructional staff decreased in for-profit schools in six years (2006, 2010, 2011, 2013, 2014, 2015) out of 11 years of the sample period. For the for-profit sector, the (inverse of) faculty course load (gold broken line) follows an offsetting pattern relative to expenditures per faculty (red dash), whereas for public and non-profit sectors, the faculty course load reflects changes in student enrollment (green line).

IV. Compositions of Instruction-Related Expenditures

In figure 6, I have shown that changes in expenditures per instructional staff match closely to changes in total expenditures in public 2-year institutions while expenditures per instructional staff grow slower than total instruction-related expenditures in the other sectors. In this section, I analyze changes in composition of instruction-related expenditures. Figure 7 plots three components of total instruction-related expenditures: direct instruction cost, cost of student services, and other education-related cost, i.e., pro-rated cost of academic support services, institutional support services, and operations and maintenance. In all sectors, the share of direct instruction cost declines as the shares of student services and other education-related cost increase. In particular, the share of expenditures related to student services increases most rapidly. This is consistent with the findings of Hanushek and Rivkin (1997) where they find that

primary and secondary schools increasingly spend more on student services including expenditures to meet requirements of the Americans with Disability Act at schools. Colleges and universities also spend more these days on student disabilities and student comfort (e.g., "safe zone").

Examining the composition of instruction-related expenditures by sector reveals how different institutions conduct their business of higher education. Surprisingly, public 2-year colleges spend a relatively small fraction of their resources on direct instruction relative to their mission and spend more on other related functions. NPI bachelor and master's institutions spend considerably more on student services while a smaller fraction on direct instruction compared to their public-sector counterpart. Doctoral research institutions spend a smaller fraction on student services while spending a larger fraction on direct instruction than public 2-year and bachelors and master's institutions. For-profit institutions, both 2- and 4-years, spend little on academic and institutional support while they spend a considerably higher share on student services, which include student recruitment (marketing), retention, and advice on how to obtain financial aid.

Figure 8 plots the changes in the share of education related expenditures in operating the business of higher education and the share of compensation in total education-related expenditures. The education share is calculated as:

$$Education\ Share = \frac{(\text{direct instruction cost}+\text{student services})}{(\text{direct instruction cost}+\text{student services}+\text{academic support services}+\text{institutional services}+\text{operatins and maintenance})}.$$

The share of education-related expenditures in total expenditures increases at all types of institutions. On the other hand, the share of compensation in total instruction-related expenditures has been decreasing in both public and non-profit sectors. At for profit institutions, on the other hand, the share of compensation increases in 2014 and 2015 while student

enrollment declines quickly and total instruction-related expenditures are cut drastically in these years. This uptick in recent years points to the fact that even in the for-profit sector, adjustments to labor costs seem difficult and firms in the higher education sector adjust costs in other variable inputs rather than compensation. This may reflect how labor contracts are written at the institutions of higher education, which must commit to labor and capital input prior to learning true market demand for their services.

V. Conclusions

I present changes in instruction-related expenditures and demand and input for different types of institutions of the U.S. tertiary education sector. I find that total instruction expenditures grow twice as fast as the number of students enrolled between 2004 and 2015. When demand for education services surge, as we have seen during the recent recession, public and non-profit colleges and universities adjust to changes in demand by enrollment per class (or section) thus necessarily increasing labor productivity of instructional staff, as measured by the number of credit hours taught by faculty members. For-profit institutions, on the other hand, seem to adjust to changes in demand more adeptly by expanding labor input. During this period, colleges and universities also increase the share of cost expended on student services, possibly reflecting that institutions of higher education serve a wider population base than a couple of decades ago.

This paper leaves many areas for further research. The immediate extension would include to cover a longer period using other measures of student enrollment. More detailed examination of instruction and related cost would reveal further how colleges and universities conduct their business. Harder conceptual improvements would include how to incorporate

quality changes in the measure of education services and how to deal with capital expenditures in accounting for cost of instruction.

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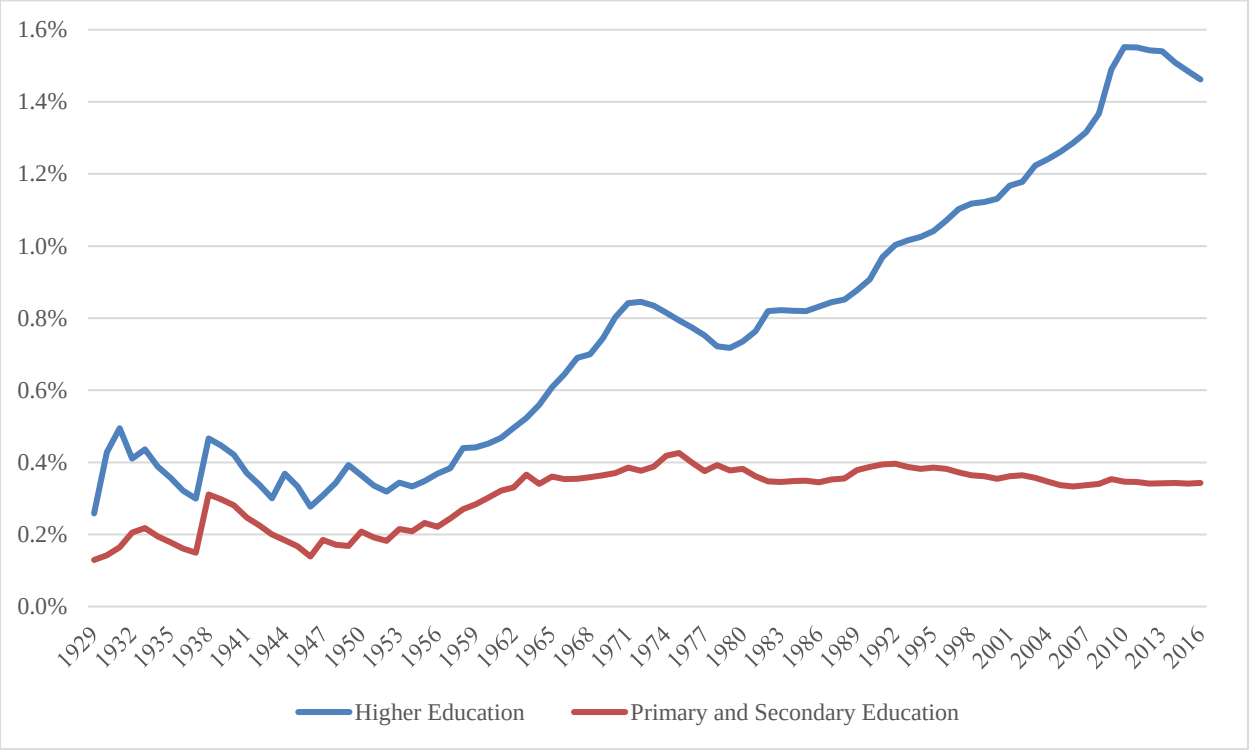
Table 1 The Number of IPEDS Institutions by Ownership and Instruction Level

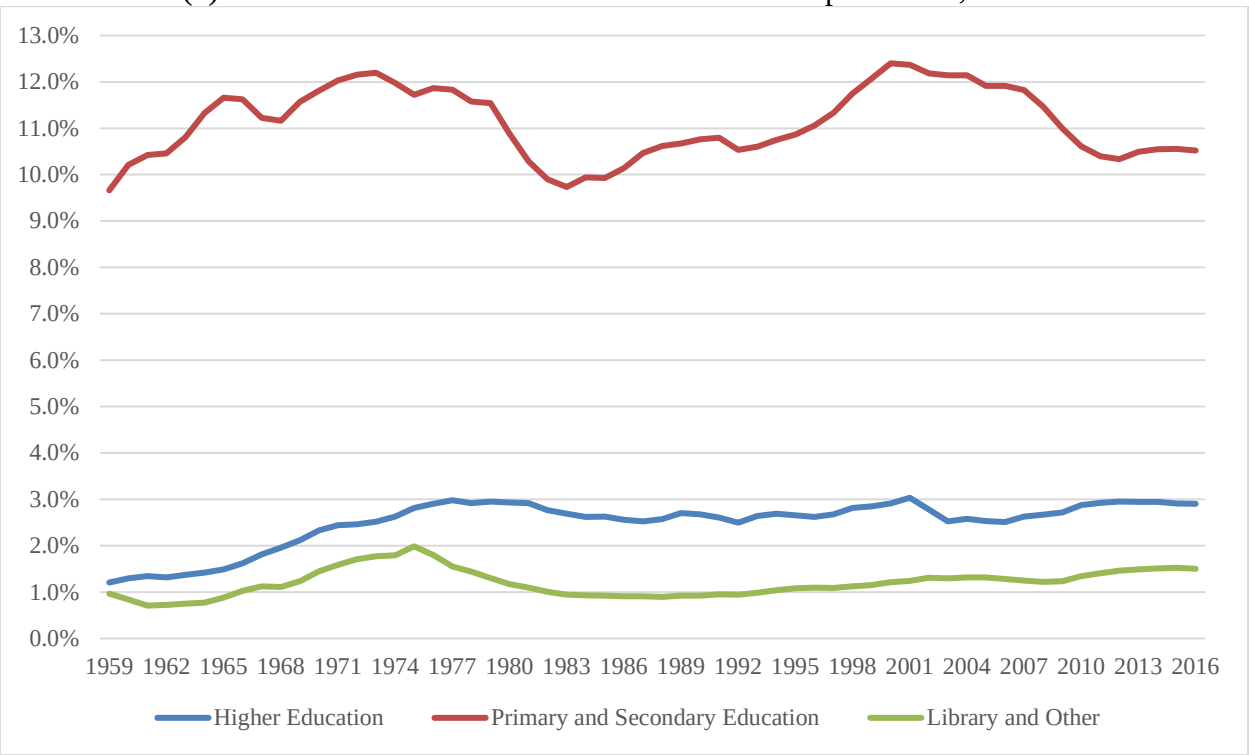
Year	Public 4 Year	NPI 4 Year	For-Profit 4 Year	Public 2 Year	NPI 2 Year	For-Profit 2 Year
2004	510	1,166	293	826	71	225
2005	511	1,166	309	863	87	342
2006	512	1,177	353	865	78	327
2007	512	1,181	363	866	80	335
2008	514	1,187	400	865	78	327
2009	513	1,191	432	865	77	322
2010	519	1,190	464	867	85	473
2011	519	1,181	517	866	82	438
2012	522	1,182	548	863	89	406
2013	517	1,180	530	857	84	379
2014	518	1,192	477	853	73	349
2015	518	1,183	487	847	67	315

Figure 1 Share of Education Sectors in the NIPAs

(a) Share of Education in Personal Consumption Expenditures, 1929-2016



(b) Share of Education in Government Current Expenditures, 1956-2016



Source: NIPA Table 2.4.5 and Table 3.16

Figure 2 Growth of Enrollment by Sector

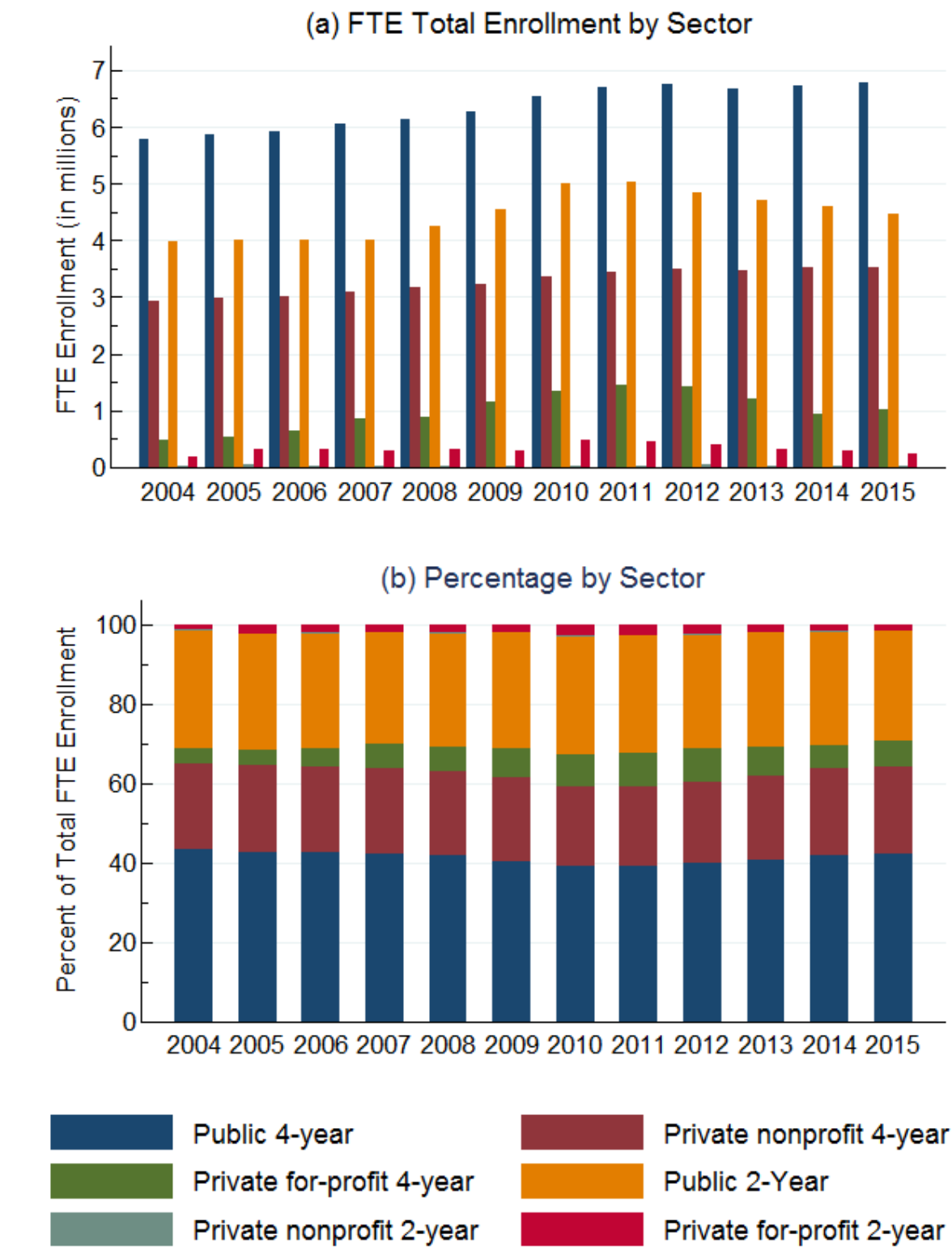


Figure 3 Growth of Spending on Instruction, FTE Student and Faculty Counts, 2004-2015

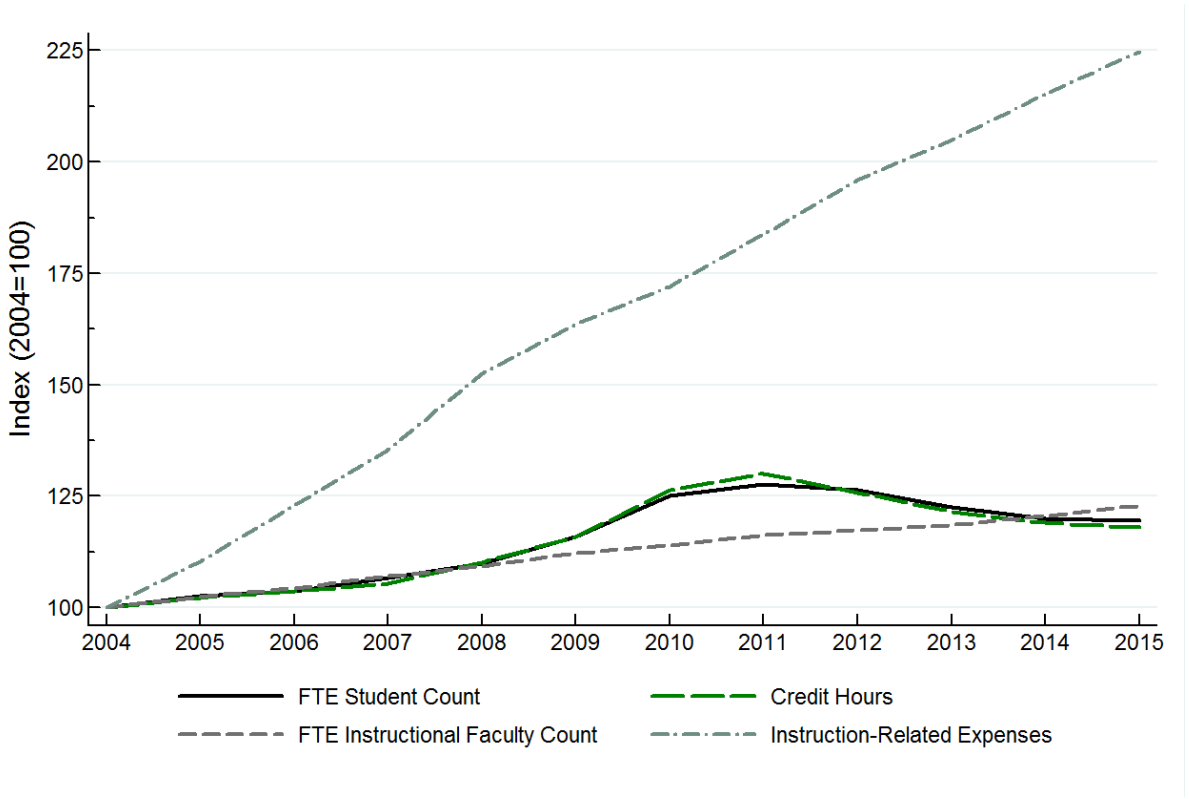


Figure 4 Growth of Spending and Student and Faculty Count by Sector, 2004-2015

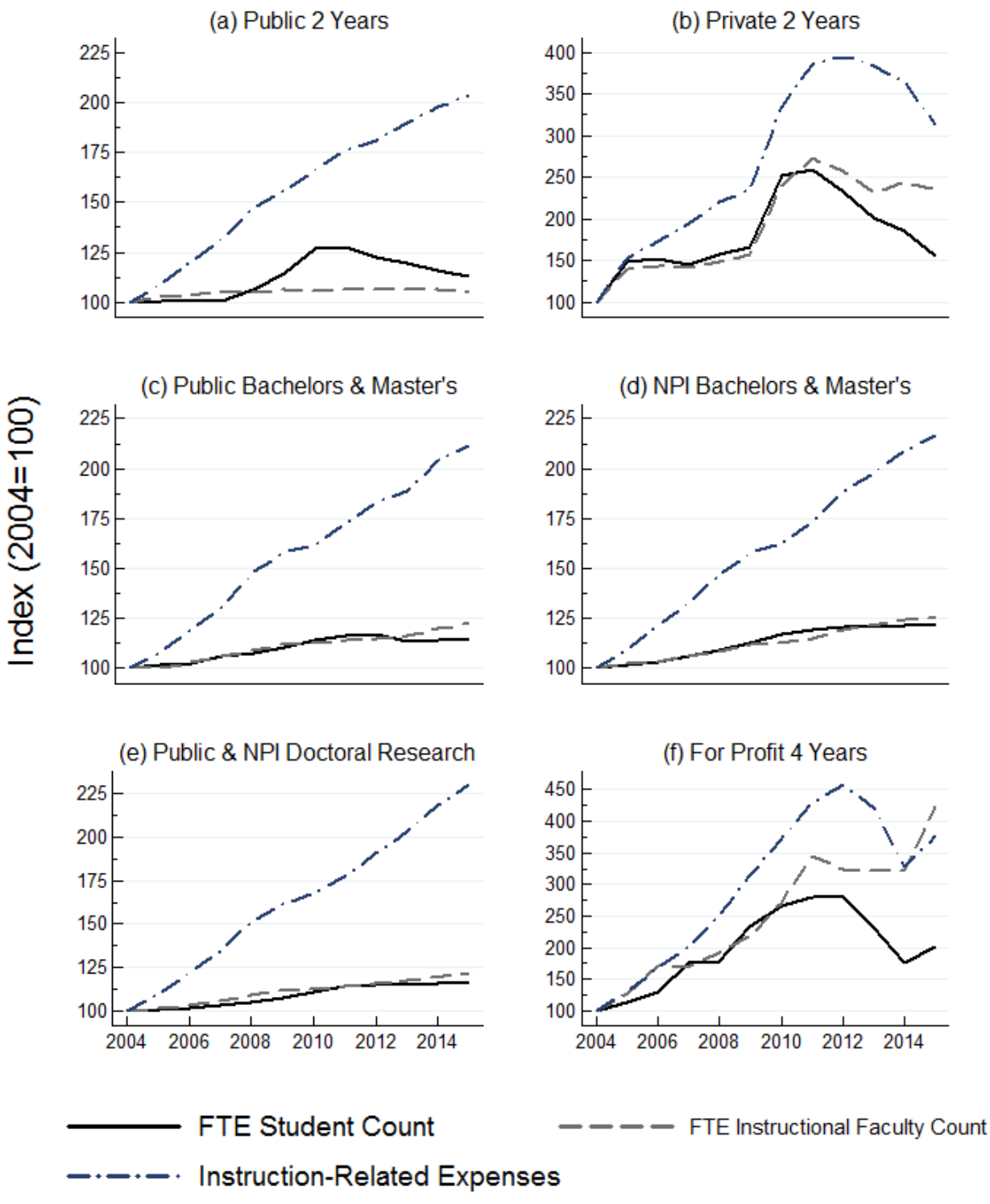


Figure 5 Decomposition of Growth of Spending on Instruction, 2005-2015

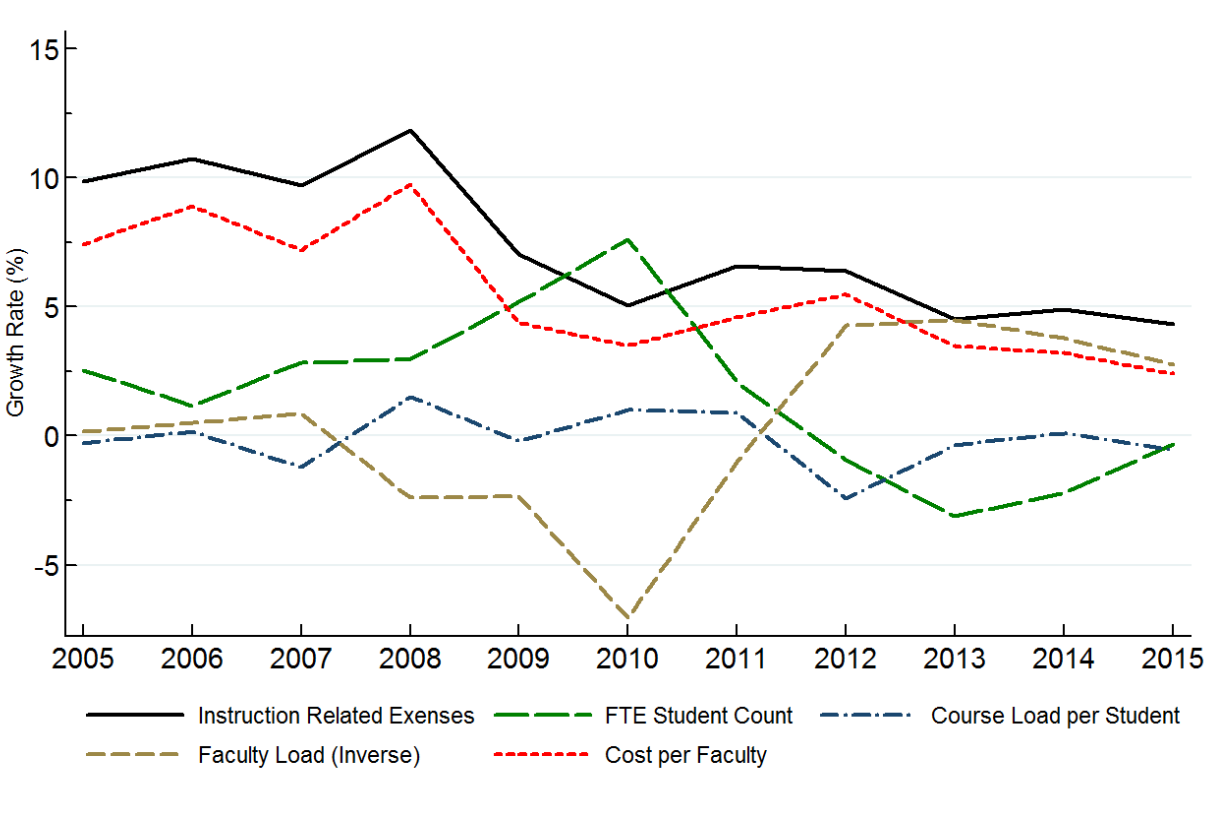


Figure 6 Decomposition of Growth of Spending on Instruction by Sector, 2005-2015

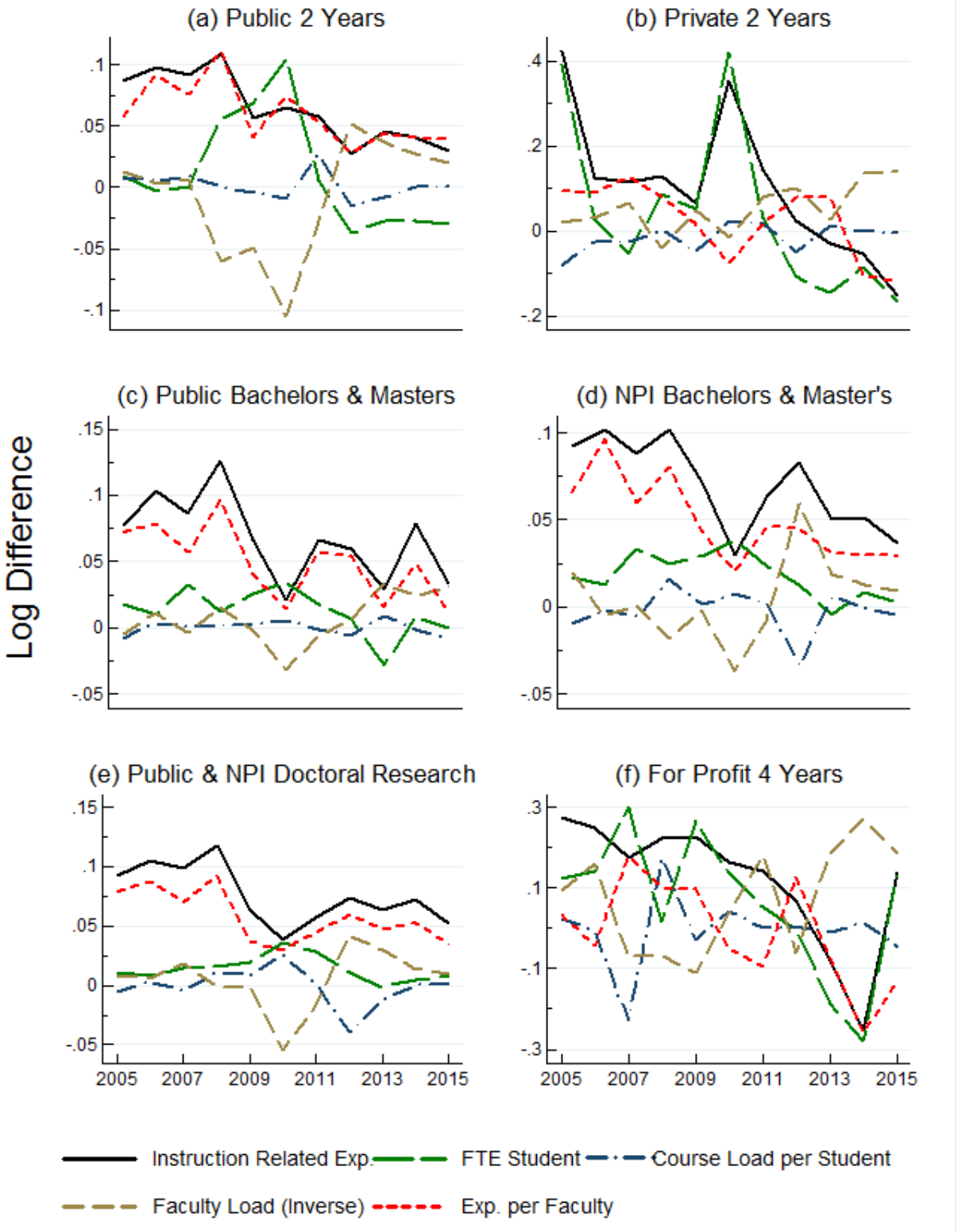


Figure 7 Composition of Instruction-Related Expenditures by Sector, 2004-2015

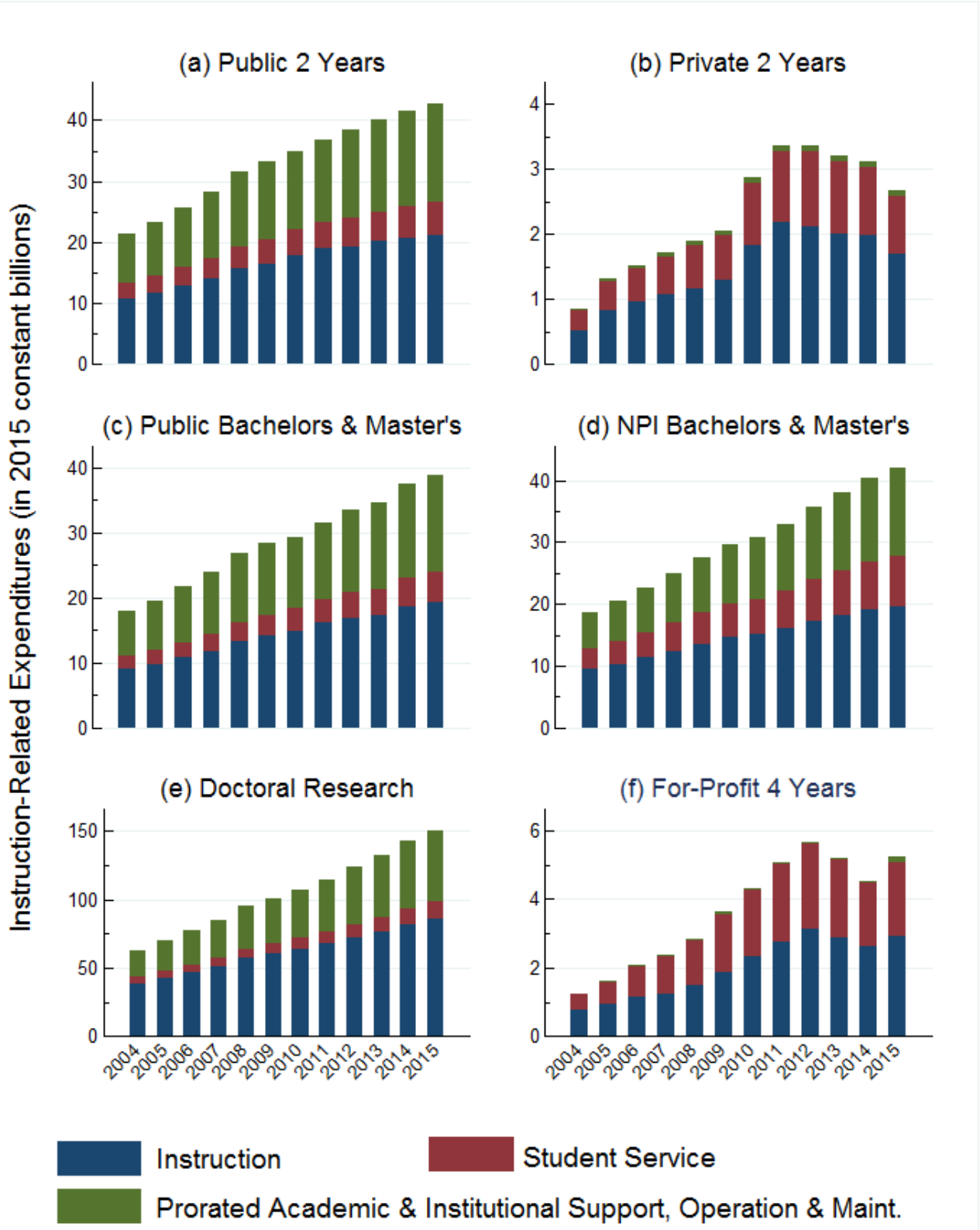


Figure 8 Share of Education-Related Expenditure and Compensation by Sector, 2004-2015