Firms Unchained: Human Capital, the Emergence of Modern Services and 21st Century Development

[PRELIMINARY AND INCOMPLETE]

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Abstract

Can the service sector drive productivity growth in developing economies? This paper argues that it can, but only when supported by a sufficiently skilled workforce. In contrast to manufacturing, productive non-tradable services scale by replicating complex operations across multiple locations – a process that requires managerial oversight and, thus, high-skilled labor. We argue that shortages of human capital in developing countries constrain service-sector productivity growth by limiting the emergence of modern, multi-market firms. To test this hypothesis, we exploit a major higher education reform in Brazil that exogenously expanded access to college in the late 1990s. Using this natural experiment and leveraging matched employer-employee data along with nationally representative surveys, we provide causal evidence that increased local college attainment led to a disproportionate rise in employment at skill-intensive, multi-market service firms, accompanied by wage gains and broader labor reallocation toward the service sector. We interpret these findings through a theoretical framework in which skilled labor is a necessary input for firm expansion across space. Together, our results highlight the central role of human capital in enabling service-led structural transformation and position multi-market firms as key engines of productivity growth in modern developing economies.

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1 Introduction

From Britain in the late 18th century to China in the late 20th century, economic development has historically gone hand-in-hand with industrialization: the shift of economic activity out of agriculture and into technologically advanced, capital-intensive sectors like manufacturing. Today in the 21st century, industrialization as a growth engine appears to have stalled. Advances in automation have rendered manufacturing increasingly skill-biased, diminishing its capacity to absorb labor and deliver inclusive growth at scale (Rodrik, 2015; Acemoglu and Restrepo, 2022). In response, a growing body of research has begun to emphasize the potential for the service sector to drive improvements in living standards across the developing world (Fan et al., 2023; Rodrik and Sandhu, 2024; Rodrik and Stiglitz, 2024). Yet while policymakers pursuing industrialization can draw on a rich set of historical examples and well-established strategies—such as export orientation—there is far less clarity on how to design policies that promote service-led growth, leaving governments with limited guidance on how to harness this emerging engine of development.

This paper argues that the key ingredient to deliver productivity growth in services is human capital. Service-led growth occurs when highly productive service firms scale up production by replicating sophisticated service techniques across locations. This replication, however, requires skilled workers—particularly in managerial roles—to oversee implementation and ensure the standardization of complex service processes. In other words, just as physical capital accumulation contributed to the First Industrial Revolution, the expansion of human capital unlocks an Industrial Revolution in Services (Hsieh and Rossi-Hansberg, 2023). To empirically document the mechanics of this process, we focus on the case of Brazil. In the 1990s, Brazil enacted a reform that dramatically increased the supply of human capital by expanding access to higher education (Cox, 2025). We show that the regions most affected by this reform saw the entry of highly productive multi-location service firms, who opened new establishments there and drove local economic growth.

We begin the paper by documenting a series of descriptive facts about Brazil's transition to a service-oriented economy, which motivate our hypothesis that both college expansion and multi-market firms played a key role in the development of the Brazilian service sector. First, we show that Brazil's structural shift mirrors the experience of many developing economies outside East Asia. While agricultural employment has declined and self-employment has given way to wage employment, the share of employment in manufacturing has remained stagnant at around 15%. By contrast, the service sector has grown steadily over the past three decades and now accounts for nearly 80% of total employment. We next show that these shifts coincided with two striking trends: a surge in the yearly flow of college graduates

from the late 1990s onwards, and a simultaneous rise in employment in multi-market firms. Both trends were concentrated in the service sector, which experienced the most pronounced increases in both skill intensity and the prevalence of multi-establishment firms across the economy.

We then examine the composition of employment in these firms to show that these simultaneous trends are not a coincidence: multi-market firms use skilled workers with significantly greater intensity than single-market firms, even when comparing firms in the same narrow industry. This fact suggests that skilled labor is a crucial input into multi-market production structures. An expansion of the supply of skills therefore disproportionately benefits firms that achieve scale by replicating the same process in distant locations.

Our final set of descriptive facts suggests that the expansion of multi-market firms has been a boon for the Brazilian economy. These firms pay significantly better than their single-market counterparts, even when factoring in worker skill, industry, and location. We argue that the large gap in pay between multi- and single-market firms is evidence of a productivity gap, so that the increasing economic importance of multi-market firms shifts economic resources to more productive uses. In line with this argument, we show that regions that saw a greater rise in the multi-market share of employment also experienced greater income gains, and that these gains are entirely explained by reallocation into multi-market firms.

While the descriptive patterns align with our hypothesis, they do not establish a causal relationship between the expansion of skilled labor and the rise of multi-market service firms. To address this, we exploit a 1996 higher education reform in Brazil that lowered entry barriers for private, for-profit colleges. Before the reform, the Federal Council of Education (FCE) exercised control over the creation of new private institutions, limiting capacity growth despite rising demand. These constraints, fueled by resistance from public universities and professional associations, created a mismatch between the potential demand for higher education and the supply of colleges. The reform dismantled these barriers by deregulating entry and introducing a more transparent system for accreditation and quality assessment. This policy change led to large, spatially heterogeneous expansions in college access, which we exploit to identify the causal effect of skill supply on service-sector firm dynamics.

A central feature of the reform is that it enabled private providers to enter precisely in under-served regions – those where the gap between potential demand and existing capacity was greatest. We use this feature to construct an instrumental variable for local increases in college attainment, following the approach in Cox (2025). The instrument is based on the pre-reform ratio of higher education capacity to potential demand, proxied by the size

of the local population aged 6 to 15 in 1991, who would reach college age following the reform. Regions with the lowest pre-reform capacity-to-demand ratios faced the most binding constraints and were therefore more likely to attract new private institutions once entry was deregulated. Consistent with this identification strategy, we show that, conditional on pre-existing development trends, these constrained regions experienced the largest post-reform increases in college attainment.

Over our observation period, a one percentage point exogenous increase in the share of college-educated individuals leads to a 3.5 percentage point increase in the employment share of multi-market firms. This finding provides further support for our central hypothesis: that the supply of college-educated workers constitutes a critical constraint on the expansion of large firms into new markets. We further show that this relationship is driven primarily by the emergence of new establishments belonging to multi-location firms in regions that experienced larger gains in college attainment, rather than by the expansion of incumbent multi-location firms already operating in those areas. Notably, the vast majority of these new establishments – particularly those reliant on skilled labor – were concentrated in the service sector.

In summary, the natural experiment generated by Brazil's higher education reform shows that expanding the supply of skilled workers facilitates the emergence of new multi-market firms, particularly in the service sector, that rely intensively on skilled labor. This expansion contributes to a reallocation of employment toward more productive firms. Taken together, the rise in skill intensity within services and the effects of increasing college attainment suggest that higher education played a pivotal role in enabling service-led growth. By equipping the workforce with the skills required to scale complex service operations, the expansion of college education transformed service production from traditional formats into more sophisticated, modern forms – what we refer to as an Industrial Revolution in Services.

To distill and quantify our empirical results, we propose a novel theoretical framework that builds on that of Hsieh and Rossi-Hansberg (2023). We allow for skill heterogeneity among workers, and introduce a modification that underscores the importance of different types of labor to firm expansion: operating a new establishment requires high-skilled workers to serve as managers. These managers, who oversee the application of the firm-level technology to new markets, are part of the fixed cost of operating establishments at distance. We assume that this fixed cost is greater at longer distances, so that multi-market firms whose operations cover large areas are more skill-intensive.

An immediate implication of our theory is that because multi-market firms face greater fixed costs to open their establishments, they are positively selected relative to local single-market firms. They also are more sensitive to the relative supply of skilled vs. unskilled

workers: their decision of whether to enter a given location depends crucially on the local skill premium. In areas where skilled labor is very scarce – and hence expensive relative to unskilled labor – multi-market firms are unlikely to enter. When a reform such as the one experienced by Brazil generates an exogenous increase in the local share of skilled labor, it reduces fixed costs for multi-market firms, allowing more of them to enter the local market and draw labor away from single-market firms. Relaxing the bottleneck on skilled labor therefore allows for the spread of productive service technology across space, fostering productivity growth in the service sector. On top of the direct effects of expanding the skill supply, our theory accommodates demand-driven feedback loops, where income effects shift demand further towards highly productive industries and firms, reinforcing service-led growth (Schwartzman, 2025).

Related literature — We contribute to four main strands of the literature.

First, we contribute to the debate on whether the service sector can serve as an engine of economic development. Since the seminal work of Baumol (1967), the dominant view has been that services offer limited potential for productivity growth. Consequently, economic development was long believed to depend on a vibrant manufacturing sector. However, in the 21st century, manufacturing has increasingly lost its traditional role as a labor-absorbing engine of broad-based prosperity (Acemoglu and Restrepo, 2022; Rodrik and Sandhu, 2024; Rodrik and Stiglitz, 2024).

In response, a growing body of research has begun to reassess the growth potential of the service sector. Fan et al. (2023) document sustained productivity growth in India's service sector, while Hsieh and Rossi-Hansberg (2023) identify an "industrial revolution in services" in the United States. In China, Chen et al. (2023) find that service sector productivity growth may have even outpaced that of manufacturing. Yet, despite these developments, there is limited guidance on how to catalyze such a transformation in other contexts. Our paper contributes to this literature by documenting sustained productivity growth in Brazil's service sector, driven by the expansion of multi-market firms. We further show that this transformation was contingent on a substantial increase in the supply of college-educated workers. Together, our findings suggest that, when supported by an adequate supply of skilled labor, multi-market firms can act as engines of service-led growth.

Second, our paper also contributes to the literature on the modernization of the service sector and the mechanisms that underpin it. Buera and Kaboski (2012) develop a theory in which rising income levels drive a transition from home production to more specialized, skill-intensive service provision. A complementary line of work emphasizes the role of information and communication technologies (ICT) as a key driver of productivity growth in services (Hjort and Poulsen, 2019; Eckert et al., 2022; Hsieh and Rossi-Hansberg, 2023; Jiang, 2023;

Hjort and Tian, 2025). More recently, Schwartzman (2025) proposes a theory in which the shift toward modern services is itself a source of aggregate growth. We contribute to this literature by providing empirical evidence that human capital plays a central role in enabling the modern provision of services. To the best of our knowledge, we are the first to establish this causal relationship empirically. Moreover, we extend the framework of Hsieh and Rossi-Hansberg (2023) by introducing worker heterogeneity to capture the pivotal role of college-educated workers in managing multi-market firms. In doing so, we highlight the importance of managerial human capital as an input in the production of modern services.

Third, our work contributes to a broad literature on human capital and firm growth. Foundational contributions by Chandler (1977) and Lucas (1978) underscore the importance of organizational structures that support managerial delegation as a key enabler of firm expansion. More recent work has documented substantial international variation in management practices and their close association with human capital accumulation (Bloom and Van Reenen, 2007; 2010; Bloom, Lemos, et al., 2014). Cox (2025) provides direct evidence that increases in human capital can drive firm expansion and catalyze structural transformation, and Engbom et al. (2024) develop a theory where firms choose to adopt managerial capitalism based on the supply of skills in the economy. We build on this literature by highlighting the role of multi-market firms in the service sector as an important channel through which human capital affects aggregate outcomes. We document the productivity advantage of multi-market firms and show that rising college attainment enables firms to expand across markets and absorb larger shares of employment, thereby facilitating broad-based structural transformation.

Fourth and finally, we contribute to the literature on multi-establishment firms. While some studies model these firms as knowledge-based hierarchies (Garicano and Rossi-Hansberg, 2015; Gumpert et al., 2022), we follow Hsieh and Rossi-Hansberg (2023) in emphasizing the role of market entry and geographic expansion. Mariscal (2018), for instance, examines how access to information and communication technologies shapes the organizational structure of multi-market firms. In contrast, our work highlights the importance of human capital – specifically, the availability of skilled workers who can serve as managers – as a key input in enabling the emergence and expansion of multi-market firms. Our paper also represents some of the first research on multi-market firms in a developing country setting.

The paper is structured as follows. Section 2 describes the datasets and presents six empirical facts that characterize the structural transformation driven by the interaction between the rising supply of college-educated workers and the expansion of multi-market firms. Section 3 introduces the education reform, outlines the empirical strategy, and presents the main empirical results. Section 4 develops a simple model of firm size and market entry

with heterogeneous workers. Section 5 concludes and highlights key challenges for future research.

2 Facts

We highlight 6 facts from the data. Before, we start by describing our data.

2.1 Data

Our main data set consists of the microdata from the Relação Anual de Informações Sociais (RAIS). The RAIS dataset contains the universe of formal establishments and workers. We use employment by education level, geographic location (micro-regions and municipalities), industry (5-digit CNAE[1]), the establishment's ID, and the ID of the firm that owns the establishment. Our observation period extends from 1995 to 2018[2].

Using the 1995 CNAE industry classifications provided by the IBGE (Instituto Brasileiro de Geografia e Estatística), we have yearly observations for 461 consistently defined industries. Hereafter, when we refer to an industry, we have in mind one of these 461 industries.

Following the literature studying local labor markets in Brazil using RAIS (see e.g. Kovak (2013) and Dix-Carneiro and Kovak (2017)), we group municipalities into 486 microregions as defined by the IBGE in its *Malha Municipal*[3] of the year 2002 as in Dix-Carneiro and Kovak (2017). Analogous to commuting zones in the United States, the IBGE regroups municipalities such that microregions respresent a single labor market.

We complement the RAIS with informality data at the municipality level from the National Household Sample Survey (PNAD) for the entire observation period. In particular, this allows us to disentangle aggregate over-time trends of the number of firms/establishments and corresponding employment from rising formalization.

Moreover, we use the long form of the decennial census for the years 2000 and 2010. The long-form Census provides individual-level data on employment status, industry of employment, take-home income, and geographic identifiers at the municipality and microregion levels. It is possible, using person-level sampling weights from the Brazilian Institute of Geography and Statistics (IBGE), to aggregate this data to the microregion-year level to construct three key statistics: (i) the share of service workers in modern employment, (ii)

[1]CNAE stands for Classificação Nacional de Atividades Econômicas and is roughly equivalent to the ISIC Rev.3 classification according to Dix-Carneiro (2014).

[2]Moreover, due to a lack of observations for either the year 1995 or 2018 (that impedes the computation of changes), we drop the following industries: space transport, investment funds, renting airplanes.

[3]The IBGE updates its definitions of microregions regularly with the publication of a new *Malha Municipal* (MMC). Each MMC defines the updated administrative division of Brazil.

the cross-sectional wage premium associated with modern service work, and (iii) income per capita. Finally, we merge the different datasets based on the municipality and year.

We make use of the establishment's firm ID for two purposes. First, we use the firm ID to aggregate employment (and different categories of it) of establishments to a firm in an industry. Second, we use the establishment ID to measure headquarter (HQ) employment. In Brazil, every firm must be registered in the national firm registry (CNPJ)[4] which allocates a 14-digit ID to each firm. The first 8 digits of a firm's CNPJ represent the "raiz" (root in english) that allows to identify the firm. The following 4 digits identify the firm's establishments where the normative instruction n°82/1999 disposed that each firm must have one "matriz"[5] (headquarter in english). where the number "0001" is attributed to the headquarter.

2.2 Fact 1: Structural Change Shifted Employment from Agriculture and Self-Employment to Employment in Services

Our first fact concerns structural change along two important dimensions. First, employment shifted away from agriculture and self-employment towards wage employment. Figure (1) depicts a clear increase in the importance of wage employment in the Brazilian economy starting in the year 2000, peaking in 2013. The early spike in the employment share around 1998/1999 can be attributed to the introduction of the SIMPLES system. The government enacted SIMPLES to curb informality by reducing bureaucracy and the tax burden on microenterprises (for an in-depth analysis of the SIMPLES policy, see Monteiro and Assunção (2012)). Beginning in 2014, Brazil experienced a recession whose impact lasted until 2018 and beyond (Barbosa-Filho, 2020), potentially explaining the decline in the wage employment share observed after 2014. Nevertheless, the shift towards wage employment remains macroeconomically significant; despite the decline induced by the recession after 2014, the share of wage employment increased by approximately 8% over a span of just ten years.

[4]CNPJ stands for Cadastro Nacional da Pessoa Jurídica and was established in 1998 via Instrução Normativa SRF N°27, 05/03/1998 of the finance ministry, replacing the CGC (Cadastro Geral de Contribuintes) in place since 1964. Firms with a CGC remained with the same number in the CNPJ.

[5]Art. 15, § 2°



Figure 1

Note: Figure displays the share of all Brazilian workers who worked for wages in the reference week. Data come from PNAD, the national household survey, and use individual sampling weights.

Second, employment creation was strongest in the service sector, leading to a service-biased structural transformation. Figure (2) presents clear descriptive evidence that the service sector is responsible for the majority of employment creation in our observation period. Starting from less than 60%, the service sector saw its employment share expanded to around 70% in 2018. In the same time, manufacturing saw its employment share remain stable with a light decrease towards the end of the observation period. This observation is in line with premature deindustralisation, a pattern documented by Rodrik (2015) for Brazil among other middle-income economies. In light of premature deindustralisation, service-led growth becomes even more important as argued by Rodrik and Sandhu (2024) and Rodrik and Stiglitz (2024). As in line with figure (1), the importance of the sectoral category agriculture/mining/others in employment diminishes with time.

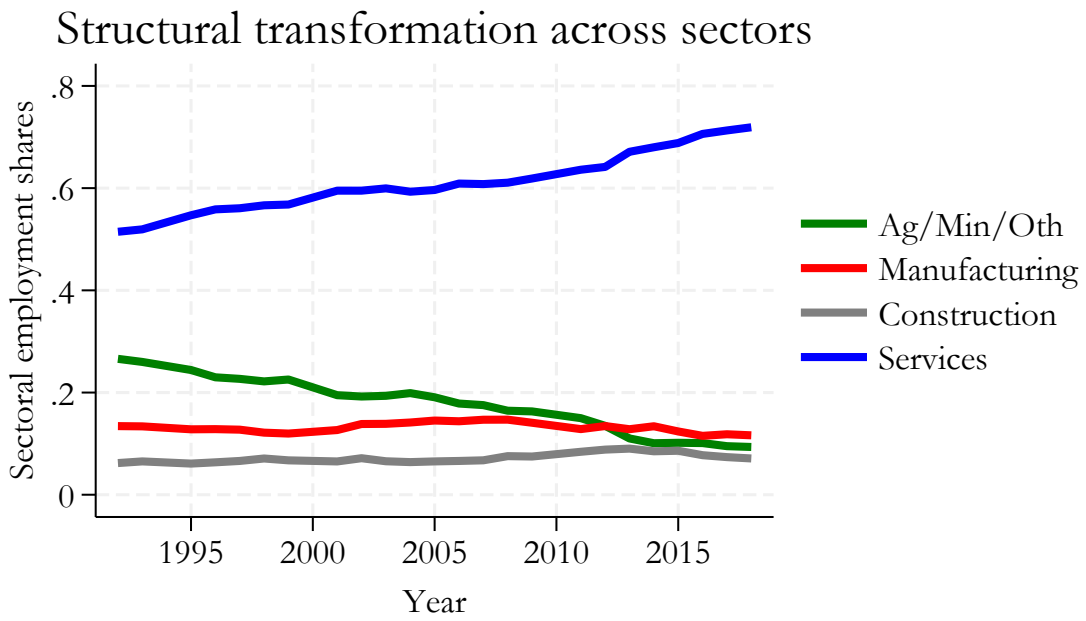


Figure 2

Note: Figure displays the share of all Brazilian workers whose main job was in each of four broad sectors in the reference week. Data come from PNAD, the national household survey, and use individual sampling weights. "Ag/Min/Oth" refers to agriculture, mining, and other industries not elsewhere classified.

2.3 Fact 2: The Expansion of Multi-Location Firms was Accompanied by a Rise of College Education

Fact 1 showed that structural change away from self-employment towards wage-employment occurred. Our second fact shows that the spatial expansion of firms, accompanied by a rise in college education, underpinned this structural change, resulting in an increase in the number of markets per firm. The number of college graduates increased substantially over our observation period, especially due to the 1996 education reform, as shown by Cox (2025). Figure (3) illustrates the number of college graduates per year. Before the reform, the number of college graduates per year remained almost stable, increasing only slightly. Four to five years after the reform, a clear upward trend emerges, corresponding to the time required for the first cohorts to graduate. The steep increase in college graduates per year temporarily slows down around the years 2005–2007. In the years 2013/2014, at the onset of the recession, the total number of college graduates per year drops slightly, but returns to its growth path two years later. In absolute terms, the number of college graduates per year increased by a factor of nearly six.



Figure 3

Note.— The figure shows the evolution of the total number of college graduates for the period 1990-2018. Data come from RAIS.

Figure (4) shows that a substantial increase in the employment share of multi-market firms began shortly after the rise in the number of college graduates per year, as depicted in Figure (3). In other words, beginning in 2000/2001—approximately 4 to 5 years after the 1996 reform led to an increase in college graduates—multi-market firms started to account for a growing share of overall employment from 2003/2004 onward. Prior to the onset of the 2014 recession, the employment share of multi-market firms peaked at approximately 20Relative to its lowest point around the year 2000, this represents nearly a 100% increase in the employment share of multi-market firms. As shown in Figure (4), this trend is robust across various definitions of multi-market firms, whether measured by the number of establishments, municipalities, or commuting zones in which firms operate. After reaching its peak in 2014, the employment share of multi-market firms stabilizes, albeit at a significantly higher level, suggesting that a substantial structural transformation had taken place.

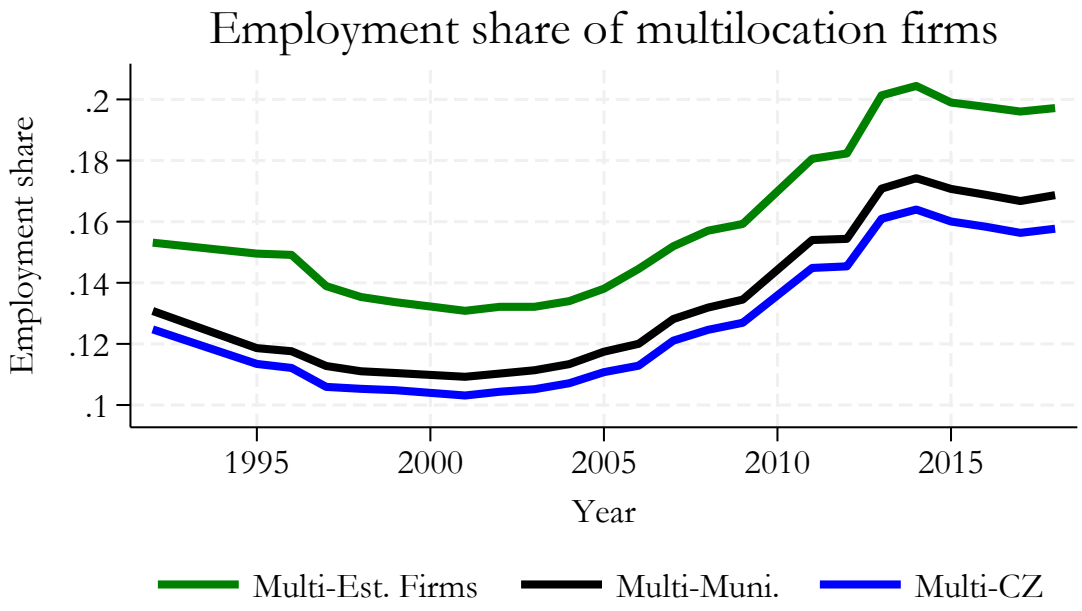


Figure 4

Note: Figure displays total employment in multi-market firms – as identified in RAIS, which links establishments belonging to the same parent firm – divided by total employment in Brazil as measured by PNAD. Total employment from PNAD uses individual sampling weights.

Table 1 provides evidence supporting the hypothesis that multi-market firms have played a significant role in driving employment growth across industries. The table reports results from regressions estimated separately for each of the 461 five-digit industries in our sample, where the change in log employment between 1995 and 2018 is regressed on various measures of the change in the average number of markets served per firm over the same period. All three measures of multi-market activity yield a consistent pattern: industries in which the average firm expanded its geographic footprint experienced significantly faster employment growth. These effects are not only statistically robust but also economically meaningful. For example, column (2) shows that a one percentage point increase in the number of commuting zones (CZs) served by the average firm is associated with a 17 percent increase in industry-level employment growth. Similarly, column (1) indicates that a one percentage point increase in the number of establishments operated by the average firm corresponds to a 10 percent increase in employment growth. Together, these results underscore the strong correlation between firm geographic expansion and aggregate employment dynamics at the industry level.

Table 1: Industry Employment Growth and Firms' Spatial Expansion

	Δ Log Ind. Employment		
	(1)	(2)	(3)
Δ Log establishments/firm	0.10***		
	(0.03)		
Δ Log CZs/firm		0.17***	
		(0.05)	
Δ Log municipalities/firm			0.04*
			(0.02)
Constant	0.34***	0.33***	0.33***
	(0.04)	(0.04)	(0.04)
R^2	0.019	0.024	0.007
Observations	461	461	461

Note.— The table shows weighted regressions of total log changes in industry employment on total log changes of the number of establishments/CZ/municipalities respectively of the average firm in an industry over the period 1995-2018. Data come from RAIS.

The observed association between multi-market firms and industry employment growth can be decomposed along several margins. Consider the share of workers with a college degree (hereafter: college workers/college employment/college firms) within industry i: $\frac{L_{c,i}}{L_i}$, where $L_{c,i}$ denotes college employment and L_i denotes total employment in industry i. Let the number of firms in industry i be F_i, and the number of firms employing *any* college workers be $F_{c,i}$; we refer to these as "college firms." Finally, let total employment in college firms in industry i be $\tilde{L}_{c,i}$; note that this includes both college and non-college workers. The college share in industry i can be decomposed as follows:

$$\frac{L_{c,i}}{L_i} = \underbrace{\frac{F_{c,i}}{F_i}}_{\text{Share of college firms}} \times \underbrace{\frac{\tilde{L}_{c,i}/F_{c,i}}{L_i/F_i}}_{\text{Relative size of college firms}} \times \underbrace{\frac{L_{c,i}}{\tilde{L}_{c,i}}}_{\text{College worker share within college firms}} \tag{1}$$

Now consider the growth in the industry's college share over time, expressed in logs: $\Delta \log \frac{L_{c,i}}{L_i}$. This growth can be decomposed into three distinct margins:

$$\Delta \log \frac{L_{c,i}}{L_i} = \underbrace{\Delta \log \frac{F_{c,i}}{F_i}}_{\text{Extensive margin}} + \underbrace{\Delta \log \frac{\tilde{L}_{c,i}/F_{c,i}}{L_i/F_i}}_{\text{Firm size margin}} + \underbrace{\Delta \log \frac{L_{c,i}}{\tilde{L}_{c,i}}}_{\text{Intensive margin}} \tag{2}$$

Using an approach similar to Table 6 in Hsieh and Rossi-Hansberg (2023), we can examine whether college expansion operates primarily along the extensive margin, the firm size margin, or the intensive margin. In other words, there are three potential channels through which an industry could increase its college share: more firms could become college firms (extensive margin), college firms could become larger (firm size margin), or college firms could more intensively hire college workers (intensive margin). Table (2) provides evidence suggesting that the intensive margin, followed by the extensive margin, are the primary drivers of the expansion of college firms. The intensive margin accounts for 62.7% of the college share expansion. This reflects human capital deepening within firms, as they employ a greater number of college-educated workers. The extensive margin contributes 37.4% to the growth in the share of college workers. By contrast, the effect of the relative firm size on the expansion of college firms is statistically insignificant and close to 0.1%.

Table 2: Decomposition of the College Share

	(1)	(2)	(3)
	Ext. margin	Rel. firm size	Int. margin
Growth of coll. share	0.374***	-0.00108	0.627***
	(0.0502)	(0.0395)	(0.0301)
Constant	0.450***	-0.502***	0.0522
	(0.0560)	(0.0441)	(0.0336)
Observations	460	460	460

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table presents weighted regressions of the extensive margin, the relative firm size margin, and the internal margin of the college share on the overall growth of the college share during the period 1995–2018. Unit of observation is an industry. The data are sourced from RAIS.

Notably, the firm size margin can be further decomposed into two components: a market number margin and a market–firm size margin. Let $M_{c,i}$ denote the number of markets in industry i served by college firms, and M_i the total number of markets in i. This decomposition allows us to separate the expansion in firm size into (i) the number of distinct markets served and (ii) the average size of a firm's establishment within each market.

$$\Delta \log \frac{\tilde{L}_{c,i}/F_{c,i}}{L_i/F_i} = \underbrace{\Delta \log \frac{M_{c,i}/F_i}{M_i/F_i}}_{\text{Market number}} + \underbrace{\Delta \log \frac{\tilde{L}_{c,i}/M_{c,i}}{L_i/M_i}}_{\text{Market-firm size}}, \tag{3}$$

Following Hsieh and Rossi-Hansberg (2023), we operationalize "markets" using three def-

initions: the total number of establishments operated by college firms, the total number of municipality–college firm pairs, or the total number of commuting zone (CZ)–college firm pairs. If college expansion facilitates the growth of multi-market firms, as our hypothesis suggests, we should expect this effect to materialize primarily through the market number margin—that is, through an increase in the number of markets served—rather than through an increase in the size of establishments within markets.

Indeed, when we decompose the near-zero average effect of college expansion on overall firm size, we find that the number of establishments per college firm rises significantly, while the average size of establishments within firms declines. This offsetting pattern persists even when markets are defined at the CZ level.

Table 3 presents this decomposition. Column (1) replicates the coefficient on relative firm size from the earlier decomposition; columns (2) and (3) break this effect into contributions from the number of markets served and the average establishment size within markets, respectively. Both components are statistically significant but offsetting. In particular, an increase in the number of establishments is associated with a 12.4% contribution to the growth of the college employment share.

Table 3: Decomposition of the College Share: Relative firm size effect (establishments)

	(1)	(2)	(3)
	Rel. firm size	N. of estab.	Estab. size
Growth of coll. share	-0.00108	0.124***	-0.125***
	(0.0395)	(0.0253)	(0.0297)
Constant	-0.502***	-0.332***	-0.170***
	(0.0441)	(0.0282)	(0.0331)
Observations	460	460	460

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table shows weighted regressions from a decomposition of the relative firm size margin (1) into the number of establishments (2) and the establishment size (3) on the overall growth of the college share for the period 1995-2018. Unit of observation is an industry. Data come from RAIS.

When we define market presence in terms of CZ coverage, the results are similar, though the magnitudes are slightly larger—by approximately one percentage point—while still offsetting one another.

Table 4: Decomposition of the College Share: Relative firm size effect (CZs)

	(1)	(2)	(3)
	Rel. firm size	N. of MMCs	MMC-firm size
Growth of coll. share	-0.00108	0.132***	-0.133***
	(0.0395)	(0.0199)	(0.0344)
Constant	-0.502***	-0.254***	-0.249***
	(0.0441)	(0.0222)	(0.0384)
Observations	460	460	460

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table reports weighted regressions based on a decomposition of the relative firm size margin (1) into two components: (2) the number of commuting zones in which a firm operates at least one establishment, and (3) the total employment size of a firm's establishments within a commuting zone. Each component is regressed on the overall change in the college-educated employment share over the period 1995–2018. The unit of observation is the industry. Data are sourced from RAIS.

Taken together, these results underscore that the rise in skill intensity across sectors is tightly linked to firms' ability to expand across space—an expansion that, under our framework, depends critically on access to skilled workers. This pattern reflects the transition from traditional, localized production to modern service provision, where the ability to replicate complex operations across markets requires managerial human capital. As firms scale geographically, their reliance on skilled labor deepens, reinforcing the link between skill intensity and the emergence of the multi-market firm.

2.4 Fact 3: "Growth in Multi-Market Firms was most Pronounced in the Service Sector"

We have shown that a structural transformation occurred, shifting employment from agriculture and self-employment to wage employment and employment in services. We have also shown that the number of college graduates per year increased following the 1996 education reform, which was eventually followed by an expansion of multi-market firms. We now investigate the sectors in which multi-market firms expanded. Figure (5) shows that, in 2018, over 60% of multi-market firms were in the service sector. This pattern holds regardless of whether multi-market firms are measured by the number of establishments, presence in municipalities, or presence in commuting zones (for earlier years—1990, 2000, and 2010—refer

to Figure (12) in the appendix).[6]

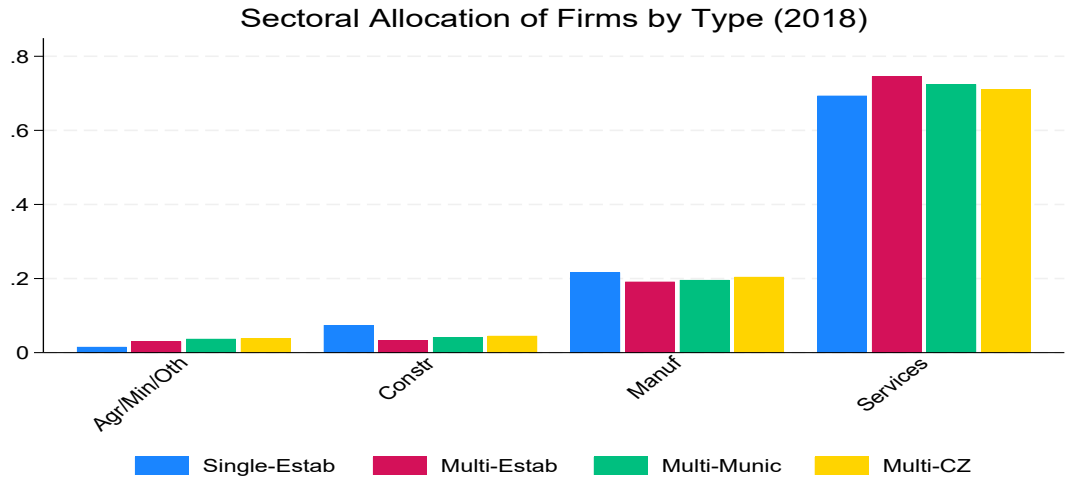


Figure 5

Note.— The figure displays the sectoral distribution of firms by organizational structure for the year 2018. Firms are categorized as follows: single-establishment firms (blue); multi-establishment firms (red); multi-establishment firms operating in at least two municipalities (green); and multi-establishment firms operating in at least two commuting zones (yellow). 'Ag/Min/Oth' denotes agriculture, mining, and other industries not elsewhere classified. Data are drawn from RAIS.

Within the service sector, there is substantial heterogeneity across subsectors regarding the presence and expansion of multi-market firms. Figure (6) makes clear that multi-market firms are most prevalent in retail. Figure (13) in the appendix confirms that this pattern has remained qualitatively consistent in the years 1990, 2000, and 2010. Consider, for example, the Brazilian retail company Magazine Luiza. Beginning with 100 establishments in 2000, the company implemented an ambitious expansion strategy that included acquiring several smaller competitors and entering the e-commerce space early. Employees at new establishments received standardized training aligned with Magazine Luiza's internal processes, enabling the company to grow to 728 establishments by 2011 (Magazine Luiza S.A, 2012).

[6]Qualitatively, the pattern remains the same, with the only notable difference being a declining share of multi-market firms in manufacturing.

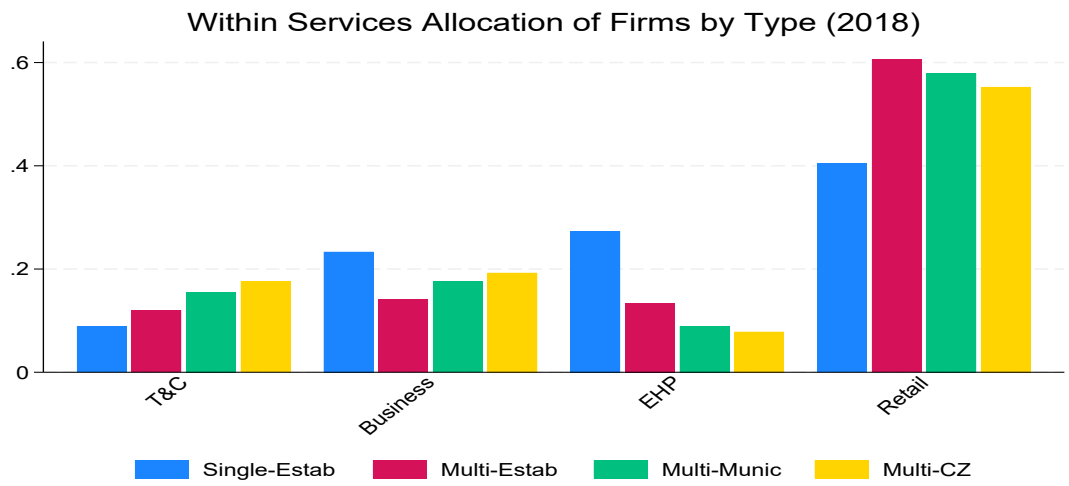


Figure 6

Note.— The figure illustrates the distribution of firms by organizational structure within the service sector for the year 2018. Firms are classified into four categories: single-establishment firms (blue); multi-establishment firms (red); multi-establishment firms operating in at least two municipalities (green); and multi-establishment firms operating in at least two commuting zones (yellow). 'TC' refers to the telecommunications and communication industries, while 'EHP' denotes the education, health, and public service sectors. Data are sourced from RAIS.

The impressive growth of multi-market firms in the service sector was accompanied by human capital deepening across the broader economy. However, this trend is particularly pronounced within the service sector. Figure (7) shows that the college-educated share of the sectoral workforce increased most significantly in services during the period 1990–2018. Moreover, this trend of human capital deepening follows an increasingly steep trajectory over time. By 2018, the college share in the service sector had reached approximately 25%. This pattern aligns with previous works that show how increasingly available human capital drives service-biased structural change such as Buera and Kaboski (2012).

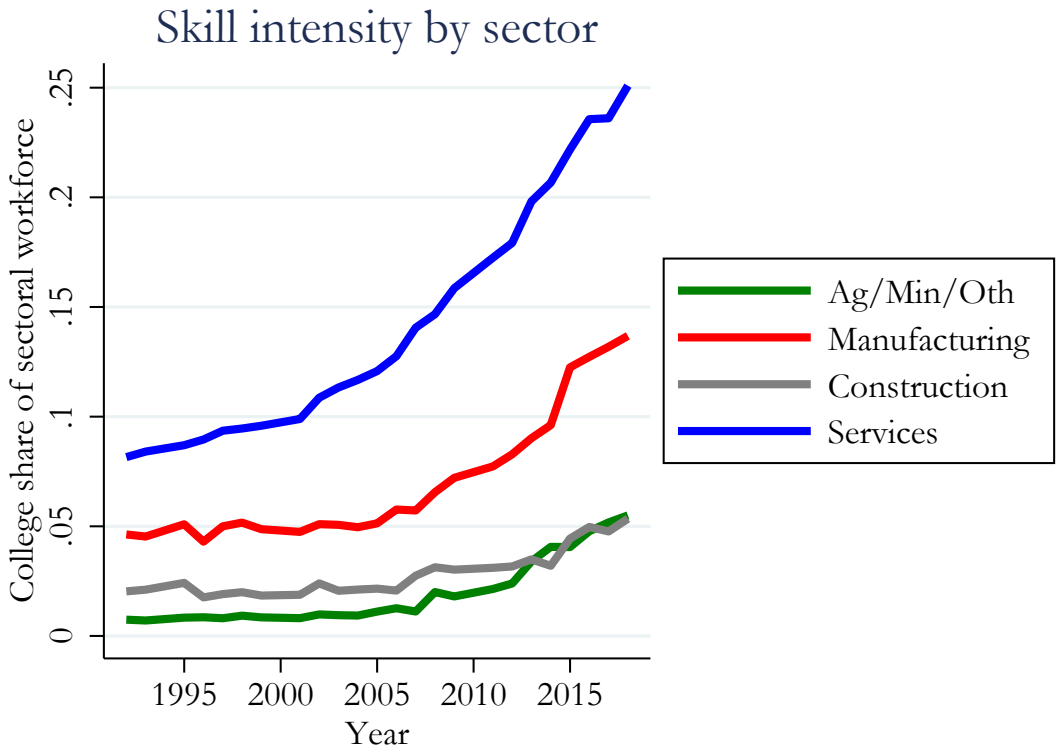


Figure 7

Note: Figure displays the skill intensity of four broad sectors of the Brazilian economy over time. Sectoral skill intensity is measured as the share of the sector's workers who completed college, according to PNAD.

2.5 Fact 4: Multi-Market Firms are More Skill-Intensive

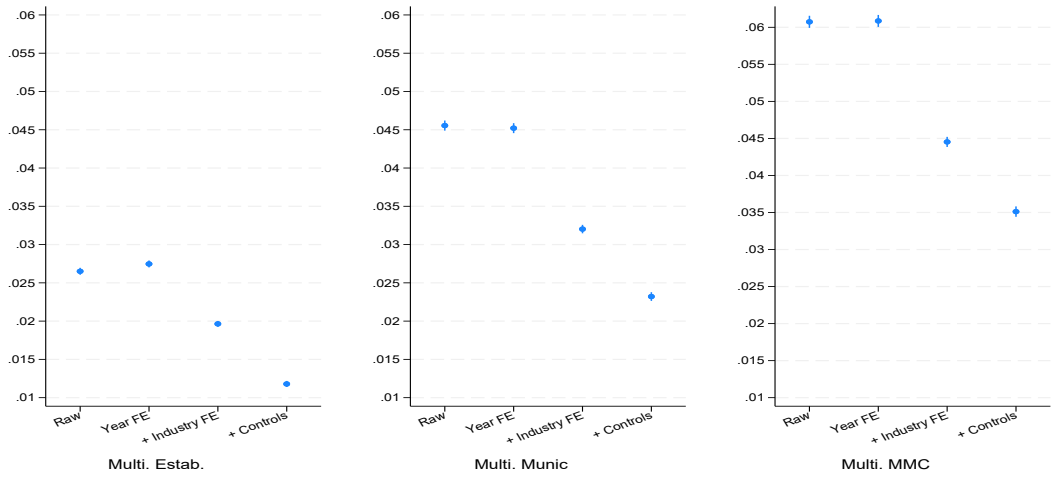
The increase in the supply of college-educated workers that we have documented thus far has benefited firms unevenly. Specifically, multi-market firms tend to employ a higher share of skilled workers. Moreover, skill intensity increases with the average distance between a firm's headquarters and its establishments. Here, we measure skill intensity as the share of college-educated workers. To examine the relationship between skill intensity and multi-market firm status, we estimate the following regression, the results of which are

$$\text{Skill Intensity}_{jit} = \alpha D_{jit}^{MM} + \theta_t + \theta_i + X_{jit}\Gamma + \varepsilon_{jit} \tag{4}$$

where $\text{Skill Intensity}_{jit}$ denotes the share of college-educated workers in firm j, operating in industry i at time t. D_{jit}^{MM} is a dummy variable indicating whether the firm has multi-market status in a given time period. To account for year-specific shocks to skill intensity, we include year fixed effects θ_t. To ensure comparability across industries, we control for fundamental

differences in baseline skill intensity using industry fixed effects θ_i. To avoid confounding skill intensity with firm size, we include firm size among the control variables X_{jit}. We estimate several specifications, beginning with a baseline regression and progressively adding fixed effects and control variables. Accordingly, the coefficient α can be interpreted as the skill intensity premium associated with multi-market firms. Figure (8) presents whisker plots for the three different measures of multi-market firm status used thus far. On the left, where multi-market firms are defined as firms with more than one establishment, the skill premium is highly statistically significant and ranges from just under 1% to slightly less than 3%. In the middle, using the definition of multi-market firms as firms operating in multiple municipalities, the associated skill premium ranges from slightly above 2% to approximately 4.5%. On the right, we use the measure that implies the greatest spatial expansion—multi-CZ firms. The increasing skill premium from left to right in Figure (8) is consistent with a positive correlation between skill intensity and the geographic distance from a firm's headquarters. The potential distance between headquarters and establishments increases from the multi-establishment to the multi-CZ definition. In the left whisker plot, firms with multiple establishments may still be entirely located within a single CZ. In the middle whisker plot, multi-municipality firms could span several municipalities within the same CZ. In the right whisker plot, multi-CZ firms are more likely to span multiple CZs, implying greater spatial separation between headquarters and establishments.

Figure 8: Distance and Skill Intensity



Note.— The figure plots estimates of α across alternative specifications of estimation equation (5). The unit of observation is an establishment-year pair. Data are sourced from RAIS.

To investigate the second part of Fact 4—namely, the relationship between skill intensity and the average distance between headquarters and establishments—we estimate the

following regression:

$$\log dist_{imjt}^{HQ,estab} = \alpha \, \text{Skill Intensity}_{imjt} + \theta_t + \theta_j + X_{jit}\Gamma + \varepsilon_{jit} \tag{5}$$

The results are presented in Table (5). As before, we include year and industry fixed effects to control for unobserved heterogeneity, and firm size is included in the set of control variables. Accordingly, Table (5) provides evidence in support of the hypothesis that skill intensity increases with the average distance between headquarters and establishments. Interestingly, skill intensity rises with distance at both the headquarters and establishment levels. However, column (3) of Table (5) shows that the increase in skill intensity is quantitatively more pronounced at the headquarters level than at the establishment level, on average.

Table 5: College decomposition: Relative firm size effect (MMCs)

Dep. Variable	ΔDistance HQ-Establishments		
Specification	(1)	(2)	(3)
Skill intensity, firm	1.27***	0.75***	
	(0.01)	(0.01)	
Skill intensity, HQ			0.58***
			(0.01)
Skill intensity, estab.			0.18***
			(0.01)
Year FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes
Obs.	848053	848053	778648
R^2	0.22	0.26	0.27

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table presents regression results for the log distance between an establishment and its headquarters as a function of skill intensity measured at the firm level, headquarters level, and establishment level. The unit of observation is the establishment. Data are sourced from RAIS.

2.6 Fact 5: Multi-Location Firms Are More Productive

Next, having shown that multi-market firms are concentrated in consumer services and that they tend to rely more on skilled labor, we also present suggestive evidence that they are more productive than single-market firms. Since we do not have establishment-level data on revenues or profits, we use wages paid to workers as a proxy for the productivity of an establishment in a given commuting zone. We show that workers of the same education level in the same industry and location are better paid in multi-establishment firms than single-establishment firms. More formally, we run regressions of the following form:

$$\log \overline{w}_{jient} = \beta_1 \mathbf{1}\{j \in \text{Multi.}\} + \theta_{ient} + \varepsilon jient, \tag{6}$$

where j indexes a firm establishment, i indexes the establishment's industry, e is an education group, n is a commuting zone, and t is a year. That is, we construct average wages for workers in an establishment-education-year cell ($\overline{w}_{jient}$) and regress their log on an indicator for the establishment belonging to a multi-market firm and interacted fixed effects for industry, education group, commuting zone, and year. We use three education groups: less than high school, high school graduates, and college graduates.

Results are in Table 6. No matter the definition of a multi-market firm – multi-establishment, multi-municipality, or multi-commuting-zone – they pay significantly higher wages, even within industry-education-CZ-year. Average wages are higher by roughly 20% in multi-market firms, suggesting that they are significantly more productive than their single-market counterparts. While some of this positive relationship could be the result of worker selection on unobservables, this would still support the hypothesis that multi-market firms are more productive, since productive workers tend to match with productive firms. In future versions of the paper, we plan to use worker transitions to identify the wage premium of multi-market firms conditional on all time-invariant worker characteristics.

Table 6: Wage regressions, pooled across years

	(1)	(2)	(3)
	Log wage	Log wage	Log wage
Multi-market firm	0.188***	0.201***	0.207***
	(0.00347)	(0.00346)	(0.00360)
Obs.	7,251,815	7,251,815	7,251,815
Market def.	Estab.	Muni.	CZ
Edu×CZ×Industry×Year FE	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: A unit of observation in these regressions is an establishment × education group × year cell. We use three education groups: less than high school, high school graduates, and college graduates. The dependent variable is the log of the average wage within this cell, while the covariate of interest is a dummy variable for the establishment belonging to a multi-market firm. All data come from RAIS in 1995 and 2018. Robust standard errors are in parentheses.

2.6.1 Time-varying productivity gaps

The results in Table 6 show that there is a large productivity gap between multi- and single-market firms when pooling the difference in wages across years. Table 7 reveals that this gap varies over time, and has in fact declined in recent decades. The first three columns of Table 7 present results from running the regression in Equation (6) in 1995, while the last three columns present results from 2018, with each column again corresponding to different definitions of a multi-market firm. The gap in wages between multi- and single-market firms was 25-32% in 1995 but shrank to 15-16% in 2018. This decline in the productivity gap suggests that barriers to becoming a multi-market firm fell between 1995 and 2018, something our theory will be able to explain through the rising abundance of skilled labor.

Table 7: Wage regressions, by year

	1995			2018		
	(1)	(2)	(3)	(4)	(5)	(6)
	Log wage	Log wage	Log wage	Log wage	Log wage	Log wage
Multi-market firm	0.248***	0.306***	0.316***	0.158***	0.151***	0.155***
	(0.00696)	(0.00893)	(0.00930)	(0.00381)	(0.00278)	(0.00287)
Obs.	2,049,197	2,049,197	2,049,197	5,202,618	5,202,618	5,202,618
Market def.	Estab.	Muni.	CZ	Estab.	Muni.	CZ
Edu×CZ×Industry FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: A unit of observation in these regressions is an establishment × education group × year cell. We use three education groups: less than high school, high school graduates, and college graduates. The dependent variable is the log of the average wage within this cell, while the covariate of interest is a dummy variable for the establishment belonging to a multi-market firm. All data come from RAIS. Robust standard errors are in parentheses.

2.7 Fact 6: Reallocation to multi-market firms drove local wage gains

As our last motivating fact, we show that local economies tend to benefit from the expansion of employment in multi-location firms. In particular, for each Brazilian commuting zone r, we compute total growth of average wages from 1995 to 2018 as $\frac{\overline{w}_{r,2018}-\overline{w}_{r,1995}}{\overline{w}_{r,1995}}$ using RAIS, then use OLS to regress this wage growth on the change in the employment share of multi-location firms, $\Delta\left(\frac{L_r^M}{L_r}\right)_{1995}^{2018}$, where L^M is employment in multi-location firms and L is total local employment in RAIS. The result of this regression is in Column 1 of Table 8. The expansion of multi-establishment firms was positively correlated with wage growth; a one percentage point increase in the multi-establishment employment share is associated with an additional 0.11 percentage points of wage growth.

Did multi-establishment firms drive wage gains because they tend to be more productive, or did they simply enter in places where wage growth would have been strong regardless? In Column 2 of Table 8, we show that mechanical gains from reallocation to multi-establishment firms more than explain the positive association with wage growth in Column 1. Specifically, we compute mechanical reallocation gains as:

$$\Delta\left(\frac{L_r^M}{L_r}\right)_{1995}^{2018} \times \frac{\overline{w}_{r,2018}^M - \overline{w}_{r,2018}^S}{\overline{w}_{1995}},$$

where $\frac{\overline{w}^M_{r,2018} - \overline{w}^N_{r,2018}}{\overline{w}_{1995}}$ is the local 2018 gap in average wages between multi-establishment firms (labeled by M) and single-establishment firms (labeled by S), normalized by average wages in 1995. The mechanical reallocation gains therefore represent wage growth delivered by shifting workers into multi-establishment firms and giving them the average associated wage premium. Column 2 of Table 8 shows that the magnitude of these gains' association with the expansion of multi-establishment employment is roughly double the overall association of wage growth with $\Delta \left(\frac{L^M_r}{L_r} \right)_{1995}^{2018}$. This result shows that residual wage gains after netting out simple reallocation effects are, if anything, negatively associated with expansion of multi-establishment firms.

Table 8: CZ-level earnings and multi-establishment growth

	(1)	(2)
	Total wage growth	Reallocation gains (2018 gap)
Δ Multi-est. emp. share	0.109^{*}	0.220^{***}
	(0.0509)	(0.0103)
Observations	486	486

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: A unit of observation is a commuting zone. The dependent variable is local wages as recorded in RAIS, while the independent variable is the change in the share of multi-establishment firms in the commuting zone's RAIS employment.

3 Empirics

3.1 Institutional Context

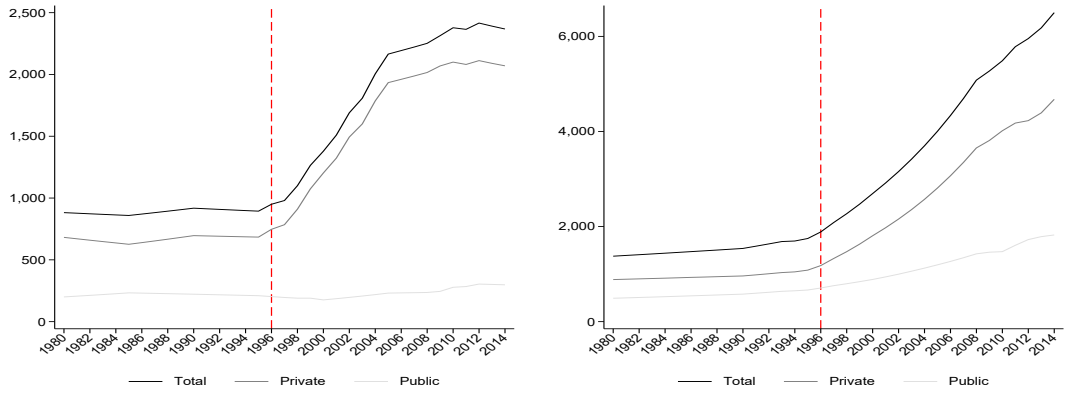
This section provides a brief overview of the 1996 higher education reform in Brazil. A detailed account is presented in Cox (2025), on which this subsection builds.

Prior to the reform, higher education in Brazil was primarily offered by public and private non-profit institutions. Public colleges were tuition-free and academically prestigious, while private providers catered to students who could not access public options, typically offering low-cost programs in areas such as business and law. The Federal Council of Education (FCE), established in 1961, regulated private colleges by approving new institutions and courses, determining curricula, and setting enrollment limits. This centralized oversight made the system highly susceptible to political and professional pressures, which over time shaped the pace and direction of higher education expansion.

Two structural constraints limited access to college prior to the reform. First, geographic disparities in college availability meant that many students had to travel long distances to sit entrance exams and attend classes. Second, admissions were highly competitive due to binding capacity constraints. These barriers led to unmet demand for higher education, especially in less developed regions.

The 1996 reform overhauled the regulatory framework, replacing the FCE with the National Institute for Educational Studies and Research (INEP) and opening the sector to for-profit providers. It streamlined approval processes for new colleges and introduced standardized quality assurance mechanisms. These changes triggered a large-scale market-driven expansion, particularly among private institutions. The number of colleges and enrolled students rose sharply. As shown in Figure 9 panel (a), the number of colleges increased substantially after 1996. The rise in private providers explains the observed growth. Panel (b) of Figure 9 highlights a corresponding surge in higher education enrollment. This expansion in capacity and enrollment followed from the fact that higher education became more geographically dispersed, lowering the cost of access and facilitating enrollment closer to students' home regions.

Figure 9: Higher Education Reform



(a) Number of Colleges

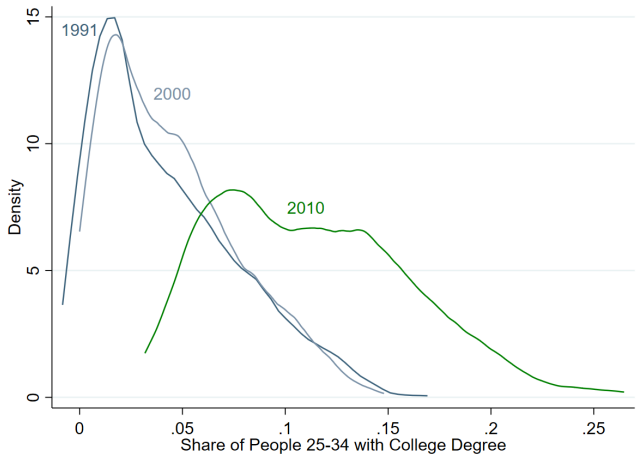
(b) Enrollment (1000s)

Note.— Panel (a) plots the time series of the total number of colleges and the number of colleges by type of institution, public or private. Panel (b) reproduces the same information using college enrollment measured in thousands. In both panels, the red line highlights 1996, when the education law was enacted.

The increase in enrollment following the reform led to a corresponding rise in college graduates. To quantify this, we calculate the share of individuals aged 25 to 34 who completed higher education in each CZ. Figure 10 presents the distribution of this share across three census years. In 1991, five years before the reform, the median CZ had 3.3% of its youth population with a college degree. By 2000, three years after the reform, this figure remained

largely unchanged, as most students had not yet graduated. However, by 2010, the distribution shifted significantly to the right, reflecting a substantial increase in college graduates. The median share of youth with a college degree rose to 10.5%, though the expansion was heterogeneous across CZs.

Figure 10: Expansion in College Attainment



Note.— The figure shows the distribution across CZs (labor markets) of the share of people in the 25 to 34 age group with a college degree. The figure shows the distribution of this share for 1991, 2000, and 2010.

While the reform raised concerns about instructional quality, new oversight mechanisms – including a national exit exam (ENADE) and periodic accreditation reviewsh – helped monitor outcomes. Evidence in Cox (2025) suggests that for-profit institutions established after the reform delivered education quality comparable to pre-existing non-profit colleges. Moreover, the occupational profiles and fields of study of graduates remained largely stable across cohorts.

Overall, the reform expanded higher education capacity, increased enrollment, and raised the share of college-educated individuals in the workforce, especially in previously underserved areas.

3.2 Empirical Strategy

This section outlines the empirical strategy used to assess the consequences of rising college attainment on the expansion of multi-market firms. The approach builds on the identification framework developed in Cox (2025), to which we refer readers for additional institutional and methodological details.

We measure the rise in college attainment as the change in the share of individuals aged 25 to 34 with a college degree between 2000 and 2010. This cohort enrolled in higher

education roughly between 1995 and 2005—a period during which the effects of the 1996 higher education reform, particularly the expansion of private colleges, became most salient.

$$\Delta Y_r = \delta_0 + \beta \Delta h_r + X_r \gamma + \theta_r^s + \epsilon_r \tag{7}$$

Equation (7) presents the baseline specification, where ΔY_r denotes the change in an economic outcome of interest in region r, such as the growth in the number of multi-market firms or the change in their employment share. The explanatory variable of interest, Δh_r, measures the change in college attainment among young adults (ages 25–34) in the region between 2000 and 2010. The coefficient β captures the effect of rising educational attainment on economic development. Control variables X_r capture pre-reform development pattern in human capital and economic development, primarily from the 1991 and 2000 censuses. Finally, ϵ_r denotes unobserved determinants of economic outcomes across regions.

Estimating β via Ordinary Least Squares (OLS) is unlikely to yield a causal estimate, since both human capital accumulation and firm expansion may respond to unobserved regional characteristics or anticipated growth. Economically dynamic areas may simultaneously attract new firm activity and encourage higher educational investment. This simultaneity leads to omitted variable bias and reverse causality.

To address these concerns, we adopt a two-part identification strategy. First, we control flexibly for pre-reform levels and trends using rich covariates X_r. Second, and most importantly, we instrument for Δh_r using a measure of pre-reform higher education scarcity relative to future potential demand. This instrument is derived from the ratio of higher education capacity in 1995 to the school-age population in 1991 (ages 6–15), who would benefit from better access to college in the post-reform period:

$$Z_r = \frac{HEC_{r,1995}}{\text{Population aged 6–15}_{r,1991}}$$

Here, $HEC_{r,1995} = \sum_{m \in \Omega_r} \omega_m Colleges^{100km} m, 1995$, where Ω_r denotes the set of municipalities in region r, ω_m is a population weight from the 1991 Census, and $Colleges^{100km} m, 1995$ is the number of colleges within 100 kilometers of municipality m in 1995. The 100km radius is supported by administrative evidence showing that over 95% of private-sector students enroll within this distance from their place of residence.[7]

The first-stage relationship captures the idea that, following the deregulation of the higher education sector, private colleges were more likely to expand in areas that had been undersupplied relative to demographic demand. This exogenous supply shock drives regional variation in the increase in college attainment across Brazil. This identification strategy is

[7]See the details in Cox (2025).

grounded in the historical regulatory structure that preceded the reform. Until 1996, the Federal Council of Education (FCE) maintained centralized control over college authorization, often failing to allocate new capacity where future demand was greatest. This regulatory mismatch—alongside the post-reform liberalization that removed barriers to private entry—generates quasi-experimental variation in the expansion of higher education. An alternative instrument based on observed post-reform entry of colleges would risk endogeneity, as investors may have targeted economically dynamic regions. Our measure, by contrast, captures pre-reform constraints and demographic structure, thus offering a more credible source of exogenous variation.

The main empirical results are presented in Section 3.3. We report reduced-form and IV estimates and assess the validity of the identification assumption through a series of robustness checks and falsification exercises discussed in the latter part of that section.

3.3 Results

This section evaluates the implications of rising college attainment on moments of the firm size distribution with emphasis on the role of multi-market firms. First, we show the results for the first stage analysis. Second, we report the implications of rising college attainment for the expansion of multi-market firms in the economy.

3.3.1 First Stage Analysis

The instrumental variable strategy exploits cross-regional variation in the scarcity of higher education capacity prior to the 1996 reform. The reform removed barriers to entry and authorized for-profit colleges to operate legally, thereby enabling a market-driven expansion of the higher education sector. Private institutions responded to these regulatory changes by expanding disproportionately into commuting zones (CZs) where centralized planning had previously limited the supply of higher education relative to potential demand. This expansion reduced geographic and capacity constraints in underserved areas, facilitating a subsequent rise in college attainment.

To evaluate this mechanism empirically, we estimate a first-stage specification in which the dependent variable, Δh_r, is either the change in college attainment among individuals aged 25–34 between 2000 and 2010 or the growth in higher education capacity between 1995 and 2005. The analysis restricts attention to capacity built before 2006, ensuring that changes in attainment by 2010 can plausibly reflect enrollment during the relevant post-reform window. The key explanatory variable is the pre-reform scarcity measure Z_r, defined as the ratio of higher education capacity in 1995 to the size of the 6–15-year-old population in

1991. Control variables X_r include pre-reform development trends in education and economic structure, measured between 1991 and 2000.

The identification strategy compares CZs with similar pre-reform characteristics but different values of Z_r. A lower value of Z_r implies greater relative scarcity of college access prior to the reform. Under the hypothesis that scarcity induced post-reform expansion, we expect a negative relationship between Z_r and both the change in higher education capacity and the rise in attainment—that is, $\hat{\alpha} < 0$.

Table 9: First-stage Analysis

Dep.Variable	Δ Colleges	Δ College attainment
Specification	(1)	(2)
Z_r	-260.08***	-7.57***
	(50.77)	(1.10)
R^2	486	486
F-test	46.93	46.93
Obs.	0.22	0.35

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table reports first-stage regression coefficients where the dependent variable is either (1) the change in college attainment among individuals aged 25–34 between 2000 and 2010, or (2) the growth in higher education capacity between 1995 and 2005. Both outcomes are regressed on a pre-reform scarcity measure, defined as the ratio of higher education capacity in 1995 to the size of the 6–15 year-old population in 1991.

Table 9 reports the first-stage estimates. Column 1 shows that regions with lower Z_r experienced significantly greater increases in higher education capacity between 1995 and 2005. Column 2 presents results for the change in college attainment, which also exhibit a negative and statistically significant relationship with Z_r. All specifications include the full set of controls.

These findings support the relevance of the instrument: college attainment rose faster in CZs that were underserved prior to the reform, consistent with the idea that the 1996 policy change induced market entry in regions where capacity had lagged behind potential demand. The next section turns to the second-stage estimates and reports the robust weak-instrument F-statistic following Olea and Pflueger (2013).

3.3.2 Second Stage Analysis

This section evaluates the impact of rising college attainment on the prevalence and expansion of multi-market firms by estimating equation (7). The analysis proceeds in four parts.

First, Table 10 presents the estimated effects of rising college attainment on two key outcomes: the change in the share of firms that operate across multiple markets, and the change in the employment share of these firms. We consider three definitions of "multi-market" status: (i) firms with multiple establishments, (ii) firms operating in multiple municipalities, and (iii) firms spanning multiple Commuting Zones (CZs). These complementary definitions capture different degrees of geographic scope.

Second, Table 11 explores the extensive margin by analyzing the change in the number of multi-market firms. This allows us to distinguish between two potential mechanisms underlying the rise in the employment share of multi-market firms: the entry or transformation of new firms into multi-market organizations versus the expansion of existing multi-market firms.

Third, the same table disaggregates the results by sector to assess heterogeneity in the responsiveness of firm structure to human capital accumulation. This analysis provides insight into the types of activities more likely to benefit from a more educated workforce through organizational scaling and geographic expansion.

Finally, Figure 11 presents the dynamic effects. The evolution of the estimated coefficients over time illustrates how the impact of rising college attainment unfolds throughout the period and provides supporting evidence for the parallel trends assumption underlying the identification strategy.

Table 10 reports the estimates for the effects of rising college attainment on the prevalence of multi-market firms. Columns (1)–(6) examine the change in the share of firms classified as multi-market between 1996 and 2018, while columns (7)–(12) focus on the corresponding change in the employment share of these firms. Odd-numbered columns present OLS estimates; even-numbered columns report Two-Stage Least Squares (2SLS) estimates using the instrumental variable strategy outlined in Section 3.2.

Table 10: Implication for the prevalence of multi-market firms, 1996-2018

Dep.Variable	Δ share of multi-market firms						Δ employment share in multi-market firms					
Market Def.	Establishment		Municipality		CZ		Establishment		Municipality		CZ	
Specification	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Δh_{25-34}	0.06	0.29	0.03	0.17	0.02	0.15	0.75**	3.57***	0.59*	3.73***	0.56*	3.64***
	(0.05)	(0.15)	(0.05)	(0.18)	(0.05)	(0.16)	(0.27)	(0.98)	(0.26)	(1.02)	(0.26)	(1.01)
R^2	0.10	0.04	0.09	0.06	0.08	0.06	0.06	.	0.04	.	0.04	.
F-test		46.93		46.93		46.93		46.93		46.93		46.93
CV 5%		37.42		37.42		37.42		37.42		37.42		37.42
CV 10%		23.11		23.11		23.11		23.11		23.11		23.11
Obs.	486	486	486	486	486	486	486	486	486	486	486	486

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table presents regression results where the dependent variables are: (1) the change in the share of multi-market firms among all firms, and (2) the change in the employment share of multi-market firms among total employment. Both outcomes are regressed on measures of college attainment.

The results indicate that rising college attainment had no discernible effect on the share of firms classified as multi-market. However, they did lead to a substantial reallocation of employment toward these firms. Specifically, a 1 percentage point increase in the share of college-educated individuals is associated with a 3.5 percent increase in the employment share of multi-market firms over the 22-year period. This effect is robust across all three definitions of market scope—multiple establishments, multiple municipalities, and multiple Commuting Zones—suggesting that the expansion of these firms spans large geographic areas, not merely within narrowly defined markets.

A comparison of the OLS and IV estimates reveals important distinctions in both interpretation and magnitude. The OLS estimates approximate the average treatment effect on the treated (ATT). However, because changes in college attainment may respond endogenously to broader economic trends, these estimates are susceptible to bias. One plausible source is skill-biased technical change, which disproportionately raises the productivity of college-educated workers and lowers the fixed or managerial costs of operating across multiple markets. While such technological shifts facilitate firm expansion, they may simultaneously displace lower-skilled workers, attenuating the net employment response. As a result, the OLS estimates may understate the true effect of rising human capital on firm-level outcomes.

The IV estimates, by contrast, capture the local average treatment effect (LATE) for

regions with relatively high pre-reform scarcity of higher education. These are the areas most affected by the relaxation of entry restrictions following the 1996 reform. That the IV estimates for the change in the employment share of multi-market firms are consistently larger than the OLS estimates suggests substantial heterogeneity in the marginal return to college attainment across regions. In particular, if the supply of skilled labor was a binding constraint on firm growth in these initially underserved areas, then relaxing this constraint through higher college attainment would yield outsized organizational and employment responses. This finding supports the hypothesis that the transition from traditional, single-market production to modern, multi-market structures is skill-intensive, and that expanding access to college education enables firms to scale operations and reorganize along more complex dimensions.

We next examine whether the observed increase in the employment share of multi-market firms is driven by the entry of new firms into the multi-market category or by the expansion of employment within already-established multi-market firms. Table 11 reports the estimated effects of rising college attainment on the growth in the number of firms. Columns (1), (2), (5), (6), (9), and (10) consider all firms, regardless of whether they employ college-educated workers. These estimates capture the overall expansion at the extensive margin. Columns (3), (4), (7), (8), (11), and (12) restrict attention to firms that report employing at least one college graduate, thereby allowing us to assess whether the expansion is mediated through the hiring of skilled labor—a key channel in our proposed mechanism. As in prior tables, odd-numbered columns report OLS estimates, and even-numbered columns report Two-Stage Least Squares (2SLS) estimates based on the instrumental variable strategy.

Table 11: Growth in the number of multi-market firms, 1996-2018

Dep.Variable	Growth number of multi-market firms											
Market def.	Establishments				Municipalities				CZ			
Sample	All		w/Skill		All		w/Skill		All		w/Skill	
Specification	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Δh_{25-34}	-0.96	8.21**	1.80	19.90***	-1.00	7.22**	1.54	17.75**	-0.94	6.74*	1.45	17.56**
	(0.77)	(2.90)	(1.05)	(5.31)	(0.73)	(2.65)	(1.00)	(5.63)	(0.73)	(2.66)	(0.99)	(5.43)
R^2	0.46	0.26	0.33	.	0.41	0.23	0.32	.	0.39	0.23	0.31	.
F-test		46.93		46.93		46.93		46.93		46.93		46.93
CV 5%		37.42		37.42		37.42		37.42		37.42		37.42
CV 10%		23.11		23.11		23.11		23.11		23.11		23.11
Obs.	486	486	486	486	486	486	486	486	486	486	486	486

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note.— The table reports regression results where the dependent variable is the growth in the number of multi-market firms over the period 1996–2018, regressed on measures of college attainment.

The results indicate that the growth in the employment share of multi-market firms reflects, at least in part, an expansion along the extensive margin: regions with greater increases in college attainment also experienced a rise in the number of firms operating across multiple markets. This finding suggests that the reform facilitated a structural transition from traditional, localized firms to more complex, geographically dispersed organizations. Importantly, the results are stronger for multi-market firms that employ college-educated workers, consistent with the idea that skilled labor plays a central role in enabling such organizational change. This pattern reinforces the plausibility of our mechanism: the expansion of higher education increased the availability of skilled workers, which in turn allowed more firms to adopt multi-market structures.

We further investigate sectoral heterogeneity in the effects of rising college attainment, motivated by the hypothesis that the transformation toward multi-market firm structures is more pronounced in service-oriented, non-tradable industries. Table 12 presents estimates disaggregated by sector. Columns (1) and (2) report results for manufacturing; columns (3) and (4) focus on infrastructure and construction; and columns (5) and (6) report estimates for service industries. Within each sector, we distinguish between OLS (odd-numbered columns) and IV (even-numbered columns) specifications. The table is organized into three panels, each corresponding to a different definition of market scope. Panel A uses the number of

multi-establishment firms as the outcome variable, capturing firm expansion through the creation of multiple physical units. Panel B shifts the focus to firms operating in multiple municipalities, while Panel C measures multi-market presence at the level of Commuting Zones (CZs), reflecting the broadest geographic reach.

Table 12: Growth in the number of multi-market firms by sector, 1996-2018

Dep.Variable	Growth number of multi-Market firms w/skill					
Sector	Manufacture		Infrastructure		Services	
Specification	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Establishments						
Δh_{25-34}	2.06	6.34	0.82	5.12	1.05	19.80***
	(1.59)	(6.94)	(1.12)	(4.01)	(1.14)	(4.90)
R^2	0.19	0.17	0.32	0.29	0.26	.
Panel B: Municipalities						
Δh_{25-34}	2.15	4.70	0.83	-0.28	0.48	15.49***
	(1.53)	(5.96)	(1.10)	(5.28)	(1.08)	(4.24)
R^2	0.16	0.18	0.32	0.34	0.24	.
Panel C: Commuting Zones						
Δh_{25-34}	2.45	4.32	0.92	-0.07	0.15	14.54***
	(1.52)	(5.91)	(1.12)	(5.39)	(1.07)	(4.24)
R^2	0.15	0.18	0.31	0.33	0.23	.
F-test		46.93		46.93		46.93
CV 5%		37.42		37.42		37.42
CV 10%		23.11		23.11		23.11
Obs.	486	486	486	486	486	486

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

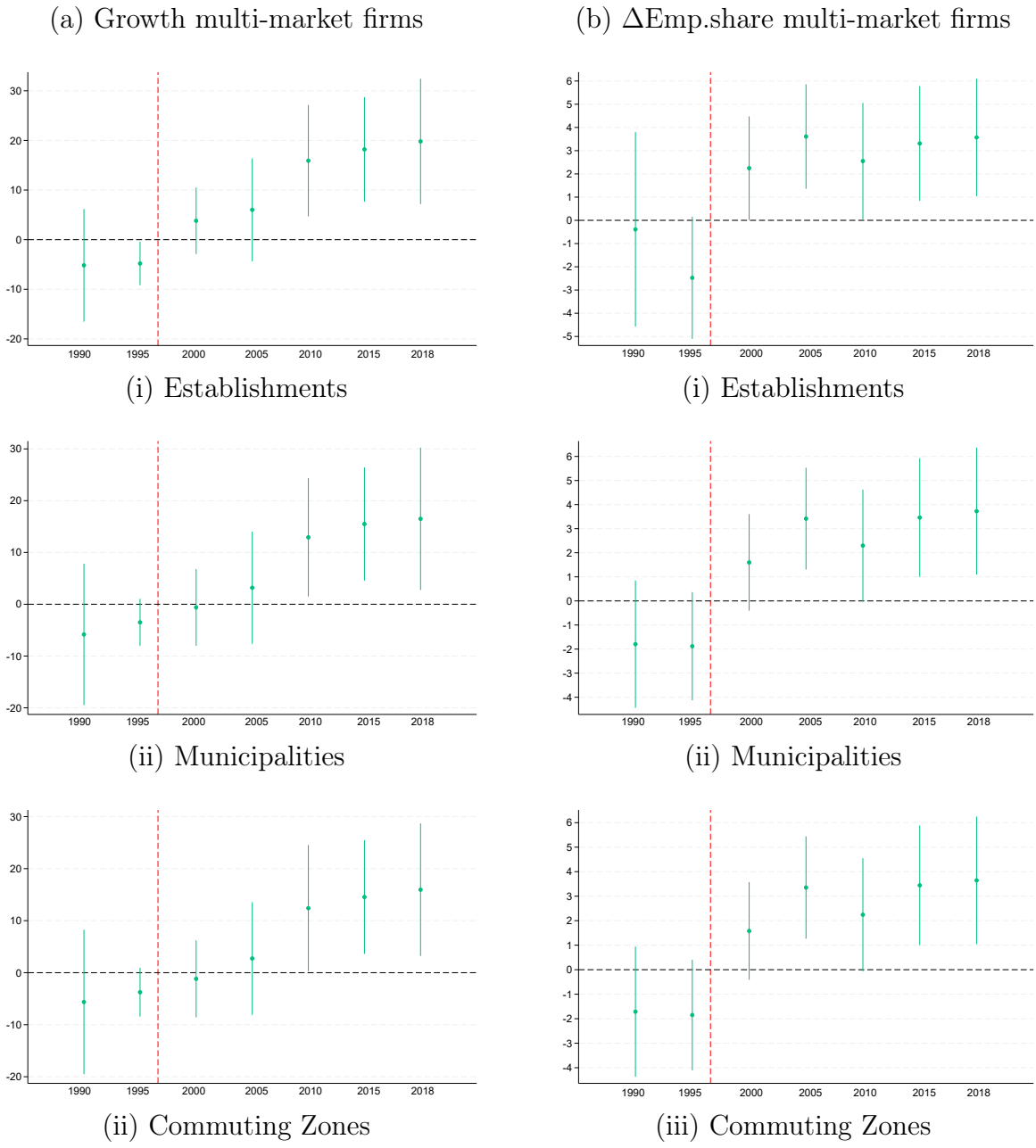
Note.— The table reports regression results by sector where the dependent variable is the growth in the number of multi-market firms over the period 1996–2018, regressed on measures of college attainment.

The results confirm that the expansion of multi-market firms is concentrated in the service sector. Across all definitions of market scope—establishments, municipalities, and Commuting Zones—the number of multi-market firms grew most rapidly in services. This pattern aligns with the hypothesis that service industries, typically non-tradable and more reliant

on skilled labor to scale, are especially responsive to improvements in local human capital. By relaxing constraints on the availability of college-educated workers, rising college attainment enables firms in these sectors to expand geographically and adopt more complex organizational structures.

Finally, Figure 11 illustrates the dynamic relationship between rising college attainment and firm-level outcomes over time. Panel (a) plots the IV-estimated effect of increased college attainment on the growth in the number of multi-market firms, while Panel (b) shows the corresponding effect on the change in their employment share. Each panel reports results separately for the three definitions of market scope—multi-establishment, multi-municipality, and multi-CZ firms. The horizontal axis indicates the final year used to compute the change in outcomes relative to the baseline year of 1996. For example, the estimate at 2010 reflects the effect of college attainment on the change in the outcome between 1996 and 2010, with 95% confidence intervals. The estimate at 1990 captures the pre-reform relationship and serves as a test of the parallel trends assumption. The timing of the 1996 higher education reform is indicated by the vertical red dashed line.

Figure 11: Tracking the effect over time



Note.— The figure reports IV-estimated effects of increased college attainment on (a) the growth in the number of multi-market firms and (b) the growth in the employment share of multi-market firms. Regressions are conducted separately for three definitions of market scope: (i) establishments, (ii) municipalities, and (iii) commuting zones.

4 Model: Skilled Workers and Firm Expansion

To make sense of the facts we documented in the previous two sections, and to quantify the economic benefits from increasing access to college, we now introduce a model. The

model resembles that of Hsieh and Rossi-Hansberg, 2023: firms in industries where output is non-tradable can access many markets by operating their technology across multiple establishments. However, we make a key modification, where operating an establishment or firm requires high-skilled workers to serve as managers.

4.1 Environment

The economy consists of $n \in \{1, ..., N\}$ local markets. Within each market n, aggregate final output combines outputs from $k \in \{1, ..., K\}$ broad sectors, such as manufacturing and consumer services, each of which contains $j^k \in \{1, ..., J^k\}$ industries, such as restaurants and grocery stores. To illustrate how the model works, we first assume that all industries' output is non-tradable and must be consumed where it is produced; we will later show how to relax this assumption. Each market n contains a measure L_n of low-skilled workers and H_n of high-skilled workers, which are the only factors of production. The model is static, so that establishments' entry and operation decisions are synonymous.

4.1.1 Production and competition

Each firm i in industry j^k is endowed with a firm-wide productivity level A_{ij^k}. If the firm operates in market n, its firm-level productivity is multiplied by an idiosyncratic local productivity term a_{ij^kn}. The firm operates a straightforward linear production function:

$$Y_{ij^kn} = a_{ij^kn} A_{ij^k} \ell^P_{ij^kn}, \tag{8}$$

where $\ell^P_{ij^kn}$ is the measure of low-skilled workers hired for production by the firm-establishment ij^kn. The cost to hire a low-skilled worker in market n is $w_{n,\ell}$.

The output of an industry-market j^kn combines the output of every establishment in j^kn according to a CES aggregator with elasticity of substitution σ. Denoting the endogenous set of available establishments in j^kn as M_{j^kn}, industry-market output is:

$$Y_{j^kn} = \left(\int_{i \in M_{j^kn}} Y_{ij^kn}^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \tag{9}$$

Firms in j^kn therefore engage in monopolistic competition and charge prices p_{ij^kn} at a constant markup over marginal costs, $p_{ij^kn} = \frac{\sigma}{\sigma-1} \frac{w_{n,\ell}}{a_{ij^kn} A_{ij^k}}$. This implies that establishment ij^kn's production labor demand and profits gross of operating costs, $\pi^G_{ij^kn}$, are isoelastic to

productivity $a_{ij^k n}A_{ij^k}$:

$$\begin{aligned}\ell_{ij^k n} &= \left(a_{ij^k n}A_{ij^k}\right)^{\sigma-1}\left(\frac{\sigma-1}{\sigma}\frac{P_{j^k n}}{w_{n,\ell}}\right)^{\sigma} Y_{j^k n} \\ \pi^G_{ij^k n} &= \left(\frac{a_{ij^k n}A_{ij^k}}{w_{n,\ell}}\right)^{\sigma-1}\frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}P^{\sigma}_{j^k n}Y_{j^k n},\end{aligned} \tag{10}$$

where $P_{j^k n}$ is the price index of industry-market $j^k n$.

4.1.2 Operating establishments

In order to operate, establishments in industry j^k require overhead $\overline{f}_{j^k}$ that is fixed with respect to production. For firms that originate in some origin market o but operate in production market n, overhead depends on the distance between o and n: $\overline{f}_{j^k}(d_{on})$. The "overhead good" is produced by combining high-skilled and low-skilled workers according to a constant returns to scale Cobb-Douglas, where high-skilled workers are used with intensity q_{j^k}. This implies that the fixed cost for an establishment from origin o to operate in industry-market $j^k n$ is $f_{j^k}(d_{on})w_{n,h}^{q_{j^k}}w_{n,\ell}^{1-q_{j^k}}$, where $w_{n,h}$ is the wage to hire a high-skilled worker in market n.

A firm will open an establishment in an industry-market if and only if gross profits from production $\pi_{ij^k n}$ exceed fixed operating costs $f_{j^k}(d_{on})w_{n,h}^{q_{j^k}}w_{n,\ell}^{1-q_{j^k}}$. Therefore the establishment operation decision can be written as a function of productivity, distance, and local factors, $m_{j^k}(a_{ij^k n}A_{ij^k}, d_{on}, w_{n,\ell}, \hat{w}_n, P_{j^k n}, Y_{j^k n})$:

$$m_{j^k}(a_{ij^k n}A_{ij^k}, d_{on}, w_{n,\ell}, \hat{w}_n, P_{j^k n}, Y_{j^k n}) = \mathbf{1}\left\{f_{j^k}(d_{on})\hat{w}_n^{q_{j^k}} \leq \left(a_{ij^k n}A_{ij^k}\right)^{\sigma-1}\hat{\sigma}\left(\frac{P_{j^k n}}{w_{n,\ell}}\right)^{\sigma} Y_{j^k n}\right\}, \tag{11}$$

where $\hat{w}_n = \frac{w_{n,h}}{w_{n,\ell}}$ is the relative wage of high-skilled workers in market n, and $\hat{\sigma} = \frac{(\sigma-1)^{\sigma-1}}{\sigma^{\sigma}}$.

Equation (11) shows that firms operating an establishment in market n are more selected on productivity when they operate from a greater distance d_{on} (provided $f(\cdot)$ is increasing in distance) and when high-skilled workers are scarce so that their relative wage $\hat{w}_n$ is high. Firms that operate establishments at a distance will also require a greater input of high-skilled workers.

4.1.3 Operating firms

In order to operate any establishments, a firm must also enter a given home location – the firm's origin o – by operating a headquarters there. Similarly to a production establishment,

a firm headquarters requires an operating cost $\overline{F}_{j^k}$, denominated in terms of an overhead good. Again the overhead good is produced Cobb-Douglas, this time with intensity ϕ_{j^k} given to high-skilled workers, so that the cost to operate a firm from origin o is $F_{j^k} w_{o,h}^{\phi_{j^k}} w_{o,\ell}^{1-\phi_{j^k}}$.

A firm learns its firm-level productivity A_{ij^k} and local productivity draws $\{a_{ij^kn}\}_{n=1}^N$ only after paying the fixed cost to open its headquarters. Free entry therefore implies that the fixed headquarters cost is greater than or equal to expected profits, taking into account the potential to operate an establishment in every location:

$$F_{j^k} w_{o,h}^{\phi_{j^k}} w_{o,\ell}^{1-\phi_{j^k}} = \sum_{n=1}^{N} \mathbb{E}\left[\max\left\{\pi_{ij^kn}^G - f_{j^k}(d_{on}) w_{n,h}^{q_{j^k}} w_{n,\ell}^{1-q_{j^k}}, 0\right\}\right] \tag{12}$$

Let the endogenous set of firms headquartered in industry-origin $j^k o$ be denoted $\mu_{j^k o}$.

4.1.4 Demand system

Equation (10) establishes that firms' labor demand and profits depends on the price and output of industry j^k in market n, specifically the term $P_{j^kn}^{\sigma} Y_{j^kn}$. Pinning this term down requires specifying the demand system for industry output, which comes from the production function for final aggregate output Y_n. In turn, $Y_n = y_n(L_n + H_n)$, where per-capita output y_n follows a nested non-homothetic CES production function over industry-specific per-capita output $y_{j^kn} = \frac{Y_{j^kn}}{L_n + H_n}$. The outer nest captures broad sectors $k \in \{1, ..., K\}$ while the inner nest captures industries $j^k \in \{1, ..., J^k\}$.

$$y_n = \left(\sum_{k=1}^{K} \beta_k^{\frac{1}{\zeta}} \left(\sum_{j^k=1}^{J^k} \omega_{j^k}^{\frac{1}{\xi}} \left(\frac{y_{j^kn}}{y_n^{\varepsilon_{j^k}-1}} \right)^{\frac{\xi-1}{\xi}} \right)^{\frac{\xi}{\xi-1}\frac{\zeta-1}{\zeta}} \right)^{\frac{\zeta}{\zeta-1}}, \ \sum_{k=1}^{K} \beta_k = 1, \ \sum_{j^k=1}^{J^k} \omega_{j^k} = 1 \ \forall k, \tag{13}$$

where ζ is the elasticity of substitution for broad sectors, while ξ is the within-sector elasticity of substitution for industries. This setup allows for sectors to be gross complements, while particular industries within a sector may be substitutes for one another.

Note that the j^kn demand shifter $P_{j^kn}^{\sigma} Y_{j^kn} = P_{j^kn}^{\sigma-1} E_{j^kn}$, where E_{j^kn} is total expenditure on industry-market j^kn. Furthermore, $P_{j^kn}^{\sigma-1} = \frac{\left(\frac{\sigma}{\sigma-1} w_{n,\ell}\right)^{\sigma-1}}{\int_{i \in M_{j^kn}} \left(a_{ij^kn} A_{ij^k}\right)^{\sigma-1} di}$. Last, according to the non-homothetic demand system above, E_{j^kn} is pinned down by the following system of

equations:

$$
\begin{aligned}
E_{j^k n} &= \omega_{j^k} \left(\frac{P_{j^k n}}{P_{kn}} \right)^{1-\xi} y_n^{(\varepsilon_{j^k}-1)(1-\xi)} E_{kn} \\
P_{kn} &= \left(\sum_{j^k=1}^{J^k} \omega_{j^k} P_{j^k n} y_n^{(\varepsilon_{j^k}-1)(1-\xi)} \right)^{\frac{1}{1-\xi}} \\
E_{kn} &= \beta_k \left(\frac{P_{kn}}{P_n} \right)^{1-\zeta} E_n \\
P_n &= \left(\sum_{k=1}^{K} \beta_k P_{kn}^{1-\zeta} \right)^{\frac{1}{1-\zeta}}
\end{aligned}
\tag{14}
$$

Therefore it is possible for income growth in and of itself to drive demand towards certain industries if those industries are luxuries, i.e. $(\varepsilon_{j^k} - 1)(1 - \xi) > 0$.

4.2 Closing the model

Pinning down the equilibrium requires specifying additional features of the entry process, as well as market clearing conditions.

4.2.1 Entry

We assume that the idiosyncratic productivity term $a_{ij^k n}$ is distributed i.i.d. across all firms, industries, and locations according to $\Gamma(\cdot)$. Meanwhile, firm-level productivity A_{ij^k} follows an industry-specific distribution $G_{j^k}(A_{ij^k})$. Note that at a given distance d_{on}, a firm i only enters $j^k n$ if its productivity draw $a_{ij^k n}$ exceeds some cutoff $\alpha_{ij^k n}(d_{on})$:

$$
\left(\alpha_{ij^k n}(d_{on})\right)^{\sigma-1} = \frac{f_{j^k}(d_{on}) \hat{w}_n^{q_{j^k}}}{A_{ij^k n}^{\sigma-1}} \sigma \frac{1}{\int_{i\prime \in M_{j^k n}} \left(a_{i\prime j^k n} A_{i\prime j^k}\right)^{\sigma-1} di\prime} \frac{w_{n,\ell}}{E_{j^k n}} \tag{15}
$$

Let $M^o_{j^k n}$ be the set of firms who enter market n while headquartered in origin o. The total set of entrants into $j^k n$ is therefore the union across all origins o of firms with sufficiently high local productivity:

$$
M^o_{j^k n} = \left\{ i \in \mu_{j^k o} | a_{ij^k n} \geq \alpha_{ij^k n}(d_{on}) \right\} \tag{16}
$$

$$
M_{j^k n} = \cup_{o=1}^{N} M^o_{j^k n} \tag{17}
$$

$$
\implies |M_{j^k n}| = \sum_{o=1}^{N} \int_{i \in \mu_{j^k o}} \left(1 - \Gamma(\alpha_{ij^k n}(d_{on}))\right) di \tag{18}
$$

And because firms enter an origin o with no knowledge of their productivity, the productivity distribution of firms headquartered there is simply $G_{j^k}(A_{ij^k})$: there is no selection on the headquarters margin, only on the establishment margin. Thus the set of headquarters in o $\mu_{j^k o}$ is characterized simply by its measure $|\mu_{j^k o}|$ and the un-selected distribution G_{j^k}. The size of $M_{j^k n}$ then depends on the distribution G_{j^k}:

$$|M_{j^k n}| = \sum_{o=1}^{N} |\mu_{j^k o}| \int_0^\infty \left(1 - \Gamma(\alpha_{j^k n}(d_{on}|A_{ij^k}))\right) dG_{j^k}(A_{ij^k}) \tag{19}$$

The measure of headquarters $|\mu_{j^k o}|$ is pinned down by the free entry condition (12).

4.2.2 Market clearing

In equilibrium, the markets for low- and high-skilled workers must clear in every market n, and total expenditures must equal total earnings. The supply of workers of each skill level is given exogenously by L_n and H_n. Demand for low-skilled workers comes from production, overhead costs of establishment operation, and overhead costs of headquarters operation. Demand for high-skilled workers comes only from overhead costs to operate establishments or firms. Labor market clearing is therefore given by:

$$\begin{aligned} L_n &= \sum_{k=1}^{K} \sum_{j^k=1}^{J^k} \left(\int_{i \in M_{j^k n}} \ell^P_{ij^k n} di + (1 - q_{j^k}) \hat{w}_n^{q_{j^k}} \sum_{o=1}^{N} |M^o_{j^k n}| f_{j^k}(d_{on}) + (1 - \phi_{j^k}) \hat{w}_n^{\phi_{j^k}} |\mu_{j^k n}| F_{jk} \right) \\ H_n &= \sum_{k=1}^{K} \sum_{j^k=1}^{J^k} \left(q_{j^k} \hat{w}_n^{q_{j^k}-1} \sum_{o=1}^{N} |M^o_{j^k n}| f_{j^k}(d_{on}) + \phi_{j^k} \hat{w}_n^{\phi_{j^k}-1} |\mu_{j^k n}| F_{jk} \right) \end{aligned} \tag{20}$$

Last, total expenditures in market n must equal total earnings of the agents living there. Earnings come from ages of low- and high-skilled workers and from profits of firms headquartered in n. However, due to the free entry condition for headquarters, total headquarter profits net of operating costs are zero. Total earnings therefore equal total wages:

$$E_n = w_{n,\ell} L_n + w_{n,h} H_n = w_{n,\ell} \left(L_n + \hat{w}_n H_n \right) \tag{21}$$

4.2.3 Equilibrium

Given skill supply $(L_n, H_n)_{n=1}^N$, operating costs $(f_{j^k}(d_{on}), F_{j^k})$, technology parameters (q_{j^k}, ϕ_{j^k}), preference parameters $\sigma, \xi, \zeta, (\beta_k, \omega_{j^k}, \varepsilon_{j^k})$, and productivity distributions $\Gamma, (G_{j^k})$, equilibrium is pinned down by a vector of wages $(w_{n,\ell}, \hat{w}_n)_{n=1}^N$ such that firms pursue optimal pro-

duction and operation decisions, industry output demand obeys the non-homothetic demand system, free entry is respected, and all markets for labor and revenues clear.

4.3 Predictions: Increasing the local supply of skilled workers

Consider an exogenous increase in the relative supply of skilled workers, i.e. an increase in H_n and reduction in L_n, such as one caused by the expansion of college access. It is clear from Equation (20) and the establishment and headquarters operation decisions that demand for high-skilled workers decreases in the skill premium $\hat{w}_n$. Therefore, the increase in supply of H_n will result in a decrease in $\hat{w}_n$. This leads to greater local entry of establishments and headquarters, especially establishments of firms operated from a distance. Because it effectively lowers the fixed cost for firms to operate an establishment from a distance, establishments from these firms become less selected and therefore the productivity gap between them and single-establishment firms shrinks. These predictions are consistent with the facts we have documented: locations with an expansion of college saw an increase in entry of multi-market firms, and the productivity gap between multi- and single-market firms shrank in the decades following college expansion. Future versions of the paper will estimate key parameters of the model using the natural experiment of college expansion and other empirical moments, in order to quantify the contribution of Brazil's college expansion to the service revolution in Brazil.

5 Conclusion

This paper has examined how the expansion of college-educated labor in Brazil enabled a new pathway of structural transformation, driven by the growth of multi-market firms, particularly in the service sector. Departing from the traditional industrialization-led narrative, we document a significant reallocation of employment toward higher-productivity, wage-based service jobs, coinciding with a rapid rise in the number and scale of multi-market firms following the 1996 higher education reform.

Our empirical findings highlight human capital formation through expanded access to tertiary education as a key driver of firm expansion and productivity gains. The reform removed longstanding regulatory barriers to private entry, disproportionately increasing college access in previously underserved regions. These same regions subsequently experienced stronger growth in multi-market firm activity, particularly among firms that hired skilled workers and offered wage premia relative to single-market counterparts. The associated reallocation of employment contributed meaningfully to local wage growth, underscoring the

developmental role of firm-level organizational change.

We complement our empirical analysis with a theoretical framework that extends Hsieh and Rossi-Hansberg (2023) by introducing heterogeneous labor and distance-sensitive fixed costs of market entry. In this model, college-educated workers act as a critical managerial input, enabling firms to overcome the spatial and organizational frictions associated with operating across multiple markets. As the relative supply of skilled labor rises, firms are better positioned to expand geographically and disseminate modern production structures.

Together, these results challenge the view that service-led growth is inherently stagnant or low in productivity. When supported by investments in higher education, modern services – especially those delivered by scalable, multi-market firms – can serve as an engine of structural transformation. This has important implications for development strategies in the 21st century, particularly for countries facing premature deindustrialization.

These findings open several avenues for future research. One promising direction is to explore how human capital interacts with emerging technologies—particularly Artificial Intelligence (AI)—in shaping the organization and productivity of multi-market firms in service-oriented economies. As AI increasingly automates tasks within firms, a critical question is whether it will complement or substitute for white-collar managerial occupations typically held by college-educated workers. Understanding the direction and magnitude of this interaction is essential for assessing how AI may reshape the demand for skilled labor and, by extension, the viability of human capital–driven service-led growth. Relatedly, future work should examine how the employment multipliers associated with human capital expansion evolve in the presence of AI and automation. More broadly, as firms adopt new technologies, how will this affect their ability to expand across markets and replicate complex service operations? Addressing these questions will be key to understanding the next phase of structural transformation in developing and advanced economies alike.

A Fact 3: "Growth in Multi-Market Firms was most Pronounced in the Service Sector"

A.1 Sectoral Allocation of Multi-Market Firms

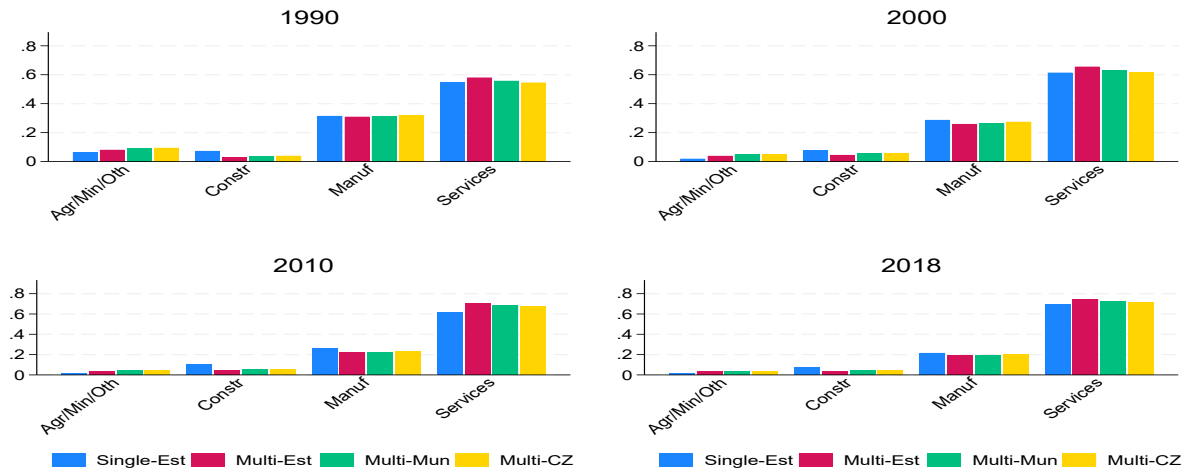


Figure 12

A.2 Allocation of Multi-Market Firms within Services

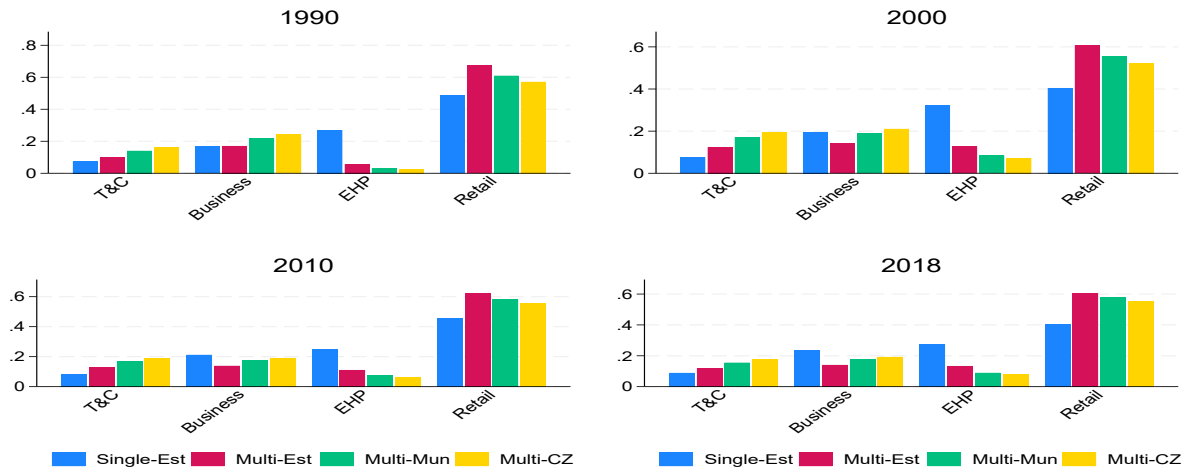


Figure 13

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