The Internal Spatial Organization of Firms: Evidence from Denmark

Acosta, Camilo and Lyngemark, Ditte Håkonsson

Economic Analysis and Policy, Rotman School of Management, University of Toronto, Kraks Fond - Institute for Urban Economic Research and Department of Geosciences and Natural Resource Management, Geography Section, University of Copenhagen

16 July 2019

The Internal Spatial Organization of Firms: Evidence from Denmark*

Camilo Acosta† Ditte Håkonsson Lyngemark‡

July 16, 2019

WORKING PAPER

Abstract

While multi-establishment firms are an important part of the economy, little is known about their spatial organization. In this article, we study how the location and the occupational composition of establishments within firms has changed during the last 36 years. Using Danish administrative employer-employee data, we present a series of stylized facts regarding the spatial internal organization of firms. We show that the average number of establishments at the firm level increased by 36% during this period. Moreover, the average distance of the establishments and workers to their headquarters has increased by more than 200%. These changes are mainly driven by increases in the average distance of production workers and business service workers, and a higher use of the latter. Finally, we show that the ratio of managers to production and clerical workers within firms has increased, in particular in establishments located in the largest urban municipalities. After presenting the facts, we briefly discuss some of the mechanisms that could be behind these changes.

JEL: J20, L22, L23, R00, R30.

Keywords: spatial organization, agglomeration, multi-establishment firms, occupational composition.

*We would like to thank Nathaniel Baum-Snow, Bernardo Blum, Rolando Campusano, Høgni Kalsø Hansen, Ignatius Horstmann, José Martínez, Ismir Mulalic, William Strange and Cecilie Dohlmann Weatherall for their valuable comments, as well as a number of participants at the 2018 Canadian Economic Association meetings, Kraks Fond Seminars, and the University of Toronto International Economics Seminars. Any remaining errors are our own.

†Email: c.acostamejia14@rotman.utoronto.ca; PhD Student, Economic Analysis and Policy, Rotman School of Management, University of Toronto

‡Email: dih@kraksfond.dk; PhD Student, Kraks Fond – Institute for Urban Economic Research and Department of Geosciences and Natural Resource Management, Geography Section, University of Copenhagen.

1 Introduction

In 1890, Alfred Marshall proposed the idea that cities or regions might specialize by sector. The mechanisms he proposed are intuitive: labor market pooling, input sharing, and knowledge spillovers lead to this specialization and to the rise of agglomeration economies (Marshall, 1890).[1] More recently, Duranton and Puga (2005) argue that the patterns of specialization are shifting from being sectoral to being functional. Specifically, they claim that larger cities are increasingly specializing in headquarter activities whereas other cities specialize in business services or production activities. The spatial organization of activity within firms could play an important role in shaping these patterns, and organizational decisions made by firms could influence regional differences and local economic dynamics. Therefore, describing the internal spatial organization of firms is essential to understand the position of a city or a region in production networks. Nonetheless, the literature studying the spatial organization of firms and the functional specialization of cities is rather thin.

In this article, we study the internal spatial organization of firms. In particular, we study how the location and the labor composition of different establishments within firms have changed in the last 26-36 years. Understanding these facts is relevant given the importance of multi-establishment firms in the aggregate economy. For instance, in Denmark approximately 7% of all firms had more than one establishment in 2016. This share increased from around 3% three decades ago. Moreover, multi-establishment firms account for approximately 47% of all employment in the private sector, around 54% of the total output revenue, and have lower exit rates. Studying these facts is a necessary first step before addressing questions concerning the causes and consequences of such organizational structures. For example, the way firms organize within a country can be an underlying mechanism explaining the distribution of workers, productivity and wages across municipalities.

We study the organizational patterns using Danish administrative register data. The data consists of the population of employers and employees collected by Statistics Denmark for the period 1981-2016. This data contains all matches between employees and establishments every year, and therefore, we are able to follow every worker through every job they have had since 1981. Moreover, since the data has unique firm and establishment identifiers, we can determine whether the firm has one or multiple establishments. In addition, we observe the location of each establishment, as well as the location reported by the firm in its accounting records. We also have information on the education and occupation of each worker. Therefore, in addition to observing the location of every establishment in Denmark, we also observe the characteristics of its workers and its changes over time and space.

Using this data, we lay out four stylized facts that describe the spatial organization of firms. Some of these facts are, to the best of our knowledge, new in the literature and represent the main contribution of this article. First, we show that the average number of establishments within a firm has increased by 36% between 1981 and 2016. Our evidence also suggests that

[1] See Combes and Gobillon (2015) for a recent survey on the literature studying the patterns of specialization and agglomeration economies.

multi-establishment firms are opening establishments at a faster rate than the rate at which they close. The increase in the number of establishments per firm in the manufacturing sector happens despite of the de-industrialization that has been taking place in Denmark during the last decades (Bernard et al., 2017).

Second, we also document an increase of more than 200% in the average distance between the establishments and their headquarters (HQ). This increase holds for the four aggregate sectors in our sample: manufacturing, finance, insurance and real estate, business service, and transportation. This fact implies that firms are either replacing establishments that are close to their HQ's for establishments farther away or opening new ones farther from their HQ's. Moreover, we also see that this increase holds even when we weight each establishment by the number of workers they employ. This fact suggests that firms are not only opening establishments further away, but also placing workers further from the HQ. Perhaps more importantly, it suggests that even if a multi-establishment firm does not open or close establishments during our sample period, it can be reallocating some of its jobs into establishments outside the HQ's municipality.

Third, we show that the increase in the average distance of workers to their HQ is driven mainly by increases in the average distance of production and business service workers, together with an increase in the usage of the latter group. For managers and engineers and scientists there have only been smaller changes in the share of employment of these occupations at the HQ. Moreover, the increase in the average distance of managers to the HQ has been relatively small. This could be pointing towards the existence of strong within-firm agglomeration economies for some of the occupations. Finally, we show that the ratio of managers to production and clerical workers within firms has increased. The increase has been particularly large in establishments located in the metropolitan area of Copenhagen and in Aarhus. Finally, we show that the increase in functional specialization observed in the data is partially driven by location and labor demand decisions of multi-establishment firms, as suggested by Duranton and Puga (2005).

After presenting the descriptive evidence, we briefly discuss some of the factors that could be behind the changes in the internal spatial organization of firms. We study some of the mechanisms in a companion paper. Moreover, the results of this paper also intend to shed light and motivate future research studying different geographic and economic consequences of changes in firms' location decisions. For instance, changes in the spatial internal organization of firms could be an important cause explaining the recent diverging trends in urban wage inequality, residential income segregation and productivity distribution across and within regions, or the changes in the patterns of agglomeration and specialization.[2]

This paper relates to a thin literature studying the spatial organization of firms and the

[2]The sorting of more talented and educated workers, and more productive firms into bigger cities has been widely studied in the literature. See Davis and Dingel (2014), Gaubert (2018), among others. There is also a large literature studying agglomeration economies and co-agglomeration between industries (Combes and Gobillon, 2015; Behrens and Guillain, 2017). The evolution of the urban wage gap for the US is studied in Baum-Snow and Pavan (2013). Most of these problems have also been studied for Denmark (Hansen and Winther, 2012; Eckert et al., 2019). Finally, Greenstone et al. (2010) finds that the opening of large manufacturing plants leads to large gains in the counties that receive them.

location of their different establishments.[3] In particular, Aarland et al. (2007), Davis and Henderson (2008) and Henderson and Ono (2008) study the agglomeration and the location decision of headquarters in the US. Among some results, Henderson and Ono (2008) suggest that it is very costly for firms to send their first stand-alone HQ away from the counties where they have the production facilities, given the existence of communication and coordination costs. Thus, it has to be the case that the new location offers something a firm can benefit from, such as, a larger variety of business services. More recently, Bartelme and Ziv (2017) document geographic location patterns for US firms. Among their facts, the authors document that the size of the establishments decreases with a larger distance to their HQ.[4] Our analysis is also guided by a few theoretical articles that have studied the location of multiple establishments of a firm. In particular, Ota and Fujita (1993) developed a model in which, as communication technologies improve, the city could move to an equilibrium in which the front units are at the Central Business District (CBD) and the back units are located in the suburbs.

Our paper also relates to those articles studying not only firm fragmentation but also the labor composition across different establishments (Duranton and Puga, 2005; Rossi-Hansberg et al., 2009; Charnoz et al., 2018; Cestone et al., 2018). Duranton and Puga (2005) present aggregate evidence showing a decrease in the sectoral specialization of US cities, but an increase in the relative concentration of managers in larger cities. The authors also develop a model, in which a fall in the costs of remote management leads to firm fragmentation and to larger cities being increasingly specialized in HQ activities, whereas other cities specialize in business services or production activities. Using data on the ownership structure of French corporate groups, Charnoz et al. (2018) test different theoretical predictions drawn from the literature, including some from Duranton and Puga (2005). They use the expansion of the French High-Speed Rail (HSR) system as an exogenous shock affecting fragmentation costs. They find that the HSR induced the creation of 0.2-1 production job for the average affiliate, and a shift of around one managerial job from affiliate to HQ.

To our knowledge, our paper is the first to analyze the internal spatial organization of firms along two equally important margins: the extensive margin on whether to have multiple establishments and where to locate them, and the intensive margin studying the distribution of workers within these firms.

The location of establishment and firms is not only the interest of urban economists. There have also been large advancements and discussions in the international trade literature regarding the study of multinational enterprises (Markusen, 2002; Antràs and Yeaple, 2014; Gokan et al., 2018). We consider the decision of a firm to become multinational to be a case of the firm fragmentation process. On the other hand, instead of fragmenting, a firm can also decide to outsource some of its tasks to another (domestic or foreign) firm. This vertical integration decision is an important endogenous margin of production that has been studied in the

[3]Firm location has been widely studied, usually treating one establishment as a whole firm. In a recent study, Gaubert (2018) proposes a theory for the location choices of heterogeneous firms that accounts for some of the uneven distribution of the French economic activity.

[4]Other papers studying empirically different aspects of the within firm location choices are Strauss-Kahn and Vives (2009), Alcácer and Delgado (2016) and Mota and Brandão (2013).

international trade and industrial organization literature (Atalay et al., 2014). Moreover, the spatial concentration of economic activity can also affect the boundaries of the firm (Helsley and Strange, 2007; Holl, 2008). Nonetheless, through our analysis we take the boundaries of the firm as given and focus only on the organizational changes within firms. Furthermore, there has been large theoretical and empirical advances in the study of models of market entry in the industrial organization literature (Holmes, 2011; Aguirregabiria and Suzuki, 2016). Finally, this paper also contribute to the branch of the organizational economics literature that studies the organization of production and its relationship with communication costs and other factors (Becker and Murphy, 1992; Garicano, 2000; Bloom et al., 2014).

The rest of the paper proceeds as follows. Section 2 describes our data. In section 3 we present our findings regarding the spatial organization of multi-establishment firms in Denmark. Section 4 discusses possible causes underlying the facts and concludes.

2 Data

To examine how the spatial patterns of activity within firms have changed recently, we use Danish administrative register data. Our data is collected by Statistics Denmark and contains the full population of employers and employees for the period 1981-2016. We use the establishment records from the Integrated Database for Labor Market Research (IDA), which contains all the matches between the employees and their workplaces for every year. Therefore, we are able to follow every worker through every job they have had during their working life. Equivalently, we can observe for each year the worker composition of each workplace/establishment inside the country.

We match this data with firm records from the General Firm Statistics and the Accounting Statistics. The Accounting Statistics are only available for the years 1995-2016. Since the data has unique firm and establishment identifiers, we can determine whether the firm has one or multiple establishments. An establishment is the individual local business unit, which is an organizational defined part of a firm, located at a given address (Statistics Denmark, 1991). In addition, we observe the location (at the municipality level) of each establishment, as well as the location reported by the firm in its accounting records. Due to the panel structure of the data, we are able to identify job changes both between and within firms, and changes in the location of workers and establishments within and across labor market areas.

In Denmark all establishments and firms are registered, even if they have very little or zero activity, which means that there are around 200,000 establishments and approximately 180,000 firms observed each year. Given that the smallest firms often have irregular activity and missing accounting records, we exclude firms that at some point in the period 1981-2016 have fewer than five employees, similar to other papers using similar data (Malchow-Møller et al., 2017).

Moreover, we link these registers with data on the workers' occupation from the Labor Classification Module (AKM). For the occupation, we use both the PSTILL variable from

the IDA register, which defines the primary job for each worker in terms of their position, and the 4-digit DISCO88 code from the Labor Classification Module (AKM). DISCO is the Danish version of the International Standard Classification of Occupations (ISCO) and is only available from 1991.[5] For most of the analysis, we aggregate the approximately 450-750 DISCO codes into 6 categories: managers, business service workers, engineers and scientists, clerical workers, production workers, and other workers.[6] Thus, for a multi-establishment firm we can observe, not only the location of its establishments, but also their composition in terms of occupations and other characteristics. To avoid outliers and firms that have establishments in every municipality, we drop those that have more than 100 establishments. Also, we exclude firms where the total number of establishments jumps a lot from one year to the next.

Statistics Denmark does not provide information on which of the establishments of a multi-establishment firm is the headquarter. However, for our analysis it is essential that we can distinguish between HQ and non-HQ establishments. Therefore, we define the HQ following an iterative process. First, we select the establishments with at least five employees that are located in the same municipality as the one reported by the firm in the General Firm Statistics. If we are left with none or with more than one establishment, we take the composition of the workers at each establishment into consideration, this is, the establishment with the largest i) number of managers, ii) number of high wage earners, iii) number of workers with long cycle education, iv) number of workers with short and medium cycle education. If we are still left with establishments tied in all of the previous categories, we choose the largest one. Some HQs move during the period and some establishments and firms are bought and sold. We do not impose any restriction on these shifts as we do not study the way firms fragment in this paper.

In 2016, approximately 5.7 million lived in Denmark. According to Statistics Denmark, out of these 5.7 million people, 53% were part of the labor force and there was an unemployment rate of 4.1%. Moreover, the geographic distribution of population and employment across Danish municipalities is very uneven. Economic growth and job creation is concentrated in the Copenhagen metropolitan area and in the second largest city, Aarhus, which is located in Eastern Jutland. Economic growth in these large cities is based mainly on knowledge intensive industries, such as the medical industry, and the rise of the service and welfare economies that have entailed a strong growth in highly skilled jobs (Hansen and Winther, 2012). Thus, for some of the analysis we separate out firms with HQ in either Copenhagen or Aarhus to see whether the dynamics of firms located in these cities differ from those in the rest of the country.

The geographical entity for our data is the municipality level, since we do not know the exact location of the establishments and the workers within the municipality.[7] Thus, we cannot

[5]The DISCO classification changes in the registers between 2009 and 2010 from DISCO88 to DISCO08. More information on the crosswalk used is available upon request.

[6]In the Other category there are mainly three types of workers. First, workers with a missing occupational category. Second, workers who did not have a specific enough occupational code to be put in one of the five categories, like "Other associate professionals". Third, workers whose occupation did not clearly belong to any of the five categories, like "Primary education teaching professionals" or "Authors, journalists and other writers", among others. See Appendix B for a detailed list of occupations within each of the categories.

[7]In 2007, there was a structural reform in the Danish public sector. With this reform, the number of municipalities went from 275 to 98. We account for this by tracking the present municipality boundaries back and using the 98 municipalities for the entire period.

compute the exact distance between the firms' establishments and their respective HQ. We compute the distances between the centroids of the municipalities using the Stata routine osrmtime (Huber and Rust, 2016). Therefore, if an establishment is located in the same municipality as its HQ, the distance takes a value of zero. As a robustness check we also use commuting areas defined by Nielsen (2005) to investigate if firms have establishments in the same functional labor market or outside.

We limit our analysis to firms in the private sector. In Denmark, the public sector accounts for around 30-35% of all full-time employees, and this share is roughly constant across municipalities. We focus on firms in the private sector, to avoid considering the political driven location decisions by the Danish national and regional governments. Further, due to the purpose of this paper, we restrict the sample to the manufacturing and the service sectors. We thereby exclude firms in farming, fishing, raw material extraction, energy/water supply, disposal, construction, wholesale, retail, hotels, restaurants and culture and leisure.[8]

Workers could be employed at several establishments at the same time, but Statistics Denmark registers the main occupation (based on income) in the IDA register. When combining workers with establishments, we keep only the employees' main occupation. In addition, we drop workers younger than 15 years old and older than 80 years old. These sample restrictions mean that, each year we have on average 8,600 firms and 13,250 establishments, which contain around 507,000 workers (approximately 20% of all employment, and 30% of all the private labor force). In total for the entire period, we have 314,203 firm-year observations, 481,024 establishments-year observations, and 18,251,870 worker-year observations.

3 The Spatial Internal Organization of Firms

In this section, we present our findings regarding the internal organization of multi-establishment firms in Denmark. We present our results as four connected facts that describe, the internal geography of firms and its changes during the last 26 to 36 years. Most of these facts are, to the best of our knowledge, new to the literature.

3.1 Number of Establishments Within Firms

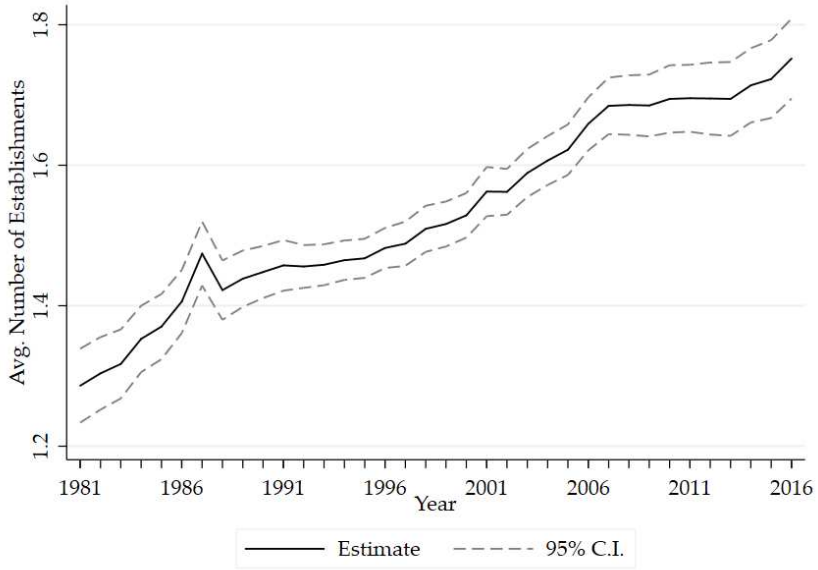
Around half of the employment generated by firms in our sample is held by multi-establishment firms that both open and close at least one establishment between 1981 and 2016. On average, these firms represent 4% of the total number of firms.[9] Furthermore, every year only around 5.5% of all the firms either open or close an establishment, but these firms generate approximately 25% of all the employment. In order to know whether firms are opening more

[8]The definition of sectors change several times during the years. To make the sectors comparable across time, we apply an aggregated sector format, divided into 36 groups, to all the years in the analysis.

[9]Moreover, around 11% of the firms only add establishments during our sample period. On the other hand, 30% of each year's total employment is generated by 70% of firms that had one establishment during the whole period.

establishments relative to the ones they are closing (positive net expansion), or if they are just replacing them (zero net expansion), we explore the evolution of the average number of establishments within firms. We do so by regressing the firms' total number of establishments on firm and year fixed effects. In Figure 1 we plot the year fixed effects of this regression relative to the 1981 average number of establishments. The details of this and all other regressions and figures can be found in Appendix C.

Figure 1: Evolution of the Total Number of Establishments



Note: This figure shows the evolution of the total number of establishments, as the year fixed effects (relative to the 1981 value) of a regression of a firm's total number of establishments on year and firm fixed effects.

Figure 1 shows that the average number of establishments within a firm increase during our sample period. The average firm has gone from 1.3 to 1.75 establishments (a 36% increase). Since we include firm fixed effects, identification for this trend comes from firms that either open and/or close establishments. The firm fixed effects are also controlling for variables that do not vary over time at the firm level. By including year fixed effects, we are controlling for yearly shocks that affect all the firms similarly. When we only look at firms that have multiple establishments at some point in our period (Figure A1), the rise in the number of establishments is larger, going from 2.1 to 3.3 establishments. We summarize this result as:

FACT 1: *The average number of establishments within firms has been increasing since 1981.*

The results also persist after controlling for age of the firm, suggesting that the increase in the number of establishments is driven by changes within age categories and not only due to the firm life cycle patterns as in Bartelme and Ziv (2017). Furthermore, our results also hold after excluding all the firms with HQ in the Copenhagen metropolitan area and in Aarhus. This implies that increasing competition for land and workers in the urban centers is not the only force, driving the firm fragmentation processes, as suggested by Rossi-Hansberg et al. (2009).

To further explore this fact, we run logistic regressions on the probability of opening or closing an establishment on indicator variables that equal 1 if the firm close or open an establishment in the current or in the previous two years. We also include firm and year fixed effects. Table 1 shows the marginal effects of the coefficients of these regressions. Since we include firm fixed effects, the effects come from firms that actually open or close establishments. Column 2 shows that closing an establishment in $t-1$ is associated with an increase in the probability of opening an establishment in t of 7 percentage points. Although small, this effect is statistically significant. Moreover, if the firm opens an establishment in either $t-1$ or in $t-2$, it is less likely to open a second one in t. The results in the flip side regression from column 4 are larger: opening an establishment in $t-1$ and $t-2$ is associated with an increase in the probability of closing an establishment in t of 35 and 20 percentage points, respectively. These results, together with Figure 1 suggest that even if large firms are constantly opening and closing establishments, on average, they are opening at a higher rate.

Table 1: Probability of Opening or Closing an Establishment

Variables	(1) Open_t	(2) Open_t	(3) Close_t	(4) Close_t
Open establishment$_t$			0.042***	0.042***
			(0.008)	(0.008)
Open establishment$_{t-1}$		-0.011		0.345***
		(0.007)		(0.007)
Open establishment$_{t-2}$		-0.079***		0.200***
		(0.008)		(0.008)
Close establishment$_t$	0.042***	0.053		
	(0.008)	(0.009)		
Close establishment$_{t-1}$		0.069***		-0.050***
		(0.009)		(0.009)
Close establishment$_{t-2}$		-0.013		-0.036***
		(0.010)		(0.009)
Observations	94,254	94,254	68,689	68,689
Number of Firms	6,424	6,424	4,112	4,112

This table shows the marginal effects of the respective logit regression. All the regressions include firm and year fixed effects. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The fact that the firms that both open and close establishments are the largest ones is very intuitive, especially if we tconsider that there are large fixed costs associated with opening and closing establishments.[10] These fixed costs are usually capital costs associated with renting or building new office space and equipment or getting rid of an older office when the establishment closes. Moreover, when a firm wants to move an establishment to a municipality farther away, the fixed costs could take the form of contractual costs often associated with the short run

[10]When we refer to the size of the establishments, we do so in terms of the number of workers, since we do not observe any other characteristic at the establishment level.

stickiness of capital and labor, even in a country with flexible labor policies like Denmark.

Figure 1 also indicates important trends in the Danish economic cycle that seem to influence the firms' average number of establishments. First, we see a positive jump in the number of establishments early in our period. This jump could be due to data issues but part of it might also be caused by the overheating of the Danish economy in the end of the 1980's and the subsequent reforms and deceleration of the economy.Second, the global financial crisis in 2008 is visible in the graph, with a stagnation in the number of establishments from 2008 to 2013, and a recovery starting in 2013.[11]

When we look at the trends by sectors, Figure A3 shows that the increase in the average number of establishments is mainly driven by an increase in the number of establishments of firms in business service (from 1.1 to 1.8), the manufacturing sector (from 1.2 to 1.4) and the transportation sector (from 1.25 to 1.8). We also observe an increase in the number of establishments in the finance, insurance and real estate (FIRE) sector, although less precisely estimated. The breakdown by sectors can be found in Figure A3. Each one of these trends are possibly being driven by different factors. In particular, we would like to note that the increase in the number of establishments per firm in the manufacturing sector is happening despite the de-industrialization that has been taking place in Denmark during the last decades (Bernard et al., 2017). Though this is somewhat puzzling, the upward trend could be explained, at least in part, by the exit of small single-establishment firms.

The business service sector has seen the largest increase in the total number of firms. This rise in the average number of establishments could be explained by the growth of single establishment firms and the large expansion of business services in the aggregate economy. It could also be explained by firms switching from manufacturing to service sectors, as documented in Bernard et al. (2017). The FIRE and transportation sectors follow similar patterns. More research investigating the sector specific dynamics and their spatial organization is needed.

3.2 Distance to the Headquarters

One of the first big decisions that a firm has to make when opening a new establishment, is probably its location. If it locates the new establishment – and thus some workers – farther away, the firm has to incur in higher communication costs due to the need of monitoring and communicating ideas between people, or higher shipping costs if it has to send inputs across establishments. However, if the firm's HQ is located in a very populated metropolitan area, by sending workers farther away, the firm could be saving on labor and land costs.[12] Moreover,

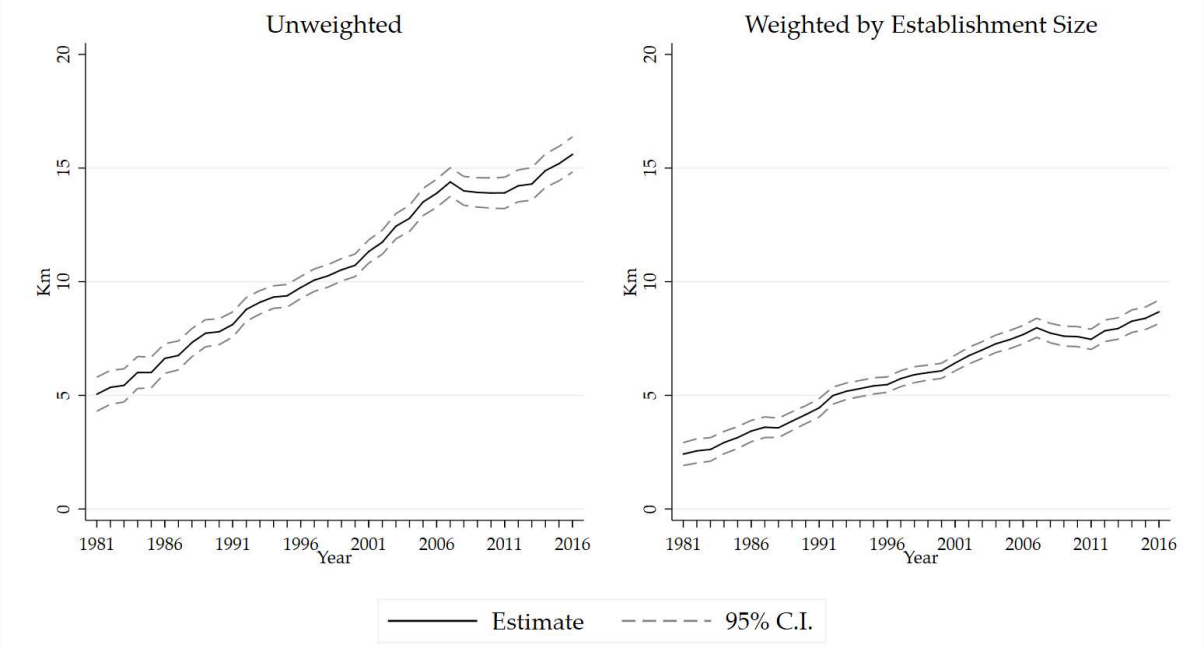
[11] These trends in the number of establishments per firm are consistent with aggregate statistics on the number of establishments and jobs published quarterly by Statistics Denmark.

[12] Around 30% of multi-establishment firms in our sample have their HQ either in Copenhagen or in its suburbs. When weighted by the size of the establishment, this share goes up to 47%, meaning that HQ's located in the capital region are larger than the ones in the rest of Denmark. This difference could be driven by productivity advantages of big cities, or by the selection of more productive firms into larger metro areas, as in Gaubert (2018). Additionally, we observe that the size of the establishments belonging to multi-establishment firms depends positively on the population size of the municipality at which it locates. This is, multi-establishment firms tend to have bigger establishments in municipalities with a large population. Suggesting that the patterns

if a multi-establishment firm is experiencing high fragmentation costs, it could also choose to close an establishment and move it closer to the HQ.

Therefore, we investigate the evolution of the average distance between a firm's establishment and its HQ. We do so by running a regression of the average distance between the firm's establishments and its HQ on year and firm fixed effects. Since we only observe the establishments' location at the municipality level, our distances correspond to the distance between municipality centroids. Therefore, the effects we show correspond to movements across municipalities. The left panel of Figure 2 plots the year fixed effects of this regression.

Figure 2: Average Distance between Establishments and Headquarters



Note: This figure shows the year fixed effects from a regression of average distance between the establishments and its headquarters (unweighted and weighted by the total number of workers in the establishment, respectively) on year and firm fixed effects.

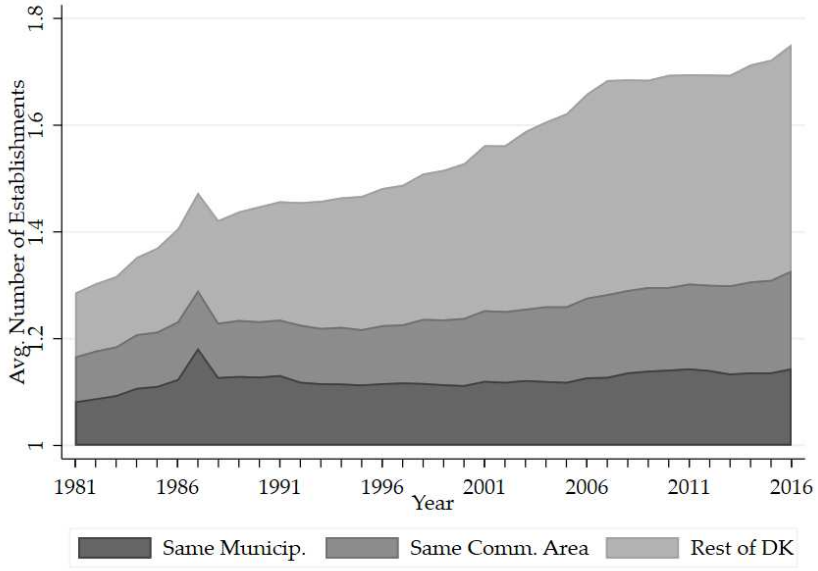
The figure shows that there has been a sustained increase in the average distance between a firm's establishments and its HQ. This increase stops in the midst of the recent global financial crisis but seems to be going back to the previous trend. In particular, the average distance increased by around 11 kilometers between 1981 and 2016. These 11 kilometers represent a 220% increase relative to the 1981 mean (5 kilometers). The scope of the change in distance leads us to think that a lot of the expansion within firms is taking place within commuting zones, in line with recent evidence for US firms presented by Bartelme and Ziv (2017).

To explore whether this expansion is in fact happening within functional labor markets, we decompose the evolution in the total number of establishments presented in Figure 1 between establishments located in the same municipality as their HQ, in the same commuting area

presented in Gaubert (2018) could be driven by the internal geography of firms.

(excluding the HQ municipality), and the rest of the country. We show the decomposition in Figure 3. The figure shows that, even though there has been increases in the average number of establishments in both the same municipality and the same commuting area as the firm's HQ (15% and 18% of the total change, respectively), these changes are small compared to the change in the number of establishments outside the HQ's commuting area, i.e. functional labor market (67% of the total change). Figure A2 in the appendix presents this figure using only those firms that had multiple establishments at some point during the period. Since these estimates are coming from firms that open and/or close establishments during the period, the results are almost equivalent.

Figure 3: Decomposition of the Total Number of Establishments



Note: This figure shows the evolution of the total number of establishments, from a regression of a firm's total number of establishments on year and firm fixed effects, separating between those establishments located in the same municipality as their HQ, in the same commuting area, and in the rest of the country.

Identification of the changes presented in Figure 2 is coming from firms that open and/or close establishments in our sample. However, given the high fixed costs involved in both opening and closing, a firm could still decentralize its labor by sending some of its workers to non-HQ establishments or hire more in these locations. Therefore, we also run the same regression but weighting each establishment by the total number of workers. Thus, this regression shows the average distance between the firm's workers and its HQ. The right panel of Figure 2 shows the results. The increase in the average distance is lower in this case: only 5.5 kilometers. This is consistent with the fact that the HQ's and the establishments relatively closer to them, tend to be the largest establishments.[13] This change corresponds to a 220% increase relative to the 1981 value of 2.5 kilometers, meaning that, even if a firm does not open new establishments farther away from the HQ's, it could be reallocating some of its labor force. When we only

[13]The average multi-establishment firm in our sample holds 65% of their employees at the firm's HQ. This distribution is skewed to the left. We will discuss the evolution of the employment at the HQ below.

look at firms that have multiple establishments at some point in our period (Figure A4), the average distance of the establishments and workers to the HQ goes from 21 to 48 kilometers (an increase of 129%), and from 10 to 27 kilometers (a 170% increase), respectively.

These trends lead us to our second fact:

FACT 2: *The average distance between the establishments and their HQ has more than doubled during the last 36 years. These changes are mainly driven by the creation of establishments outside the HQ's functional labor market.*

The average distance is, naturally, equally influenced both by establishments close to and far from the HQ, i.e. if the second establishment is located 20 km from the HQ, the average distance is 20 km, but if the firm then opens a third establishment 10 km from the HQ, the average distance decrease to 15 km. Therefore, as a robustness check we also look at the evolution of the distance to the establishment farthest away from the HQ. Figure A5 shows that when we only consider the maximum distance, this has overall increased from 10 to 32 km (a 220% increase) and for multi-establishment firms the distance has grown from 42 to 100 km (138% increase).

Figure A6 and A7 in the appendix show the results by firm sector. All the sectors experience an increase in the average distance between the establishment and its HQ from 1981 to 2016: the business service and the transportation sectors by 17 km (increase of 567% and 340%), the manufacturing by 6 km (133%), and the FIRE sector by 7 km (75%), this last one is less precisely estimated. The lower increase in the manufacturing sector is consistent with this sector facing higher fixed capital costs and higher fragmentation costs (both communication and shipping is needed). When we weight by size of the establishments, we see an increase of 3.5 km for manufacturing (153%), 9 km for transportation (304%), 10.5 km for business services (117%), and 3.5 km for FIRE (70%). The small change in the FIRE sector could be due to high within firm agglomeration forces, or to outsourcing of business services in this sector.

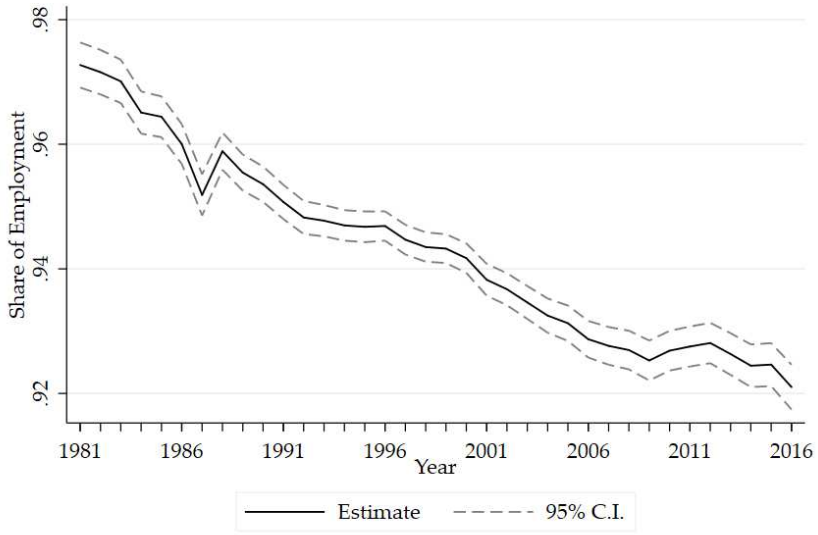
We believe that Fact 1 and 2 are behind the increase in the share of establishments and workers belonging to multi-establishment firms in Denmark between 1981 and 2016. We show the change in these shares for each municipality in Figure A8. The maps show that the share of establishments belonging to multi-establishment firms has increased in most of the country. The same goes for the workers, except for some municipalities in the southern part of the country.

Finally, we would like to point out that the increase in the average distance of workers to their HQ has been accompanied by a decrease in the share of workers employed at the firms' HQ. We show the evolution of this share in Figure 4. The figure shows a significant reduction of 5 percentage points in the share of employment at the HQ. Just as the increasing trends documented in Fact 1 and 2, the decrease in this share stopped between 2008 and 2013. This reduction is similar, when looking at our four aggregated sectors.[14] Even though a reduction of 5 percentage points might seem small, recall that firms with multiple establishments are usually large firms, and even a small change in this share could mean that a considerable amount of

[14]The levels of the figure might seem high. However, note that the entry and exit of firms in our sample, together with the fact that single establishment firms have higher entry and exit rates, could shift the estimates of the year fixed effects upward.

jobs are being reallocated. Figure A9 in the appendix shows the same figure, using only those firms that have multiple establishments at some point in our sample period. For this group of firms, the reduction is of 13 percentage points, going from 89% to 76%.

Figure 4: Concentration of Employment at the HQ



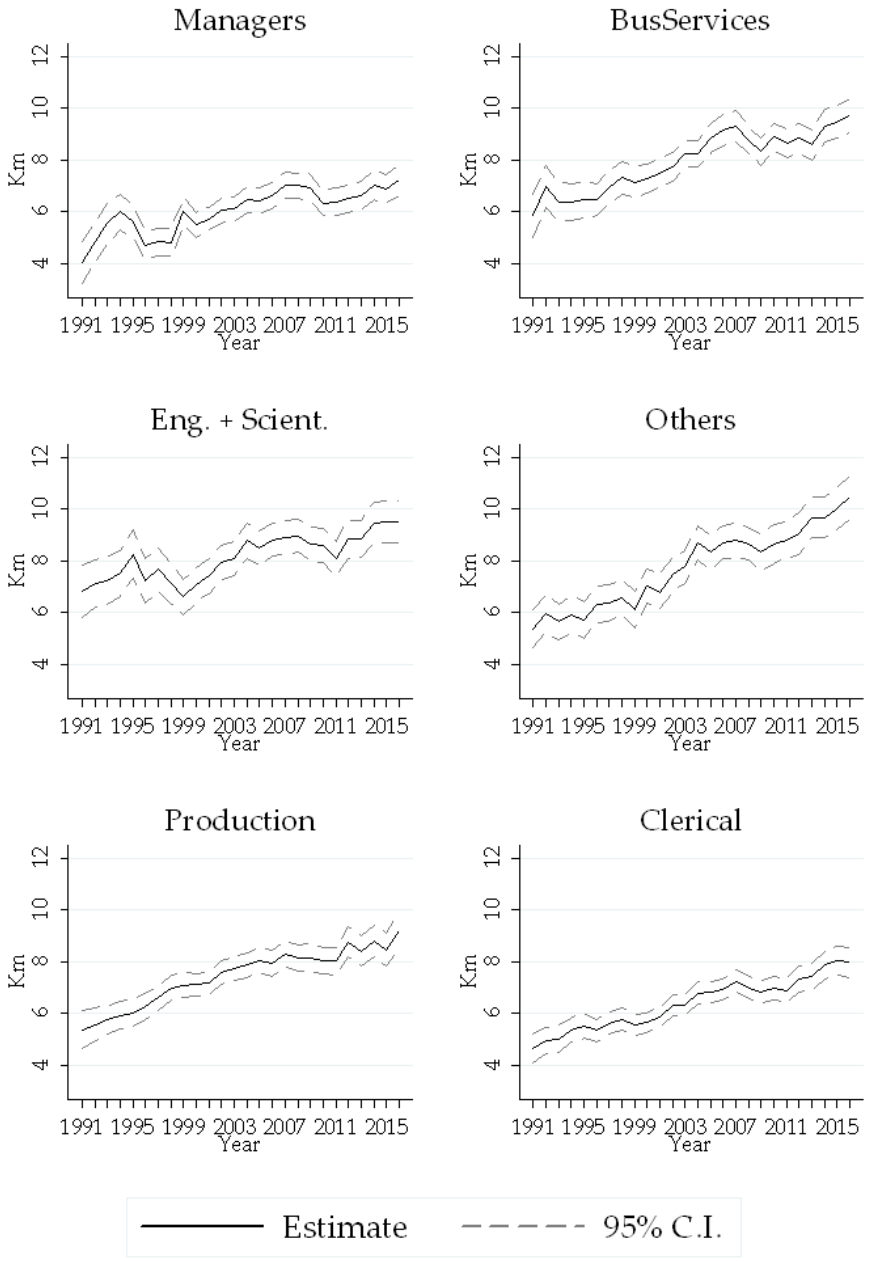
Note: This figure shows the year fixed effects of a regression of the share of employment at the firm's HQ on year and firm fixed effects.

3.3 Labor Composition

If a large number of jobs is be being moved away from the HQ the distribution of different types of workers within a firm will change. Thus, we investigate whether the changes from Figure 2 and 4 are driven by some particular type of worker, or if it is a general phenomenon for all the workers, regardless of their occupation. Therefore, Figure 5 shows the evolution of the average distance to the HQ of workers within a particular occupational group. The figure shows the year fixed effects from similar regressions as the ones described for Fact 2. We do these regressions starting in 1991, which is the first year for which we have the DISCO occupational classification.

Note that all groups experience an increase. Workers in lower skilled occupations, such as clerical and production workers, experience an increase of approximately 4 km in the average distance to their HQ (82% and 80%, respectively). The business service workers and managers also experience an increase in their average distance of respectively 67% and 75% over the same period. Engineers and scientists experience the lowest increase of 36%. When we explore the share of firm's employment at the HQ for each of the occupation categories in Figure A10 the pattern is similar; the lower skilled occupational groups experience the largest decrease, while the decrease in the concentration of employment at the HQ for high skilled occupation groups is a bit lower. For engineers and scientists, the level in 2016 is not statistically significant from the level in 1991.

Figure 5: Average Distance to the HQ by Occupation



Note: This figure shows the year fixed effects of a regression of the average distance of the establishments to their HQ weighted by the establishment's relative number of employees within each occupation category, on year and firm fixed effects.

These results could point to the existence of strong within firm agglomeration economies, in particular regarding high skilled workers. Specifically, firms might realize that there could be productivity gains by putting workers of particular occupations together, e.g. by concentrating the managers at the HQ. The decrease in communication costs brought by the expansion of the broadband coverage in the first half of the 2000s that Henten and Falch (2011) documents, could contribute to this pattern. If communicating across establishments is relatively easier, it

could become more affordable for the firm to send some occupations further from the HQ. On the other hand, the firm might want to leave occupations at the HQ that benefit the most from agglomeration economies and Face-to-Face communication (Storper and Venables, 2004).

To explore the contribution to the changes from Figure 2 of each occupation category, we do the following decomposition. We define the firm's f average distance of the workers to their HQ at time t ($\bar{D}_{HQ,t}$) as a weighted sum of the average distance for each occupation o, $\bar{D}^o_{HQ,t}$:

$$\bar{D}_{HQ,t} = \sum_o \left(\frac{L_{of}}{L_f}\right)_t \bar{D}^o_{HQ,t} = \sum_o \left(\frac{L_{of}}{L_f}\right)_t \left[\sum_j dist_j \left(\frac{L_{oj}}{L_{of}}\right)_t\right] \tag{1}$$

where $\left(\frac{L_{of}}{L_f}\right)_t$ is the share of workers of occupation o within firm f at time t, and $\left(\frac{L_{oj}}{L_{of}}\right)_t$ the share of workers of occupation o at establishment j relative to the total amount of workers in that same occupation in the firm f at time t. Using equation (1), we can investigate the yearly contribution of each occupation category to the average distance of the workers to their HQ. Moreover, we can further decompose the contribution into two parts: the relative use of occupation o inside the firm, and the average distance of workers from this occupation to their HQ. We show the results in Table 2. Technical details of the decomposition can be found in Appendix C.

The decomposition shows that workers in production and in business service contribute by 35 and 30% to the overall change in the average distance of workers to their HQ (30.8 and 26.2 percentage points out of 88.1, respectively). Engineers and scientists contribute by around 22% to this change, while managers and clerical workers are the two occupational categories that contribute least to the change, by around 7 to 10% each. Further decomposing each occupation's contribution into their changes in relative use and changes in average distance to HQ, we observe that the contribution of each occupation comes from different sources. For the managers, 60% of their contribution to the total change in the average distance comes from an increase in the usage of managers at the firm level. Between 1991 and 2016, managers went from being 4% of the total number of workers within firms to being around 7%.

For clerical workers, we observe that the change in use of occupations inside this category contribute negatively to the total change, but the increases in these occupations' average distance to their HQ contribute positively. Furthermore, we observe that increases in the distance of production workers to their HQ drive almost 30% of the total change of distance observed between 1991 and 2016. This is consistent with a decrease in the use of workers in these occupations and the increase in their average distance to the HQ (shown in Figure 5). For the engineers and workers in science professions, we see that most of their contribution comes from changes in their average distance to the HQ. Moreover, there is also an increase in the usage of workers in this occupation category. Looking more closely at the data, it seems the main increases in the average distance of engineers and scientists to their HQ happen in two waves: the first one at the beginning of 2000's, and a recent second one starting around 2011. Curiously, these two waves coincide with the recovery periods of both the Dot-com bubble and the recent financial crisis, respectively.

Table 2: Changes in Average Distance of Workers to HQ, 1991-2016

Value 1991	**Value 2016**	**Change**
4.41 km	8.29 km	88.07%
Managers		6.07%
Change in Use		3.62%
Change in Dist		2.45%
Production		30.82%
Change in Use		2.14%
Change in Dist		28.67%
Business Services		26.23%
Change in Use		13.23%
Change in Dist		13.00%
Engineers & Scientists		19.70%
Change in Use		4.10%
Change in Dist		15.60%
Clerical		8.71%
Change in Use		-5.02%
Change in Dist		13.73%
Others		-3.45%
Change in Use		-9.06%
Change in Dist		5.61%

Note: This table shows the decomposition by different occupational categories described in Equation (3). The percentages add up the total change from the first row, and not 100%.

Workers in occupations related to business services contribute with more than a fourth of the total change in the average distance of workers to their HQ. For workers in these professions, the increase in their relative use within the firm is almost as important as the increase in the average distance to the HQ. On one hand, both business service firms and business service workers in all types of firms have become more important in the last decades. On the other hand, this has probably caused more competition for office space and workers, promoting the re-allocation of business service workers to smaller municipalities for cost saving reasons, as argued by Liao (2012). This re-allocation becomes easier under the presence of better communication technology.

Based on these findings we formulate a third fact:

FACT 3: *The increase in the average distance of workers to the firm's HQ is especially driven by an increase in the average distances of production workers, engineers and scientists and clerical workers to their HQ, and an increase in the use of business service workers.*

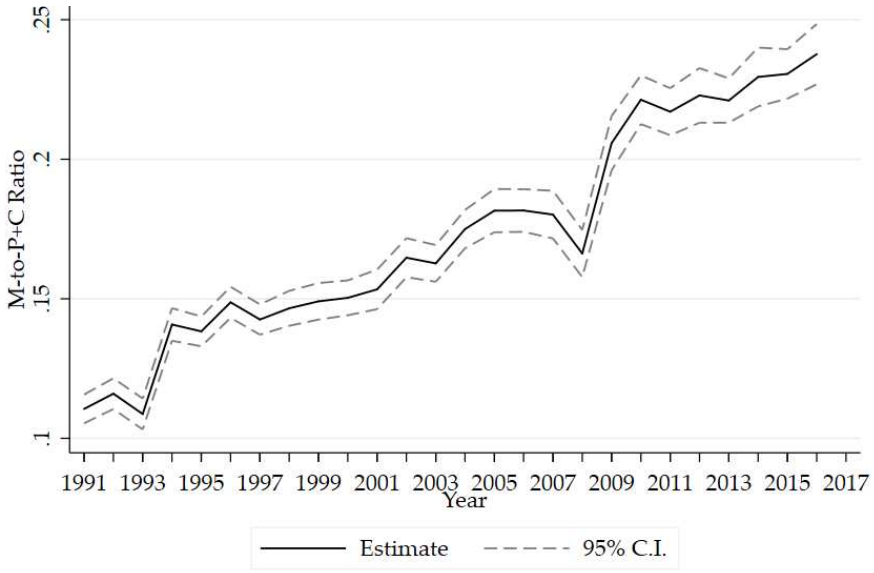
3.4 Team Size

In the previous decomposition, we showed that there has been both a reduction in the average number of production and clerical workers, as well as an increase in the average number of managers at the firm level during the last 26 years. These trends imply that the size of production teams, defined as the ratio of managers to production and clerical workers, should have gone up during the same period.

We compute the ratio of managers to production and clerical workers for each establishment and regress it on firm and year fixed effects. Figure 6 shows the estimated year fixed effects relative to the average value in 1991. As expected, we observe a clear upward trend of this ratio, which means that there has been a systematic reduction in the size of production teams. The ratio went from approximately one manager for every 9-10 production workers, to around one manager for every four production workers in 2016.

Figure 6: Managers to Production and Clerical Workers

Firm Level

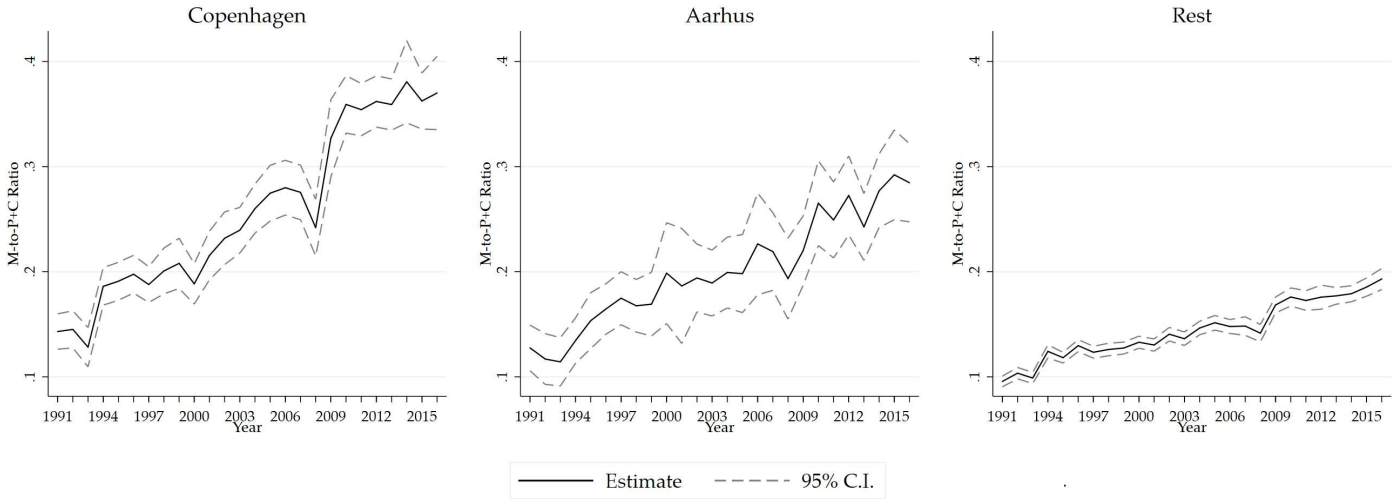


Note: This figure shows the fixed effects from a regression of the establishments' ratio of managers to production and clerical workers, on year and firm fixed effects.

However, this reduction in team size is not necessarily a general phenomenon within the firm. In Figure 7, we show that the increase in the managers to production workers ratio that we observe at the firm level is coming mainly from establishments located in the two city areas: Copenhagen (metropolitan area) and Aarhus. More specifically, we observe an increase of 164%, 115% and 95% of this ratio for establishments located in Copenhagen, Aarhus and the rest of the country, respectively. We confirm this by running a regression of the ratio of managers to production plus clerical workers on year and firm fixed effects, with an interaction between the year fixed effects and the municipality size of the establishment. Figure A11 in the appendix

shows these results. In this figure we observe an increase in the correlation between this ratio and the size of the municipality, consistent with Figure 7, suggesting that production teams are becoming smaller in more populated municipalities. The trend is in line with similar results for the US presented in Santamaria (2017), who argues that the changes could be generated due to a rise in the complexity of the production process in big cities.

Figure 7: Managers to Production and Clerical Workers by Municipality



Note: This figure shows the yearly correlation from a regression of the establishments' ratio of managers to production and clerical workers on year and firm fixed effects, for Copenhagen metropolitan area, Aarhus and the rest of the country.

Given that Copenhagen and Aarhus contain more than a third of the country's headquarters, the reduction in the size of production teams is consistent with the reduction in the share of employment at the firms' HQ and increasing average distances for some types of workers to their HQ that we observed above. We summarize these findings in our fourth fact:

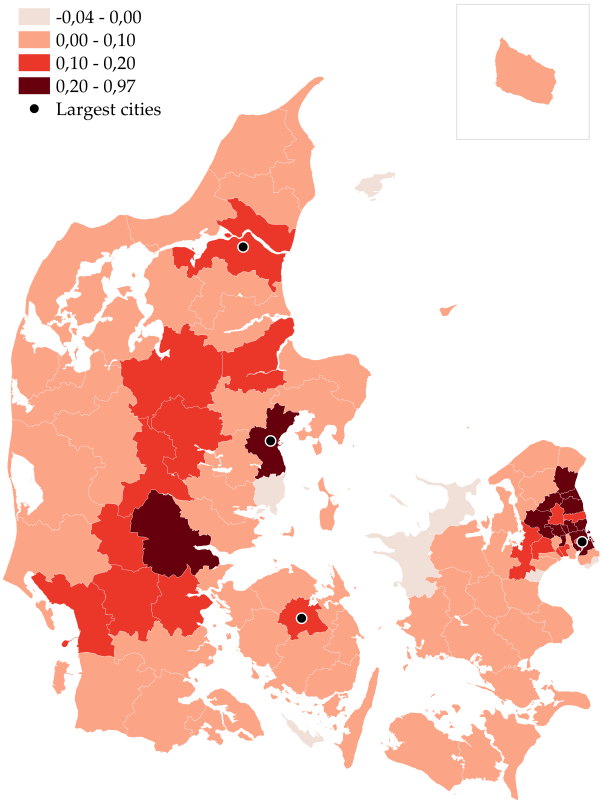
FACT 4: *The ratio of managers to production and clerical workers within firms has been increasing over the last 26 years. This is driven by an increase in the ratio at establishments located in the most populated municipalities.*

Our results could partially explain the evolution of the aggregate specialization patterns that Duranton and Puga (2005) describe. In particular, Duranton and Puga (2005) argue that increasing firm fragmentation is leading to a decrease in the sectoral specialization of US cities, regardless of their size, and to an increase in the functional specialization, measured as the relative concentration of managers to production workers in large cities. In order to briefly explore this last hypothesis, we compute the change in the average ratio of managers to production and clerical workers across establishments for each municipality between 1991 and 2016. In Figure 8, we show that this ratio has increased during the last 26 years for almost every municipality in the country. Figure A12 in the appendix shows the levels of this ratio for 1991 and 2016 separately. The two figures also show that, at the beginning of the 1990's, all the municipalities were not too different in terms of this measure, but that it increased substantially

for Copenhagen and its metropolitan area, and the other main city areas.

Figure 8: Managers to Production and Clerical Workers Ratio by Municipality

1991-2016 Changes



Note: This figure shows the percentage point difference between 1991 and 2016 for the average ratio of managers to production and clerical workers across establishments for each municipality. The 98 municipalities are divided into quartiles according to the changes in the ratio, and the black dots mark the largest municipalities: Copenhagen, Aarhus, Aalborg and Odense.

Furthermore, we decompose these changes between changes in the ratio for single-establishment firms, for establishments belonging to multi-establishment firms, entry of establishments belonging to single-establishment and multi-establishment firms and exit of establishments. We do this decomposition for the whole country and for each municipality. For the whole country, we find that 70% of the nationwide increase in the average ratio of managers to production and clerical workers was driven by increases in the average ratio within multi-establishment firms, while increases in the average ratio within single-establishment firms, explained 36% of the total increase.[15] Second, at the municipality level, we find that increases in the average ratio within multi-establishment firms is the main contributor to the growth in the average ratio of managers to production and clerical workers in 35 out of 98 municipalities. Moreover, the opening of establishments belonging to multi-establishment firms is the main contributor in 15 municipalities. This is, in more than half of the country's municipalities (51%) the decrease in the average team size is being driven by growth or entry of establishments belonging to multi-

[15]This sum to more than 100% since composition changes and net entry explain -4.5% and -2.4%, respectively.

establishment firms. This share is even larger in the capital region (*Hovedstaden*) with 19 out of 32 municipalities (60%).

4 Possible Causes and Conclusions

In Denmark approximately 7% of all firms have more than one establishment. These firms account for approximately 47% of the private sector total employment and around 54% of the total output. Given the importance of multi-establishment firms for the aggregate economy, it is crucial to know and understand the facts regarding their spatial organization.

In this article, we use highly detailed register data covering the universe of firms between 1981 and 2016 to lay out four stylized facts regarding the spatial internal organization of firms. Some of these facts are, to the best of our knowledge, new in the literature. First, we show that the average number of establishments has increased by 36% during the last 36 years. Second, we show that the average distance between the establishments and workers to their headquarters also increased by more than 200% during the same period. This increase holds for the four aggregate sectors in our sample: manufacturing, finance, insurance and real estate, business services and transportation. This fact suggests that firms are placing workers further away from their HQ.

Third, we show that the increase in the average distance of workers to their HQ is driven mainly by increases in the average distance of production and business service workers. The changes in the average distance of managers to their HQ is small and contributes 6% of the total change. Finally, we show that the ratio of managers to production and clerical workers within firms has been increasing, going from, approximately, one manager for every 9-10, to one manager every four production and clerical workers. This increase has been particularly large in establishments located in the metropolitan area of Copenhagen and the most populated municipalities in general. Finally, we show that these within-firm changes in the ratio of manager to production workers could partially explain the increase in the aggregate functional specialization, as suggested by Duranton and Puga (2005).

What could be the factors causing this spatial distribution of firms, establishments and workers, and their evolution over time? Based on the literature, the potential most important causes are: i) fragmentation costs, ii) location specific comparative advantages, iii) land and labor costs, iv) agglomeration economies, v) market access, and vi) skilled-biased technical change.[16] Also, these causes are probably interconnected and there could be complementarities between some of them. We study some of the mechanisms in a companion paper.

First, the presence of fragmentation costs are an important factor since the movement of knowledge, people and/or goods can be very important for different operations within or across

[16]We refrain from discussing other important factors like differential tax rates across regions. Even though this could be a very important mechanism for firm location decisions in countries like the United States (Suárez Serrato and Zidar, 2016), we do not think that this is an important factor in the fragmenting decision of firms inside Denmark.

firms. On one hand, in the presence of high communication costs, a firm might choose to operate in only one establishment. However, if communication costs decrease, it can decide to open new establishments and change its organizational structure for one that is more profitable (Duranton and Puga, 2005). For instance, if communicating across establishments is relatively easier, it could become more affordable for the firm to send some occupations further from the HQ. Furthermore, it could choose to leave only those workers at the HQ that benefit more from Face-to-Face communication (Storper and Venables, 2004). Communication costs have also been emphasized in the organizational economic literature as an important determinant of organizational structures (Garicano, 2000; Brynjolfsson and Hitt, 2000; Bloom et al., 2014). On the other hand, internal transportation costs are also important, especially for firms in the manufacturing sector where intermediate inputs have to be shipped between establishments. Improvements in the transportation infrastructure, such as the Great Belt Bridge that opened in 1998 connecting Zealand and Funen, can have a similar effect on firm fragmentation and organizational structure, as shown in Charnoz et al. (2018) for the expansion of the French High-Speed Rail.

Second, some municipalities might have comparative advantages in the production of certain goods and services. For instance, larger municipalities, who are usually more skill intensive, could specialize in skill intensive tasks (Davis and Dingel, 2014). Therefore, once a firm reaches a certain scale it might want to locate part of it in a more advantageous location. This is also connected with the existence of fixed costs of opening (and potentially closing) an establishment. These costs could cause a firm to not open as many establishments as it would like, due to its small scale, low productivity, among others.

Third, higher labor and land costs in certain locations might cause a firm to fragment in order to lower their marginal costs. This has been the case with business service workers in the U.S. (Liao, 2012). These higher input costs could be driven by higher population growth, as in (Rossi-Hansberg et al., 2009), and/or by other factors such as an inelastic supply for office or residential space. When facing higher costs, firms could decide to leave in that particular establishment, only those occupations that benefit the most from the municipality's urbanization economies (e.g. higher income workers have a higher preference for consumption amenities, as shown by Couture and Handbury (2017)). A firm could choose not to reallocate those tasks that benefit the most from input-output sharing, labor pooling or other types of agglomeration economies (Faggio et al., 2017). For example, a firm might want to locate their R&D facilities in the capital region due to the relatively high concentration of academic institutions.

Fifth, a firm could also choose to open a new establishment in a municipality if it believes there is enough local demand for its product. Even though we exclude retail and wholesale firms from our analysis, we still believe that market access can be an important mechanism for the firms in our sample. For instance, a business service firm might want to open an establishment near to manufacturing or service firms in order to be close to its (potential) clients. On the other hand, a firm might want to locate in Copenhagen, in another port city, or near the German border, in order to be more exposed to international markets.

Finally, these changes could also be affected by skill-biased technical change. It has been shown extensively in the literature that technology (including communication and information technology) complements highly educated workers engaged in abstract tasks and substitutes workers performing cognitive and manual tasks (Autor et al. (2003)). Consequently, the increases in the ratio of managers to production and clerical workers could be driven by skill-biased technical change. The fact that this ratio seems to be increasing more in the largest municipalities, could be explained in part by increases in the skill bias of agglomeration economies, as in Baum-Snow and Pavan (2013).

Two important caveats of our results are worth mentioning. First, we are not able to observe the establishments of a Danish firm outside Denmark, nor its labor force. It is clear that recent trends in globalization have seen an increase in offshoring and foreign outsourcing, especially for manufacturing firms, but also for firms in the business service sector.[17] This is consistent with recent reports by Statistics Denmark showing increases in foreign employment held by Danish firms abroad.[18] Therefore, our results should probably be interpreted as a lower bound of the actual decentralization patterns within firms. Second, there has also been an increase in outsourcing within national boundaries (Goldschmidt and Schmieder, 2017). We cannot observe this either in our data. In consequence, there could be more occupational specialization and spatial decentralization than the one dictated by the boundaries of the firms.

The results of this paper intend to shed light and motivate future research studying different geographic and economic consequences of changes in firms' location decisions, for example, changes in the sorting of different types of workers, local productivity, and urban and rural development. Perhaps more importantly, the changes in the spatial organization within firms could be a very important cause explaining the recent diverging trends in urban wage inequality and residential income segregation across and within municipalities and regions.

[17] For example, through anecdotal evidence we know that a firm from the medical manufacturing industry has a plant in Hungary and is considering expanding its size, while closing the one in Denmark.

[18] For example, https://www.dst.dk/da/Statistik/nyt/NytHtml?cid=26775

References

Aarland, K., Davis, J., Henderson, J. V., and Ono, Y. (2007). Spatial organization of firms: the decision to split production and administration. *RAND Journal of Economics*, 38(2):480–494.

Aguirregabiria, V. and Suzuki, J. (2016). Empirical Games of Market Entry and Spatial Competition in Retail Industries. In Basker, E., editor, *Handbook of the Economics of Retailing and Distribution*, volume 1, chapter 9, pages 201–232. Edward Elgar.

Alcácer, J. and Delgado, M. (2016). Spatial organization of firms and location choices through the value chain. *Management Science*, 62(11):3213–3234.

Antràs, P. and Yeaple, S. R. (2014). Multinational firms and the structure of international trade. In Gopinath, G., Helpman, E., and Rogoff, K., editors, *Handbook of International Economics*, volume 4, chapter 2, pages 55–130. Elsevier.

Atalay, E., Hortaçsu, A., and Syverson, C. (2014). Vertical integration and input flows. *American Economic Review*, 104(4):1120–48.

Autor, D. H., Levy, F., and Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly journal of economics*, 118(4):1279–1333.

Bartelme, D. and Ziv, O. (2017). The Internal Geography of Firms. Work in Progress.

Baum-Snow, N. and Pavan, R. (2013). Inequality and City Size. *The Review of Economics and Statistics*, 95(5):1535–1548.

Becker, G. S. and Murphy, K. M. (1992). The division of labor, coordination costs, and knowledge. *The Quarterly Journal of Economics*, 107(4):1137–1160.

Behrens, K. and Guillain, R. (2017). The determinants of coagglomeration: Evidence from functional employment patterns. CEPR Discussion Papers 11884, CEPR.

Bernard, A. B., Smeets, V., and Warzynski, F. (2017). Rethinking Deindustrialization. *Economic Policy*, 32(89):5–38.

Bloom, N., Garicano, L., Sadun, R., and Reenen, J. V. (2014). The Distinct Effects of Information Technology and Communication Technology on Firm Organization. *Management Science*, 60(12):2859–2885.

Brynjolfsson, E. and Hitt, L. M. (2000). Beyond computation: Information technology, organizational transformation and business performance. *Journal of Economic Perspectives*, 14(4):23–48.

Cestone, G., Fumagalli, C., Kramarz, F., and Pica, G. (2018). Insurance Between Firms: The Role of Internal Labor Markets. Work in Progress.

Charnoz, P., Lelarge, C., and Trevien, C. (2018). Communication Costs and the Internal Organisation of Multi-plant Businesses: Evidence from the Impact of the French High-speed Rail. *The Economic Journal*, 128(610):949–994.

Combes, P.-P. and Gobillon, L. (2015). The Empirics of Agglomeration Economies. In Duranton, G., Henderson, J., and Strange, W., editors, *Handbook of Regional and Urban Economics*, volume 5, chapter 5, pages 247–348. Elsevier.

Couture, V. and Handbury, J. (2017). Urban revival in America, 2000 to 2010. Technical report, National Bureau of Economic Research.

Davis, D. R. and Dingel, J. I. (2014). The Comparative Advantage of Cities. NBER Working Papers 20602, National Bureau of Economic Research, Inc.

Davis, J. C. and Henderson, J. V. (2008). The agglomeration of Headquarters. *Regional Science and Urban Economics*, 38(5):445–460.

Duranton, G. and Puga, D. (2005). From sectoral to functional urban specialisation. *Journal of Urban Economics*, 57(2):343–370.

Eckert, F., Hejlesen, M., and Walsh, C. (2019). The Return to Big City Experience: Evidence from Danish Refugees.

Faggio, G., Silva, O., and Strange, W. C. (2017). Heterogeneous agglomeration. *Review of Economics and Statistics*, 99(1):80–94.

Garicano, L. (2000). Hierarchies and the Organization of Knowledge in Production. *Journal of Political Economy*, 108(5):874–904.

Gaubert, C. (2018). Firm sorting and agglomeration. *American Economic Review*, 108(11):3117–53.

Gokan, T., Kichko, S., and Thisse, J.-F. (2018). How do trade and communication costs shape the spatial organization of firms? Technical report, National Research University Higher School of Economics.

Goldschmidt, D. and Schmieder, J. F. (2017). The rise of domestic outsourcing and the evolution of the German wage structure. *The Quarterly Journal of Economics*, 132(3):1165–1217.

Greenstone, M., Hornbeck, R., and Moretti, E. (2010). Identifying agglomeration spillovers: Evidence from winners and losers of large plant openings. *Journal of Political Economy*, 118(3):536–598.

Hansen, H. K. and Winther, L. (2012). *The Urban Turn: Cities, Talent and Knowledge in Denmark*. Aarhus University Press.

Helsley, R. W. and Strange, W. C. (2007). Agglomeration, opportunism, and the organization of production. *Journal of Urban Economics*, 62(1):55–75.

Henderson, J. V. and Ono, Y. (2008). Where do manufacturing firms locate their headquarters? *Journal of Urban Economics*, 63(2):431–450.

Henten, A. and Falch, M. (2011). Broadband Development in Denmark. Paper presented at the European Regional ITS Conference, Budapest, Hungary.

Holl, A. (2008). Production subcontracting and location. *Regional Science and Urban Economics*, 38(3):299–309.

Holmes, T. J. (2011). The diffusion of Wal-Mart and economies of density. *Econometrica*, 79(1):253–302.

Huber, S. and Rust, C. (2016). Calculate travel time and distance with OpenStreetMap data using the Open Source Routing Machine (OSRM). *The Stata Journal*, 16(2):416–423.

Liao, W.-C. (2012). Inshoring: The geographic fragmentation of production and inequality. *Journal of Urban Economics*, 72(1):1–16.

Malchow-Møller, N., Munch, J. R., and Skaksen, J. R. (2017). Do Foreign Experts Increase the Productivity of Domestic Firms? *The Scandinavian Journal of Economics*.

Markusen, J. (2002). *Multinational Firms and the Theory of International Trade*, volume 1. The MIT Press, First edition.

Marshall, A. (1890). *Principles of economics*. Macmillan London.

Mota, I. and Brandão, A. (2013). The determinants of location choice: Single plants versus multi-plants. *Papers in Regional Science*, 92(1):31–49.

Nielsen, B. (2005). Udviklingen i pendlingen siden år 2000. *Arbejdsnotat, Skov-og Naturstyrel*.

Ota, M. and Fujita, M. (1993). Communication technologies and spatial organization of multi-unit firms in metropolitan areas. *Regional Science and Urban Economics*, 23(6):695–729.

Rossi-Hansberg, E., Sarte, P.-D., and Owens III., R. (2009). Firm fragmentation and urban patterns. *International Economic Review*, 50(1):143–186.

Santamaria, C. (2017). Small Teams in Big Cities: Inequality, City Size, and the Organization of Production. Work in Progress.

Statistics Denmark (1991). IDA – An integrated data base for labour market research. Technical report, Statistics Denmark.

Storper, M. and Venables, A. J. (2004). Buzz: Face-to-Face contact and the urban economy. *Journal of Economic Geography*, 4(4):351–370.

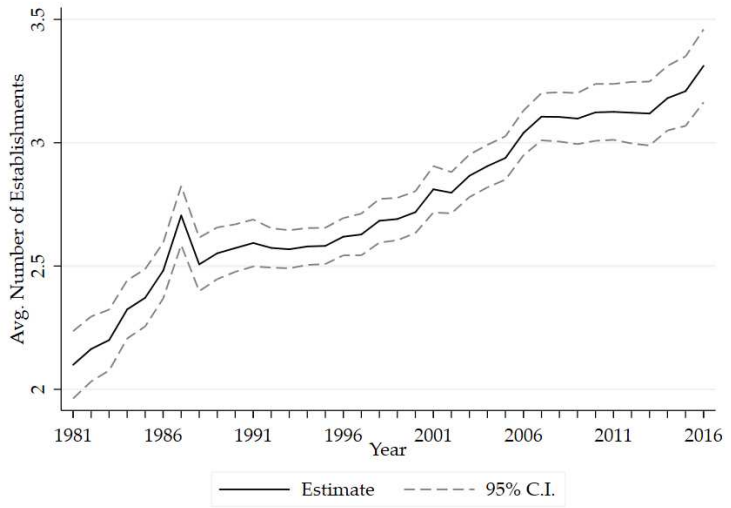
Strauss-Kahn, V. and Vives, X. (2009). Why and where do headquarters move? *Regional Science and Urban Economics*, 39(2):168–186.

Suárez Serrato, J. C. and Zidar, O. (2016). Who Benefits from State Corporate Tax Cuts? A Local Labor Markets Approach with Heterogeneous Firms. *American Economic Review*, 106(9):2582–2624.

A Extra Tables and Figures

Figure A1: Evolution of the Total Number of Establishments

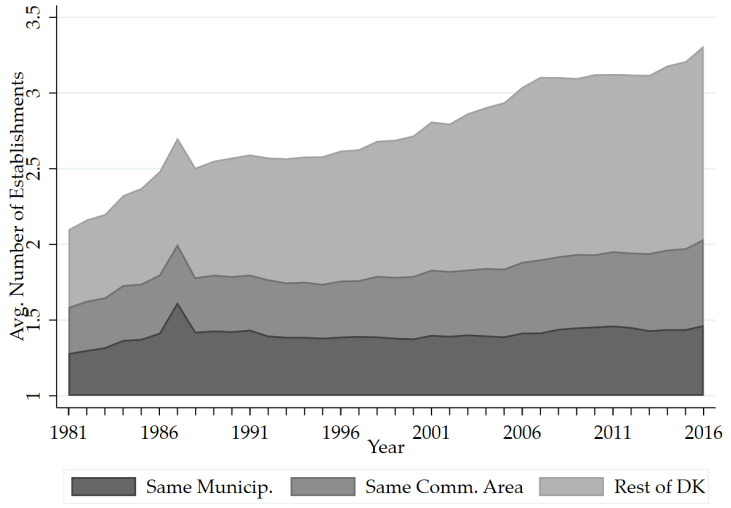
for Multi-establishment Firms



Note: This figure shows the evolution of the total number of establishments for firms that had a multiple establishment at some point between 1981 and 2016, from a regression of a firm's total number of establishments on year and firm fixed effects.

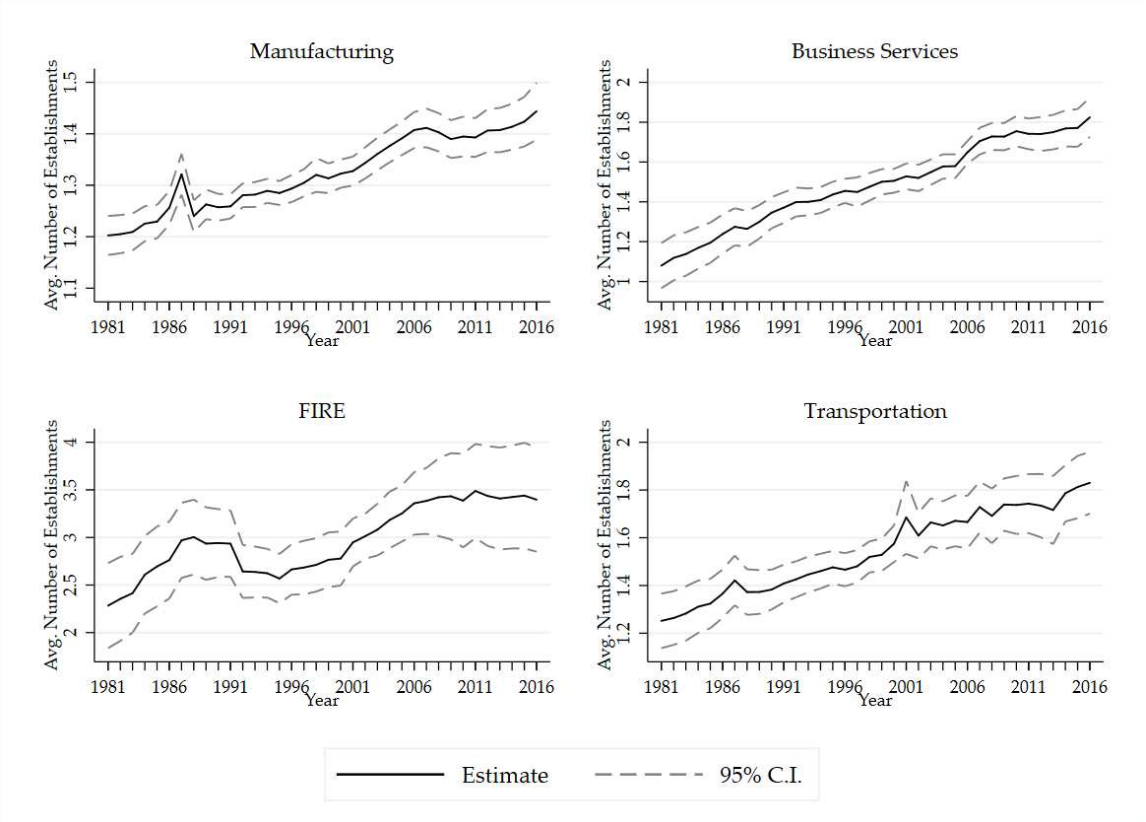
Figure A2: Decomposition of the Total Number of Establishments

for Multi-establishment Firms



Note: This figure shows the evolution of the total number of establishments in the same municipality, same commuting area or different commuting area as the firm's HQ, for firms that had a multiple establishment at some point between 1981 and 2016.

Figure A3: Evolution of the Total Number of Establishments

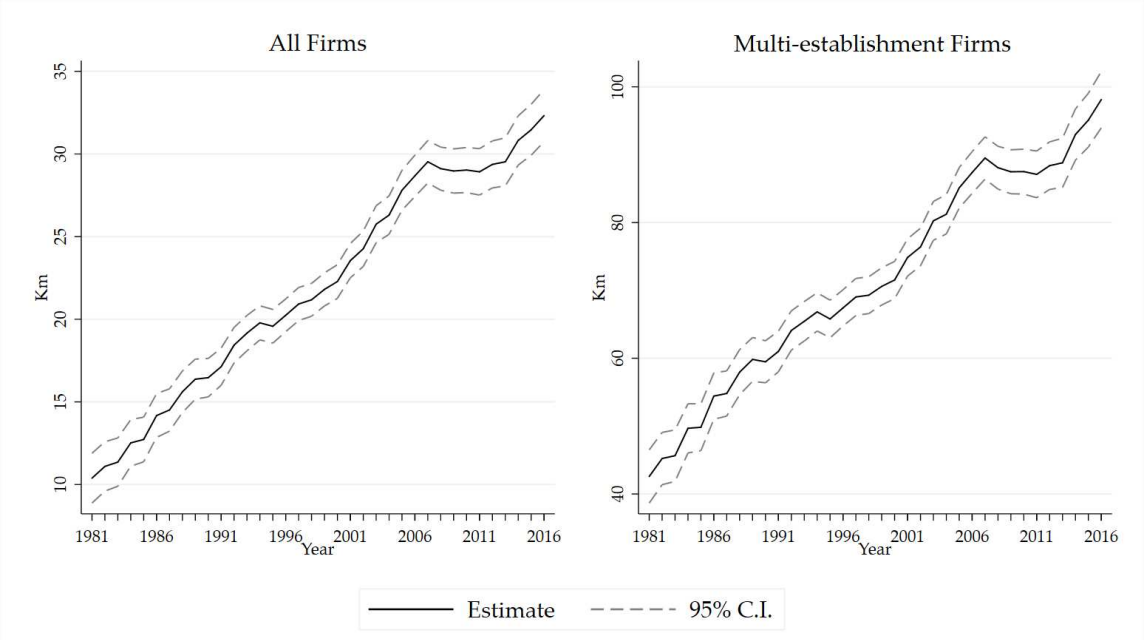


Note: This figure shows the evolution of the total number of establishments by sectors, as the fixed effects (relative to the 1991 value) of a regression of a firm's total number of establishments on year and firm fixed effects.

Figure A4: Average Distance between Establishments and Headquarter for Multi-establishment Firms

Note: This figure shows the year fixed effects from a regression of average distance between the establishments and its headquarters (unweighted and weighted by the total number of workers in the establishment, respectively), for firms that had a multiple establishment at some point between 1981 and 2016, on year and firm fixed effects.

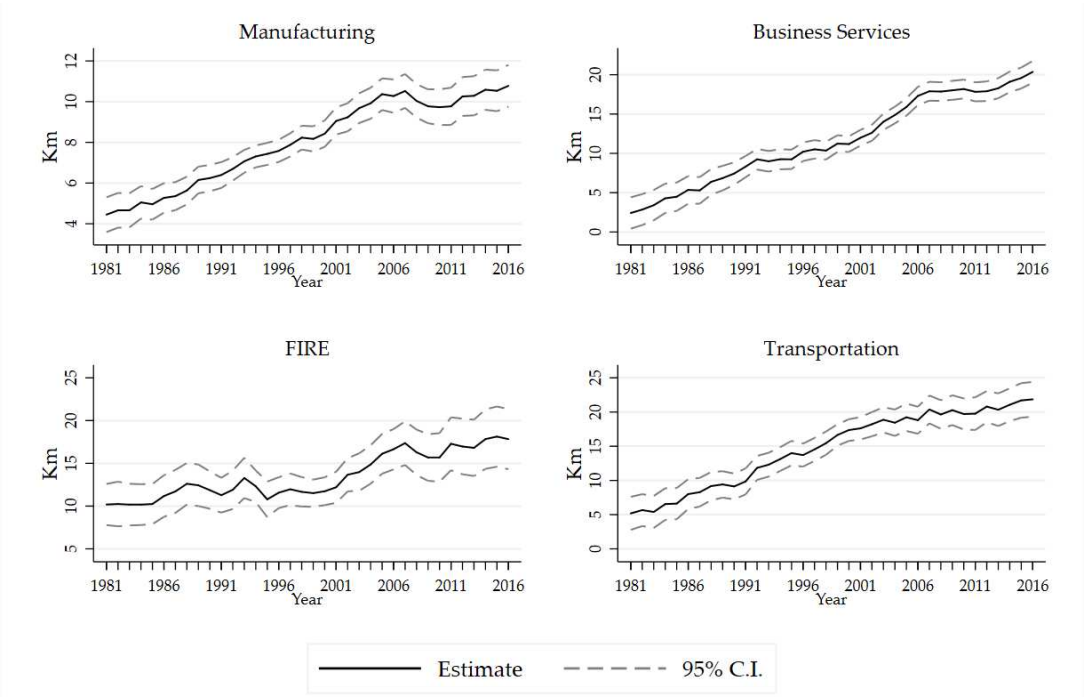
Figure A5: Maximum Distance between Establishments and Headquarters



Note: This figure shows the fixed effects from a regression of maximum distance between the establishments and its headquarters on year and firm fixed effects.

Figure A6: Average Distance between Establishments and Headquarters by Sectors

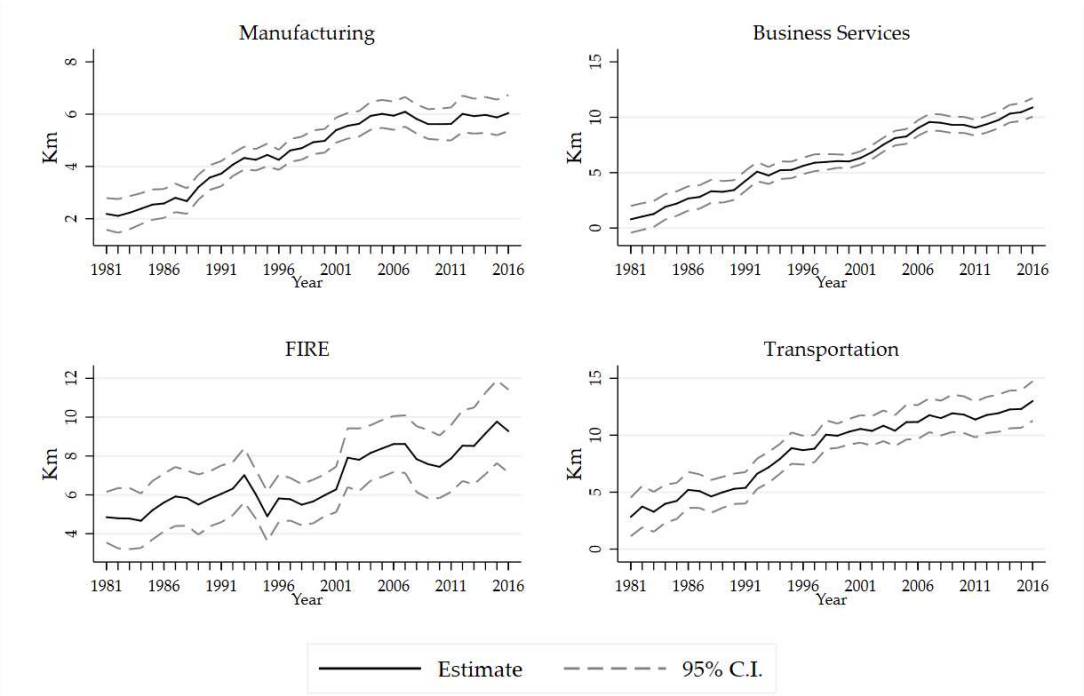
Unweighted



Note: This figure shows the fixed effects from a regression of average distance between the establishments and its headquarters on year and firm fixed effects, by sector.

Figure A7: Average Distance between Establishments and Headquarters by Sectors

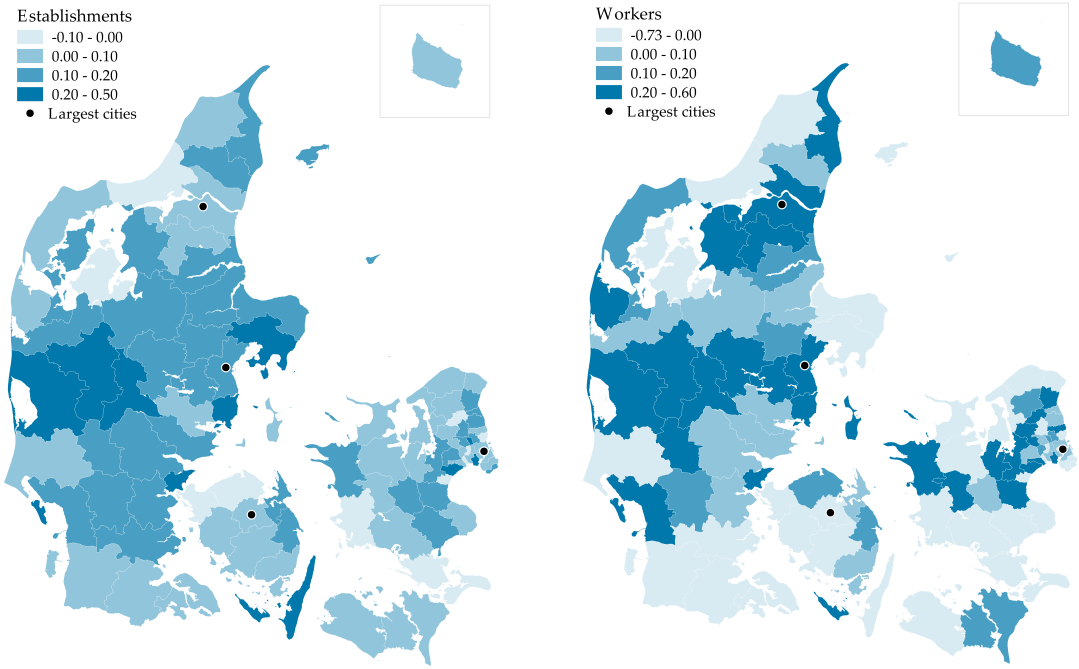
Weighted by Number of Workers



Note: This figure shows the fixed effects from a regression of average distance between the establishments and its headquarters (weighted by the relative number of workers in each establishment) on year and firm fixed effects, by sector.

Figure A8: Changes in the Share of Establishments and Workers

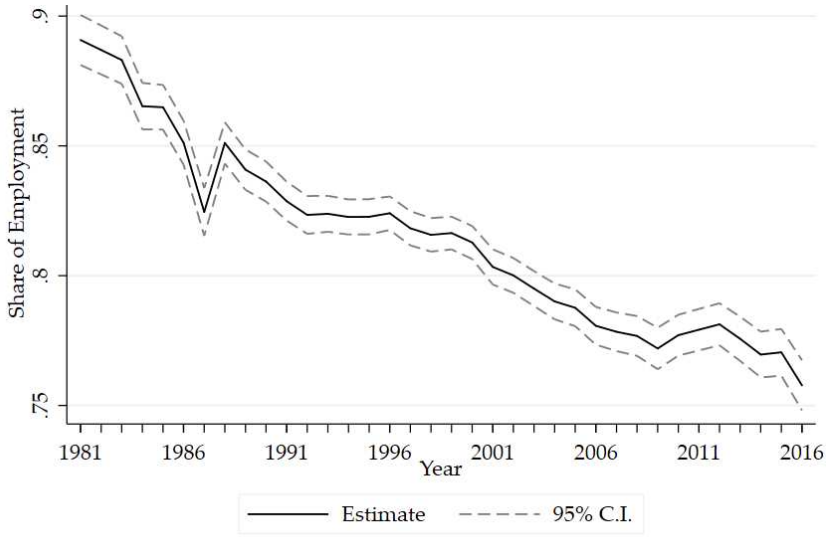
Belonging to Multi-establishment Firms, 1981-2016



Note: This figure shows changes in the share of establishments (left panel) and workers (right panel) belonging to multi-establishment firms. The black dots mark the largest municipalities: Copenhagen, Aarhus, Aalborg and Odense.

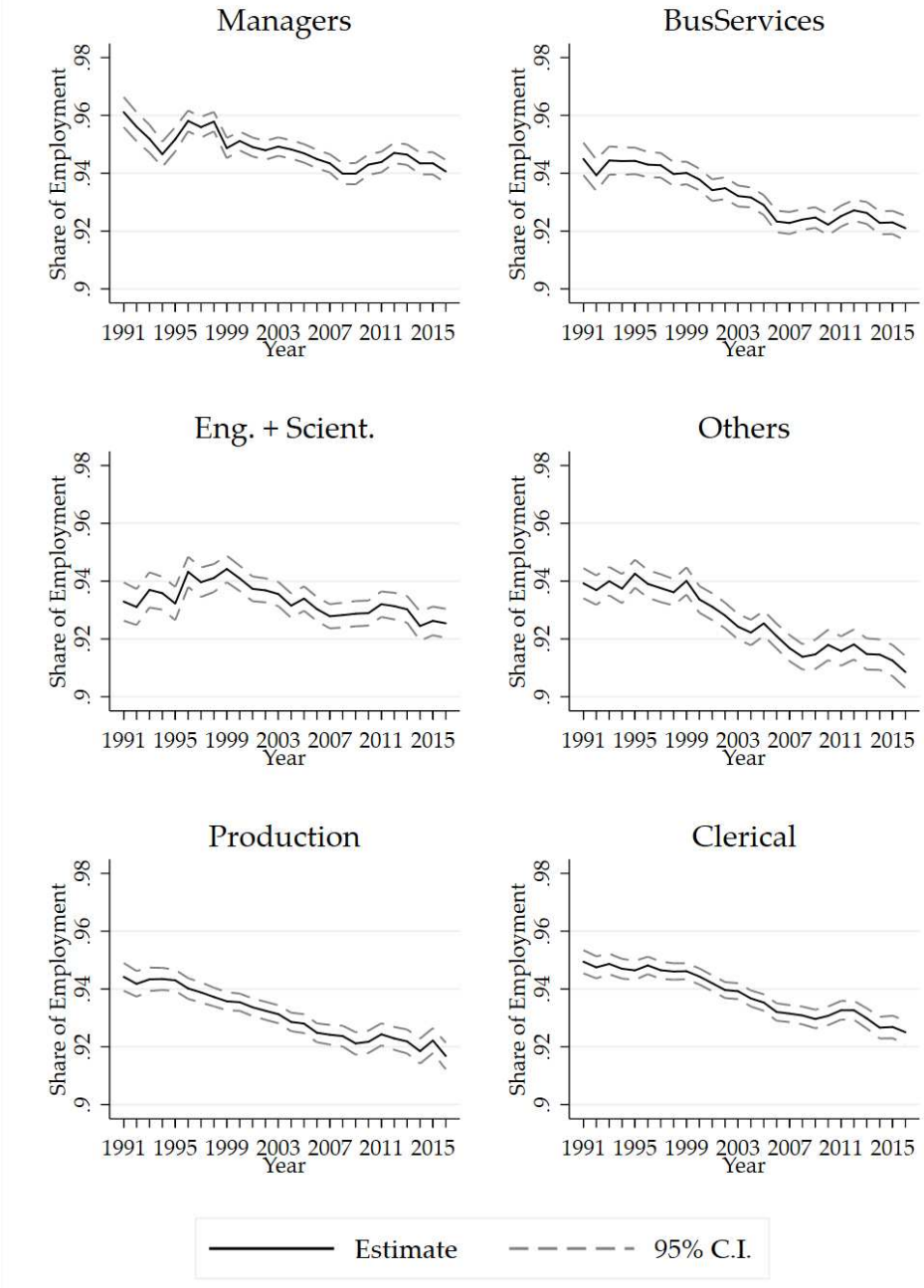
Figure A9: Concentration of Employment at the HQ

for Multi-establishment Firms



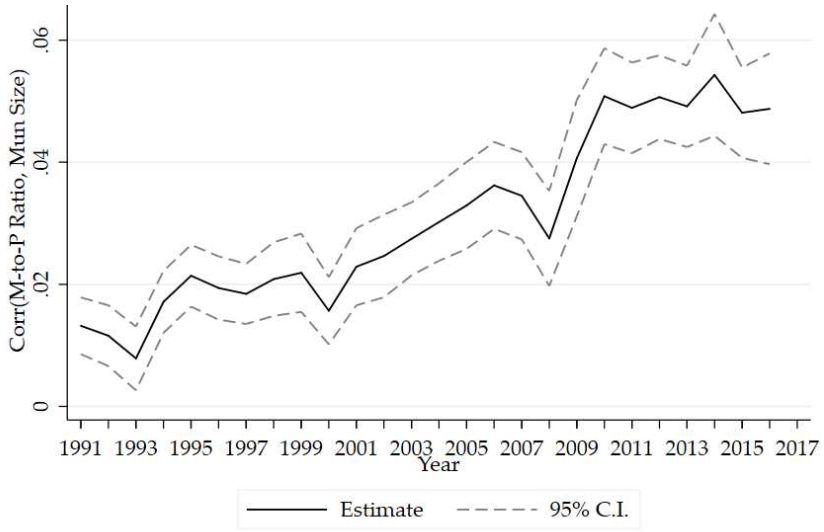
Note: This figure shows the year fixed effects of a regression of the share of employment at the firm's HQ on year and firm fixed effects, only for firms that were multi-establishment at any point in our sample.

Figure A10: Concentration of Employment at the HQ by Occupation



Note: This figure shows the year fixed effects of a regression of the share of employment at the firm's HQ on year and firm fixed effects, for each one of the occupational categories.

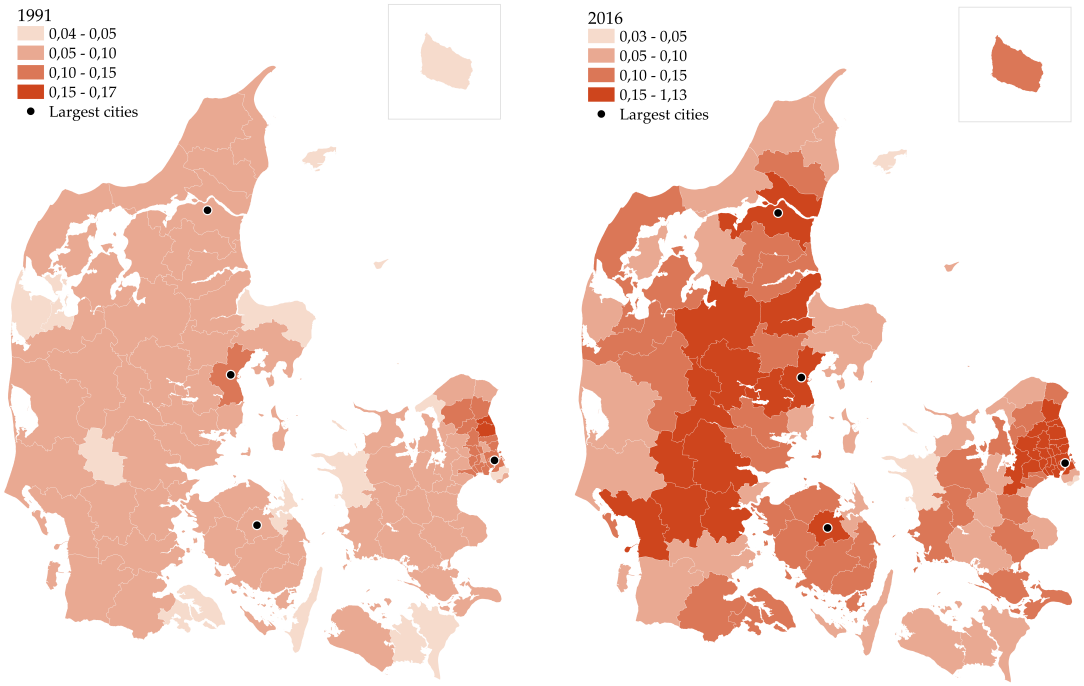
Figure A11: Managers to Production and Clerical Workers, and Municipality Size



Note: This figure shows the yearly correlation from a regression of the establishments' managers to production and clerical workers ratio on year and firm fixed effects, and the size of the municipality where the establishment is located interacted with time fixed effects.

Figure A12: Managers to Production and Clerical Workers Ratio by Municipality

1991 Levels and 2016 Levels



Note: This figure shows the average ratio of managers to production and clerical workers across establishments for each municipality in 1991 (left panel) and in 2016 (right panel). The black dots mark the largest municipalities: Copenhagen, Aarhus, Aalborg and Odense.

B DISCO Categories

In this appendix we describe what occupations belong to each one of the six occupational categories that we use throughout the paper.

Category	**DISCO Codes (ISCO)**
Managers	1000-1999
Production Workers	60-83, 92-93
Business Service Workers	2400-2419, 242, 2440-2449, 3400-3439, 344, 346-347
Clerks	243, 40-52, 90-91
Engineers and Scientists	200, 21, 220-222, 231, 311-312, 32

Finally, we build an "Others" category, which contains every other occupation that is not in any of the previous categories defined above. For example, groups like "Other Associate Professionals", "Primary Education Teaching Professionals" or "Authors, Journalists and Other Writers", among others. This category also includes those workers with a missing DISCO code.

C Estimating Equations

C.1 Number of Establishments

In order to know the evolution of the average number of establishments per firm that we show in Figure 1, we run the following regression:

$$Esta_{ft} = \alpha_f + \delta_t + \varepsilon_{ft}$$

where $Esta_{ft}$ denotes the number of establishments of a firm f in time t, α_f are firm fixed effects and δ_t time fixed effects. For the figures by sector, we ran the previous regression only for firms belonging to each one of the sectors.

For the results we show in Table 1, we run the following logistic regressions for columns 1 to 4, respectively:

$$\begin{aligned}
Open_{ft} &= Close_{ft} + \alpha_f + \delta_t + \varepsilon_{ft} \\
Open_{ft} &= Close_{ft} + Close_{f,t-1} + Close_{f,t-2} + Open_{f,t-1} + Open_{f,t-2} + \alpha_f + \delta_t + \varepsilon_{ft} \\
Close_{ft} &= Open_{ft} + \alpha_f + \delta_t + \varepsilon_{ft} \\
Close_{ft} &= Open_{ft} + Open_{f,t-1} + Open_{f,t-2} + Close_{f,t-1} + Close_{f,t-2} + \alpha_f + \delta_t + \varepsilon_{ft}
\end{aligned}$$

where $Open_{ft}$ is a dummy variable that equals to 1 if a firm opened an establishment in period t, and $Close_{ft}$ equals to 1 if a firm closed an establishment in period t.

C.2 Distance to HQ

In order to know the evolution of the average distance of establishments to their HQ that we show in Figure 2, we start by defining it as:

$$\bar{D}_{ft} = \frac{1}{E_{ft}} \sum_{j} dist_{j,HQ}$$

where $\bar{D}_{ft}$ denotes the average distance between the firm's establishments and its HQ, E_{ft} denotes the number of establishments of a firm f in time t, and $dist_{j,HQ}$ the distance of a particular establishment j to their HQ. We also define a weighted version of this distance, where the weights are the relative size of each one of the establishments:

$$\bar{D}_{ft} = \sum_{j} dist_{j,HQ} \left(\frac{L_{jt}}{L_{ft}} \right)$$

where L_{jt} is the total employment in establishment j and L_{ft} is the total employment in the firm at time t. We then run the following regression for these two variables:

$$\bar{D}_{ft} = \alpha_f + \delta_t + \varepsilon_{ft}$$

where $\bar{D}_{ft}$ denotes either one of the average distance variables defined above. For the figures by sector, we run the previous regression only for firms belonging to each of the sectors.

For Figure 5 we run the same regression, but the dependent variables are defined as:

$$\bar{Dist}_{ft} = \sum_{j} dist_j \left(\frac{L_{ojt}}{L_{oft}} \right) \tag{2}$$

where L_{ojt} is the total employment of occupation o in establishment j and L_{oft} is the total employment of occupation o in the firm at time t.

C.3 Share of Employment at the HQ

In order to know the evolution of the share of workers employed at the firm's HQ that show in Figure 4, we run the following regression:

$$\frac{L_{HQ,t}}{L_{f,t}} = \alpha_f + \delta_t + \varepsilon_{ft}$$

where α_f are firm fixed effects and δ_t time fixed effects. For the figures by occupation, we compute the shares for each occupation and run the previous regression for each one of them.

C.4 Team Size

In order to know the evolution of the ratio of managers to production and clerical workers that show in Figure 6, we run the following regression:

$$\left(\frac{M}{P+C}\right)_{jft} = \alpha_f + \delta_t + \varepsilon_{jft}$$

where j denotes an establishment, α_f are firm fixed effects and δ_t time fixed effects. For Figure 7, we run the same regression but include a year specific fixed effect for each one of the municipality groups:

$$\left(\frac{M}{P+C}\right)_{jft} = \alpha_f + \delta_{c,t}\mathbf{1}_{\{j,CPH\}} + \delta_{a,t}\mathbf{1}_{\{j,Aarhus\}} + \delta_{a,t}\mathbf{1}_{\{j,Rest\}}\varepsilon_{jft}$$

where $\mathbf{1}_{\{j,X\}}$ is an indicator function that equals to 1 if the establishment j is located in $X \in \{CPH, Aarhus, Rest\}$, and CPH denotes Copenhagen metropolitan area, which we defined as the municipality of Copenhagen, its surroundings and Northern Zealand. Finally, for Figure A11, we run:

$$\left(\frac{M}{P+C}\right)_{jft} = \alpha_f + \delta_t + \beta_t \log(N_{jt}) + \varepsilon_{jft}$$

where $\log(N_{et})$ denotes logarithm of the number of the workers in the municipality where the establishment j is located.

C.5 Decomposition of Distance by Occupation

For the decomposition presented in Table 2, we take equation (2)

$$\bar{D}_{ft} = \sum_j dist_j \left(\frac{L_{jt}}{L_{ft}}\right) = \sum_j dist_j \left(\frac{\sum_o L_{ojt}}{L_{ft}}\right)$$

where o denotes an occupation. Multiplying and diving inside the summation by the number of people of an occupation o inside the firm L_{oft}, we can rewrite this expression as:

$$\bar{D}_{HQ,t} = \sum_o \frac{L_{oft}}{L_{ft}} \left[\sum_j dist_j \left(\frac{L_{ojt}}{L_{oft}}\right)\right] \equiv \sum_o \left(\frac{L_{of}}{L_f}\right)_t \bar{D}^o_{ft} \tag{3}$$

which is Equation (3) from the text. To find out the contribution of each occupational category to the average distance of the workers to their HQ, we run the following regression for each occupation o:

$$\bar{D}^o_{ft} = \alpha_f + \delta^o_{decomp,t} + \varepsilon_{ft}$$

Then, we use the estimate of the year fixed effects as the predicted average value of $\hat{\bar{D}}_t^o = \hat{\delta}^o_{decomp,t}$ for each occupation.

To further decompose each occupation's contribution between the firm's relative use of the occupation and the average distance of workers from this occupation to their HQ, we start by running a regression:

$$\frac{L_{oft}}{L_{ft}} = \alpha_f + \delta^o_{use,t} + \varepsilon_{ft}$$

Similarly, we use the estimate of the year fixed effects as the predicted average value of the relative use of each occupation $\frac{\hat{L_{ot}}}{L_t} = \hat{\delta}^o_{use,t}$. Finally, we compute the predicted average distance of workers in an occupation o to their HQ as $\hat{\bar{Dist}}_{ot} = \hat{\delta}^o_{dec,t}/\hat{\delta}^o_{use,t}$. Using these predicted averages, we can define for each occupation and year:

$$\hat{\bar{D}}_t^o = \frac{\hat{L_{ot}}}{L_t} \cdot \hat{\bar{Dist}}_{ot}$$

In particular, consider the change in $\hat{\bar{D}}^o$ between 1991 and 2016:

$$\Delta_{25}\hat{\bar{D}}^o \equiv \hat{\bar{D}}^o_{2016} - \hat{\bar{D}}^o_{1991} = \frac{\hat{L_{o,2016}}}{L_{2016}} \cdot \hat{\bar{Dist}}_{o,2016} - \frac{\hat{L_{o,1991}}}{L_{1991}} \cdot \hat{\bar{Dist}}_{of=,1991} \tag{4}$$

Adding and subtracting $\frac{\hat{L_{o,1991}}}{L_{1991}} \cdot \hat{\bar{Dist}}_{of,2016}$ to the right-hand side of the equation, we can rewrite it as:

$$\Delta_{25}\hat{\bar{D}}^o = \Delta_{25}\left(\frac{\hat{L_o}}{L}\right) \cdot \hat{\bar{Dist}}_{o,2016} + \Delta_{25}\hat{\bar{Dist}}_o \cdot \frac{\hat{L_{o,1991}}}{L_{1991}} \tag{5}$$

We use Equation (5) to decompose the contribution of each one of the occupational categories into two parts: the changes in the relative use of the occupation, and the changes in the average distance of workers of this occupation to their HQ. Alternatively, we could add and subtract $\frac{\hat{L_{o,2016}}}{L_{2016}} \cdot \hat{\bar{Dist}}_{of,1991}$ to the right-hand side of equation (4). The results obtained from this alternative decomposition are very similar to the ones we show in Table 2.