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D4.2.3

Location patterns of business agents in the rural-urban system

Detecting the presence of agglomeration economies: quasi-experimental evidence

Gabriel Pons Rotger* (AKF)

*Responsible partner and corresponding author
Tel: +44 43333439; Email: gpr@akf.dk

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Contents

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Abstract

The aim of this study is to detect the possible presence of agglomeration economies at four selected industries present at rural and peri-urban regions. The local economic impact of land use change due to a local increase on economic activity within particular sectors is assessed by means of quasi-experimental econometric analysis. We use a unique employee-employer data set in conjunction with road distance software data to estimate the effects of agglomeration on productivity and employment propensity of employees of workplaces located close to the land use change.

We argue that our empirical strategy solves the important endogeneity issue arising from the fact that most productive establishments and employees are overrepresented in clustered areas.

We find evidence that new local economic activity increase productivity and local labour market pooling for employees of the Furniture manufacturing industry. Productivity effects are heterogeneous suggesting that the benefits of localisation economies are primarily enjoyed by the most productive and experienced workers, including high-ranking or executive employees, who are also those agents who decide location. Employment effects suggest that the benefits of labour market pooling are mostly enjoyed by mobile workers. However, we find no evidence of increased productivity or improved local labour market one year after the treatment year for the employees of Wood processing industry and Sale of motor vehicles. Finally, we find positive but statistically insignificant effect on employees of Repair of motor vehicles.

Classification of results / outputs:
For the purpose of integrating the results of this deliverable into the PLUREL Explorer dissemination platform as fact sheets and associated documentation please classify the results in relation to spatial scale; DPSIR framework; land use issues; output indicators and knowledge type.

Spatial scale for results: Regional, national, European	Regional,National
DPSIR framework: Driver, Pressure, State, Impact, Response	Pressure, Impact
Land use issues covered: Housing, Traffic, Agriculture, Natural area, Water, Tourism/recreation	Natural area,Industry
Scenario sensitivity: Are the products/outputs sensitive to Module 1 scenarios?	No
Output indicators: Socio-economic & environmental external constraints; Land Use structure; RUR Metabolism; ECO-system integrity; Ecosystem Services; Socio-economic assessment Criteria; Decisions	Socio-economic assessment Criteria
Knowledge type: Narrative storylines; Response functions; GIS-based maps; Tables or charts; Handbooks	Response functions, Tables,

How many fact sheets will be derived from this deliverable:	1

Introduction

This report contributes to the understanding of the economic impact of land use change due to a local increase of economic activity at different industries. Concretely, we consider the Wood processing industry, mainly present at rural region; and Furniture manufacture and Sales and Repair of Motor which are mainly present at peri-urban regions. We assess the productivity and local labour market impact of land use changes due to the increase of number of establishments in the neighbourhood of previously existing establishments. Due to the endogeneity of business land use decisions, e.g. entrepreneurs located where they expect highest profit, we argue that quasi-experimental method is most suitable to evaluate the economic impacts of this type of land variation.

This deliverable is devoted to assessing economic impacts of industrial land use changes on established industry. The positive economic impacts of land-use change due to increased agglomeration of economic activity, is referred as agglomeration economies (Marshall, 1920). The objective of this work package is to detect the possible presence of agglomeration economies for the selected industries and discuss their implications. The findings of this empirical study will contribute to PLUREL Agent-based model "ABM*Land*" which incorporates the decision making process of households and key stakeholders on land use issues ((e.g. lobbying, decisions of developers and city planners, businesses, infrastructure providers)) at local and regional scale. The presence of agglomeration economies and their geographical attenuation (Rosenthal and Strange, 2008) are relevant for three groups of agents: individuals who seek optimal matches with employers, business who seek most productive locations, and local planners, who seek to create or maintain "competitive" environments to attract firms.

The geographical concentration of individual industries is a common feature of developed countries. Certain locations have favourable climate, raw materials, transport infrastructures, local services or tax differentials, which make them attractive to specific sectors. Figures A1 and A2 in the appendix present employment shares for 2004 at postal code level for the Wood processing and Furniture manufacturing industries. These maps demonstrate that both industries are disproportionately located in West Jutland, but also that many locations, particularly on Zealand, have no employment in these sectors.[1] The Furniture manufacturing and Wood processing industries have special needs for wood, and many locations outside West Jutland have access to this raw material. Figures A3 and A4 in the appendix show the distribution of establishments for the Sale and Repair of motor vehicles sectors. As these maps illustrate, these industries are much more spread out than Furniture and Wood processing, with establishments in practically every county. However, the maps also show that activity tends to concentrate at particular locations. In

[1] Employment shares correspond to employees of establishments with at least 10 employees.

the case of Sale of motor vehicles, there are different areas, such as West Zealand, West Jutland and North Jutland, where we do not find any establishments with at least 10 employees, while in other areas, like South Zealand, Central Jutland and South Jutland, it is possible to find several neighbouring postal codes with high concentrations of establishments trading with motor vehicles. Thus, the concentration of activity at these industries suggests that there are benefits to agglomeration that might counteract other forces like natural advantages in the wooden and furniture sectors or transportation infrastructure in the case of motor vehicles.

This paper seeks to determine the role of externalities to production for location of these industries. As is discussed by Marshall (1920), firms may benefit from proximity to other businesses engaged in similar activities,[2] due to the presence of externalities to different markets, e.g. the input market, the labour market and the knowledge market (see Duranton & Puga 2004). In the first instance, businesses locate near each other in order to enjoy the benefits of sharing indivisible goods or intermediate inputs. The concentration of manufacturers attracts input suppliers to locate in the area which, due to the scale of production, can offer specialised services and reduced transport costs.

Agglomeration of similar firms may be characterized by a local labour market where employees and employers are more likely to find their optimum match, such that agglomeration improves the chances of matching and improves the quality of matches. Industrial clusters facilitate the creation of pools of specialised workers who acquire specific skills valuable to the businesses located in the cluster. A larger labour pool permits workers to move to more productive firms when there are shocks.

Finally, businesses which locate near one another learn from each other, increasing their rate of innovation. A classic example of this is the software industry in Silicon Valley (see Saxenian 1994).

The empirical evidence on agglomeration economies has progressed in the 2000's due to the availability of better micro data but the endogeneity problem due to the disproportionate presence of most productive entrepreneurs at agglomerated areas is still an unsolved challenge (see Rosenthal & Strange 2004). Due to the difficulty of estimating the effects of agglomeration on total factor productivity at manufacturing plant level, recent studies adopt indirect approaches trying to detect the presence of agglomeration economies by considering the impact of agglomeration on individual productivity (see Freedman 2008) or by assessing the effect of agglomeration on establishment births (see Arzaghi & Henderson 2007).

However, a common weakness of these approaches is that statistical inference is not based on a causal model. As discussed in the following section, establishments located in agglomerated areas constitute a selected group. The estimation of production functions or individual productivity may therefore potentially suffer from

[2] A different source of externality which is not explored in the paper is the level and diversity of economic activity in their neighbourhood (Jacobs 1969).

endogeneity bias. This paper adopts a causal inference approach to the detection of agglomeration economies, by estimating the effect of an increased number of manufacturing plants in the 'neighbourhood' on the earnings of the employees from already established manufacturing plants. We argue that the increase in number of neighbouring manufacturing plants in the same sector can be considered an exogenous shock to the level of agglomeration. This paper is, to our knowledge, the first in economic literature to analyse the effects of agglomeration by means of a quasi-experimental approach.

We adopt an indirect approach, measuring the effect of agglomeration on the earnings and employment propensity of individuals. The estimation of the effect of agglomeration directly on manufacturing plant productivity assumes that agglomeration enhances input productivity proportionally, e.g. Hicks neutral technology. However, because production externalities arise due to knowledge spillover and a labour pooling, it is more realistic not to restrict productivity effect.

Determining the presence of agglomeration economies is relevant to local planners who seek to create 'competitive' business environments and who are interested in the multiplier effects of local development policies, such as attracting key businesses or promoting industrial areas. Finally, the presence of agglomeration economies is relevant to business location decisions, which may decide between locating a new manufacturing plant in a downtown area or in an edge city where other related plants are located.

The present paper is organised as follows: Section 2 reviews the empirical literature on agglomeration economies. Section 3 describes the data used in this study. Section 4 discusses the empirical approach used in the paper and presents the main empirical results. Section 5 summarises and draws conclusions. The appendix contains figures and tables not included in the main text.

Empirical Literature

Empirical literature on the impact of agglomeration economies either examines the direct effect of the density of related economic activity on the total factor productivity of establishments (e.g., Henderson 2003; Martin et al. 2008) or measures the implications of externalities in terms of employment growth (Glaeser et al. 1992; Henderson et al. 1995), wage gains (e.g. Glaeser & Maré 2001; Wheaton & Lewis 2002; Freedman 2008), on new establishment births and survivorship (Carlton 1983; Rosenthal & Strange 2003; Arzaghi & Henderson 2007; Burger et al. 2008) or on industrial rents (see Dekle & Eaton 1999).

Direct and indirect approaches share a common challenge: the self-selection of establishments in particular areas. The direct method aims to estimate the contribution of geographical, time and industrial dimensions of agglomeration economies to total factor productivity with establishment-level data. For that purpose, assumptions concerning the form of production function and need to be adopted. In addition to relying on such conditions, many data sets lack reliable information on inputs. For the most part, data on materials produced internally, land use and stock of capital are typically not available (see Rosenthal & Strange 2003).

Recent studies have adopted more indirect approaches. In the 1990s, several authors, including Glaeser et al. (1992), Henderson et al. (1995) and Ciccone & Hall (1996), have studied the link between agglomeration and local growth. Implementing this approach requires long panels, can be subject to aggregation bias and cannot deal with the geographical attenuation of agglomeration economies (see Rosenthal & Strange 2003).

A different approach considers new establishments (see Carlton 1983; Rosenthal & Strange 2003; Arzaghi & Henderson 2007). In the case of manufacturing plant births, environmental conditions can be treated as exogenous. However, in highly concentrated industries like wooden or furniture industries, there will be many locations (postal codes or Metropolitan Statistical Area (MSA) with zero births.

Finally, the most explored approach in recent empirical literature is the assessment of the agglomeration effect on labor productivity (see Glaeser & Maré, 2001; Wheaton & Lewis 2002; Freedman 2008). The main reasoning is that businesses which cluster with others in the same industry may enjoy higher productivity due to labour pooling and knowledge spillover. In this case, it is possible to determine the extent to which different types of employees benefit from the existence of industrial clusters. A relevant issue for assessing the effect of agglomeration in terms of wages is the possibility that higher wages only come with time. Initial earning levels among workers may even be lower in anticipation of higher earnings growth later (see Freedman 2008). This suggests that empirical methods should allow for lagged impact of agglomeration on employee productivity.

An important challenge for both direct and indirect approaches is endogeneity. In the instance, agglomeration economies are at play, most productive businesses will be

overrepresented in agglomerated areas and the effect of agglomeration economies will be overestimated. Henderson (2003) addresses the endogeneity of agglomeration by including MSA-level and manufacturing plant-level time invariant effects.[3] However, in this context, it is still possible that the presence of a manufacturing plant in a given MSA for a particular time period is entirely by choice on behalf of the company.

Ideally, the effect of agglomeration economies should be assessed by comparing the performance of establishments in agglomerated areas with identical establishments located in less agglomerated areas by means of an experimental approach. For obvious reasons, a randomised trial approach of this type is not feasible. Alternatively, this paper applies a quasi-experimental method based on the assumption that new establishments in the proximity of existing manufacturing plants can be seen from the point of view of the individual employee at the 'old' establishment as an exogenous variation at the level of agglomeration. Given this mechanism and the availability of a rich data set on employees-employers, including precise information on road distance among establishments, we argue that it is possible to identify the causal effect of increased agglomeration on employee productivity, and use causal inference on the agglomeration effect on employees' productivity as evidence on agglomeration effect on establishments.

[3] Henderson also attempted to use instrumental variable methods (2SLS and GMM), however instruments were found to be weakly correlated with agglomeration.

Data

Sources and Variables

Data for this analysis are in the form of merged administrative registers which combine information at the individual, establishment and firm level, providing longitudinal employee-employer data covering 2004-2006. We have chosen to concentrate on the Wood processing, Furniture manufacturing, Sale of motor vehicles and Repair of motor vehicles industries because they are represented by a relatively large number of establishments with at least 10 employees and because Wood and Furniture are, to a great extent, geographically organised in industrial clusters with similar spatial patterns, while Sale and Repair of motor vehicles present a more disperse distribution, but with the relative degree of activity still concentrated around many different locations. A priori and due to the importance of innovation and design in the Danish Furniture manufacturing, we would expect more evidence of agglomeration for the Furniture establishments than for the other industries.

The data cover 100 per cent of establishments with at least 10 employees (as of the last week of November) in the sectors of Wood processing, Furniture manufacturing, Sale of motor vehicles and Repair of motor vehicles. The data set includes a random sample of 10 per cent of the individuals employed at these establishments. Establishment and business data comprise extensive annual accounts information (covering the tax year May to April as reported to Danish tax authorities) on sales, input costs, investments, inventories, assets and liabilities.[4] Additional information on establishments is obtained from workplace register IDAS, including establishment full-year equivalents, number of employees as of the last week of November, number of other establishments within the same business and payroll data for all employees.

Individual data on workers have been obtained from the family information register FAFA, from which we obtained figures on number of children; the household and family information register FAIN, from which we obtained figures on partner status, age, gender and municipality of residence; the immigration status register IEPE, from which we obtained figures on ethnic status; and the income register INDK, from which we obtained figures on socioeconomic status, gross personal income, personal assets, liabilities and individual earnings. We supplement personal information with data from the personnel register IDA, which includes year of employment at the workplace, number of days employed, level of previous

[4] A potential problem with workplace information concerns firms with multiple workplaces. Since a firm is defined by its juridical level and information from tax authorities is collected at this level only, some information from annual accounts is distributed across workplaces by Statistics Denmark according to a standard key and may thus be susceptible to measurement error.

unemployment, job category and job change with respect to the previous year and with respect to the following year. Educational information has been obtained from the education register UDDA.

Our key register has been the integrated database for labour market research – business register FIDA, which contains workplace figures and personal figures to link employee variables with employer workplace variables. The FIDA file contains all employment relationships in the industries studied for the last week of November, thus permitting us to match establishments and employees in the last week of November in each year to build up our 2004-2006 panel.

Similar to Rosenthal & Strange (2003; 2008) we construct ring variables linked to the establishments in the industries in question, informing on the number of establishments within a distance *a-b* to the establishment of interest. To do so, road distance software has been used to compute a matrix of distances for each of the establishments with at least 10 employees in the industries of interest with other establishments in the same general industry and with establishments in related industries. Distances have been computed within a maximum road distance of 30 km. Initially, nine ring variables have been constructed (i.e. within 100 metres, between 100 and 500 metres, between 500 and 1,000 metres, between 1,000 and 5,000 metres, between 5,000 and 10,000 metres, between 10,000 and 20,000 metres and between 20,000 and 30,000 metres).[5]

We compared the earnings and employment propensity of employees at establishments which in 2005 experienced an increase in number of establishments in the same sector located in their neighbourhood. For the Wood and Furniture sectors, the neighbourhood is delimited to a hypothetical circle where the radius is a road distance of 10 km, while the neighbourhood for Repairs and Sales is smaller, i.e. with a road distance radius of 5 km. By doing so, and by not considering a geographical circle, we have been able to take into account variations in transport facilities across different locations. In the case of the Wood processing industry, the 'treatment group' comprises 185 employees and the control group 650. In the case of the Furniture industry, the treatment group comprises 288 employees and the control group 1,258. In Sale of motor vehicles, our sample includes 1,166 individuals in the treatment group and 1,158 in the control group. Finally, in Repair of motor vehicles, the treatment group comprises 511 employees and the control group 1,836.

The effect of agglomeration economies is measured in terms of annual earnings and the employment propensity of employees at the establishments in the treatment group one year after the variation in neighbourhood. In the process, we allow a delay of up to one year with regard to earnings impact. As is discussed in Freedman (2008), wage increases due to labor market pooling or knowledge spillovers may be

[5] Related sectors defined in terms of industrial proximity are delimited according to the Input/Output Table from 2005 (see I/O Table, Statistics Denmark 2005). See the appendix for the composition of related sectors.

experienced with delay, such that the effect of new establishment(s) may take some time due to rigidities in the local labour market and knowledge market.

Descriptives

Table 3.1 provides basic descriptives at agglomeration level in the industries studied, complementing the visual information provided in figures A1 through A4 in the appendix. The figures illustrate that the Wood and Furniture industries are much more concentrated than the Motor vehicle-related industries in terms of their distribution across the country. However, Table 3.1 demonstrates that Motor vehicle-related establishments are more closely clustered to similar establishments than is the case for Wood-related industries. This is particularly clear in the case of Sale of vehicles, where 19 per cent of establishments with at least 10 employees are located 100 metres from a similar establishment in terms of road distance, while 87 per cent of this type of establishment is located within 1,000-5,000 metres of a similar establishment. This contrasts with Wood processing, where only 28 per cent of establishments have similar neighbours within a radius of 1,000-5,000 metres. Furniture establishments deviate in terms of localisation with respect to Wood processing plants. Furniture manufacturers tend to have neighbours within a distance of 1,000 metres. In this instance, 56 per cent of this type of manufacturing plant is located between 1,000-5,000 metres from a similar plant. The case of Repair of motor vehicles is not as extreme as Vehicle sales. However, the density of similar establishments is still much higher than for Wood and Furniture-related manufacturing plants. For example, 33 per cent of establishments which repair motor vehicles are located within 100-500 metres of a similar establishment.

Table 3.1 Frequency of establishments with similar neighbours

Neighbourhood	Wood processing	Furniture	Sale of vehicles	Repair of vehicles
0-100 m	0.04	0.05	0.19	0.07
100-500 m	0.10	0.17	0.47	0.33
500-1 km	0.11	0.22	0.50	0.38
1 km-5 km	0.28	0.56	0.87	0.73
5 km-10 km	0.54	0.71	0.74	0.75

The differences in terms of local clustering suggest a need to define our treatment event differently for each pair of industries. Consequently, we considered agglomeration variation for Wood industries within a road distance radius of 10 km , while we considered a smaller radius of 5 km for Motor vehicle-related industries.

We motivate our empirical analysis in table 3.2, which presents basic descriptive statistics for establishments broken down by whether they are located with similar neighbours in agglomerated areas or without similar neighbours. This table presents

the general picture that manufacturing plants with similar neighbours differ from 'isolated' plants. Clearly, and due to the way we delimitate isolation, more plants from these industries are located in agglomerated areas. The most relevant difference between the two groups of plants is that average earnings are higher for those employees working in clusters. Larger establishments tend to be more highly clustered in the Wood processing and Sale of motor vehicles industries, while the Furniture and Repair sectors tend to be less highly clustered. Job change rates are slightly higher for employees working in clustered establishments in all industries except Repair of motor vehicles.

Table 3.2 Summary statistics for establishments

	Plants with neighbours	Plants without neighbours
Wood processing		
Average earnings 2004	251	242
Job changes 2004	0.35	0.33
Number of employees 2004	58	52
Establishments >10 employees	146	52
Furniture manufacturing		
Average earnings 2004	251	223
Job changes 2004	0.31	0.29
Number of employees 2004	53	57
Establishments >10 employees	231	44
Sale of motor vehicles		
Average earnings 2004	262	225
Job changes 2004	0.40	0.38
Number of employees 2004	27	18
Establishments >10 employees	663	67
Repair of motor vehicles		
Average earnings 2004	264	199
Job changes 2004	0.37	0.37
Number of employees 2004	20	22
Establishments >10 employees	308	70

Notes: Average earnings measured in 1000 2004 DKK. Wood processing and Furniture manufacturing are considered to have neighbours if the same type of manufacturing plants are found within a road distance of 10 km. Sale and Repair of motor vehicles have neighbours if similar establishments are found within a road distance of 5 km.

Tables 3.3 to 3.6 present panel estimates of the Cobb-Douglas production function under a Hicks-neutral assumption, $y_{it} = \beta_A A_{it} + \beta_N N_{it} + \beta_K K_{it} + \gamma_t + \eta_i + v_{it}$, where y_{it} is the log valued-added of plant *i* in year *t*, A_{it} is a vector of agglomeration economies, N_{it} is the log of full-year equivalent of plant *i* in year *t*, K_{it} is the log capital stock of plant *i* in year *t*, γ_t is a year-specific intercept reflecting common shocks to all manufacturing plants in the industry, η_i is an unobserved time-invariant, plant-specific effect and v_{it} is a productivity shock to plant *i* in year *t*. Agglomeration is measured in terms of the density of manufacturing plants in the same general industry and in terms of the density of establishments of related industries within different rings (0-1 km; 1 km-5 km; and 5 km-10 km).

We then estimate the contribution of these agglomeration measures, which are deflated by ring size, [6] to total factor productivity at manufacturing plant level. The estimates presented in these tables do not fully address endogeneity due to more productive establishments are over-represented in the more highly clustered areas, and therefore it is likely the presence of time variant unobservable component correlated with measures of agglomeration. System GMM could be a reasonable approach, however, agglomeration measures are highly persistent, and therefore dynamic instruments are weak (see Blundell & Bond 1998) which precludes the application of this method.[7] The tables present pooled OLS estimates, pooled feasible generalised least squares, Fixed Effects and Random Effects estimates. As can be seen in table 3.3, localisation and urbanisation economies do not seem to contribute to the total factor productivity for establishments in the Wood processing industry. However, in the Furniture industry, there is some evidence that having similar establishments within 10 km is associated with higher plant productivity. In the case of Motor vehicles, we find that the presence of related establishments may have a negative impact on establishment productivity.

All in all, the results obtained for estimating plant production functions do not seem to indicate that agglomeration economies play an important role for the industries of interest, once we control for establishment's input size.

Table 3.3 Production function, Wood processing industry (panel estimation)

Dependent variable: ln (Valued Added)													Sample period: 2004-2006 (594 establishments)		
Independent variables	OLS			PFGLS			FE			RE					
ln (FTE)	0.94	0.03	***	0.98	0.03	***	0.95	0.05	***	0.97	0.03	***			
ln (capital stock & materials)	0.11	0.02	***	0.07	0.02	***	0.06	0.02	***	0.08	0.02	***			
Similar establishments per km^2 within 1 km	0.02	0.15		-0.02	0.05		-0.02	0.06		-0.01	0.05				
Similar establishments per km^2 within 1-5 km	2.59	1.84	*	0.25	0.84		-0.09	1.12		0.43	0.94				
Similar establishments per km^2 within 5-10 km	1.21	3.79		-1.30	1.86		-1.35	2.21		-1.16	2.02				
I/O-related establishments per km^2 within 1 km	0.00	0.04		0.00	0.02		-0.01	0.02		-0.01	0.02				
I/O-related establishments per km^2 within 1-5 km	0.01	0.31		0.17	0.12	*	0.21	0.16	*	0.17	0.14				
I/O-related establishments per km^2 within 5-10 km	-0.21	0.57		-0.64	0.33	**	-0.64	0.25	***	-0.54	0.34	*			
Year 2005	0.05	0.01	***	0.06	0.01	***	0.06	0.01	***	0.06	0.01	***			
Year 2006	0.12	0.03	***	0.09	0.02	***	0.09	0.02	***	0.09	0.02	***			
Constant term	6.05	0.14	***	6.30	0.15	***	6.55	0.20	***	6.27	0.15	***			

[6] To control for differences in ring size, the number of establishments within the different rings is deflated by ring area in km^2.

[7] We attempted to use lags and lagged differences of agglomeration measures as instruments in a sys GMM method, but the instruments were too weak to be reliable.

Table 3.4 Production function, Furniture industry (panel estimation)

Dependent variable: ln (Valued Added)												Sample period: 2004-2006 (825 establishments)
Independent variables	OLS			PFGLS			FE			RE		
ln (FTE)	1.07	0.04	***	1.05	0.03	***	1.03	0.03	***	0.86	0.09	***
ln (capital stock & materials)	0.06	0.03	***	0.06	0.02	***	0.06	0.02	***	0.05	0.02	***
Similar establishments per km^2 within 1 km	-0.01	0.05		-0.02	0.04		-0.01	0.04		-0.01	0.04	
Similar establishments per km^2 within 1-5 km	1.98	1.08	*	0.58	0.58		0.46	0.53		0.04	0.59	
Similar establishments per km^2 within 5-10 km	2.16	1.95		1.89	1.10	*	1.70	1.12	*	1.51	1.27	
I/O-related establishments per km^2 within 1 km	-0.01	0.03		0.00	0.02		0.01	0.02		0.02	0.03	
I/O-related establishments per km^2 within 1-5 km	-0.12	0.18		0.01	0.10		0.00	0.09		0.00	0.12	
I/O-related establishments per km^2 within 5-10 km	-0.14	0.22		-0.29	0.18	*	-0.19	0.17		-0.17	0.20	
Year 2005	0.07	0.02	***	0.07	0.02	***	0.07	0.02	***	0.07	0.02	***
Year 2006	0.14	0.03	***	0.12	0.03	***	0.13	0.03	***	0.12	0.03	***
Constant term	6.01	0.16	***	6.16	0.12	***	6.17	0.12	***	6.92	0.31	***

Table 3.5 Production function, Sale of motor vehicles (panel estimation)

Dependent variable: ln (Valued Added)												Sample period: 2004-2006 (2,190 establishments)
Independent variables	OLS			PFGLS			FE			RE		
ln (FTE)	1.04	0.04	***	1.03	0.03	***	1.03	0.03	***	0.94	0.07	***
ln (capital stock & materials)	0.06	0.02	***	0.06	0.01	***	0.06	0.01	***	0.06	0.01	***
Similar establishments per km^2 within 1 km	0.01	0.03		0.00	0.01		0.00	0.01		-0.01	0.01	
Similar establishments per km^2 within 1-5 km	0.34	0.36		-0.01	0.20		0.00	0.20		-0.12	0.22	
Similar establishments per km^2 within 5-10 km	-0.64	0.97		-0.05	0.51		0.03	0.45		0.26	0.49	
I/O-related Establishments per km^2 within 1 km	-0.05	0.03	*	-0.04	0.02	***	-0.03	0.02	**	-0.03	0.02	*
I/O-related Establishments per km^2 within 1-5 km	0.19	0.19		0.09	0.11		0.12	0.10		0.09	0.12	
I/O-related Establishments per km^2 within 5-10 km	0.69	0.40	*	0.20	0.20		0.07	0.19		-0.13	0.21	
Year 2005	0.07	0.01	***	0.07	0.01	***	0.07	0.01	***	0.08	0.01	***
Year 2006	0.13	0.03	***	0.07	0.02	***	0.07	0.02	***	0.06	0.02	***
Constant term	7.22	0.14	***	7.31	0.12	***	7.30	0.12	***	7.58	0.25	***

Table 3.6 Production function, Repair and maintenance of motor vehicles (panel estimation)

Dependent variable: ln (Valued Added)												Sample period: 2004-2006 (1,041 establishments)
Independent variables	OLS			PFGLS			FE			RE		
ln (FTE)	1.04	0.06	***	0.97	0.05	***	0.97	0.05	***	0.90	0.05	***
ln (capital stock & materials)	0.04	0.03	***	0.06	0.02	***	0.06	0.02	***	0.06	0.03	***
Similar establishments per km^2 within 1 km	-0.09	0.07		-0.06	0.04	*	-0.06	0.03	**	-0.06	0.04	*
Similar establishments per km^2 within 1-5 km	-0.07	0.77		-0.14	0.33		0.02	0.32		0.05	0.35	
Similar establishments per km^2 within 5-10 km	1.48	1.79		0.71	0.94		0.52	0.86		0.24	0.94	
Related establishments per km^2 within 1 km	-0.05	0.03	**	-0.01	0.02		-0.01	0.02		-0.01	0.02	
Related establishments per km^2 within 1-5 km	-0.32	0.25	*	0.05	0.10		0.09	0.09		0.18	0.10	**
Related establishments per km^2 within 5-10 km	-0.08	0.49		-0.30	0.25		-0.30	0.24	*	-0.32	0.28	
Year 2005	0.07	0.02	***	0.08	0.02	***	0.08	0.02	***	0.09	0.02	***
Year 2006	-0.02	0.04		0.04	0.03	*	0.05	0.03	**	0.07	0.03	***
Constant term	6.73	0.20	***	6.68	0.18		6.68	0.17	***	6.83	0.20	***

Empirical Analysis

In this section we introduce the empirical approach used estimate the causal effect of agglomeration. Ideally, the impact of agglomeration economies should be assessed based on a randomised trial where a group of establishments experiences an increase in the number of neighbouring establishments while an identical control group of establishments does not experience a variation in their environment. Any difference in the performance of the two groups of establishments would be attributable to the presence of agglomeration economies.

However, no such experimental data are available. Instead, given the particular sample design and the availability of a very rich data set capturing employee-employer characteristics, we argue that it is possible to identify the effect of agglomeration economies taking a quasi-experimental approach. Observation units i=1,...,N are employees at establishments which during the treatment year experienced an increase in the number of workplaces in the same industry within a particular area delimitated by road distance, i.e., the treatment group includes employees at workplaces which experienced an increase in number of neighbouring manufacturing plants, while the control group includes employees at workplaces which did not experience any variation in the number of manufacturing plants in the same sector. The treatment received by the employee i is represented by the random variable T_i, which can take two values, 1 in the case of an increased number of the same type of plant within a particular road distance (10 km for Wood-related establishments and 5 km for Motor vehicle-related establishments), and 0 in the case there is no variation in the number of similar establishments within the neigbourhood. We measure the effect in terms of annual earnings, and employment frequency, one year after treatment. We assume in the post-treatment year the existence of two potential individual outcomes (earnings and employment), denoted Y_i (1) and Y_i (0), where the first corresponds to the treatment outcome (that realised if any manufacturing plants moved into the neighbourhood of the employee's establishment in 2005) and the second denotes the control outcome (that realised if there is no variation on the number of neighbouring manufacturing plants).

Covariates capturing endogenous selection are measured at the pre-treatment year 2004, in order to avoid the effect of agglomeration on observable confounding variables. As seen in tables A6-A9 in the appendix, there are important differences for all sub-samples between control and treatment employees, which could affect both the outcomes for individuals and the propensity to work in a location with increased agglomeration. In the case of the Wood processing industry, treated employees are younger and work at smaller establishments located in areas with a higher number of establishments within the same or related sectors. In the case of Furniture

manufacturing, treated employees work for plants with a similar number of employees, but which have higher inflow and outflow of both machinery and equipment. Treated employees in Furniture manufacturing tend to reside in a different municipality than that of their workplace. As in the Wood processing industry, the treated Furniture employees work in more highly clustered areas than the control employees. In the case of Sale of motor vehicles, the treated employees have higher earnings and work at larger establishments and in more highly clustered areas than the control employees. Finally, treated employees in the Repair industry, have higher earnings, are more experienced and work at larger establishments located in highly clustered areas.

We use matching to transform the control group according to the covariate distribution of the corresponding treatment group under the selection of observable assumption. The observable outcome for employee *i* can be written as follows $Y_i \equiv T_i Y_i\ (1) + (1 - T_i) Y_i\ (0)$, such that the effect of an increase in terms of agglomeration economies with regard to employee outcome reads $\beta_i = Y_i\ (1) - Y_i\ (0)$, where $Y_i(1)$ is the outcome if there was an increase in number of neighbouring establishments and $Y_i(0)$ is the outcome if there was no environmental change.

Obviously, we face a problem with missing information because we do not observe the counterfactual outcome ($Y_i(0)$) for individuals working in establishments without variation in number of neighbours. Despite this problem, however, it is possible, under certain conditions, to identify the average treatment effects for employees with characteristics $X_i = x$,

$$ATT(x) \equiv E(\Delta_i | T_i = 1, X_i = x)$$

where $T_i = 1$ indicates that the individual *i* has been exposed to new neighbour(s), and X_i is a vector of employee and establishment characteristics which cause both T and $Y_i\ (0)$. In order to highlight the evaluation challenge, let us rewrite $ATT(x)$ as follows:

$$ATT(x) = E(Y_i(1) | T_i = 1, X_i = x) - E(Y_i(0) | T_i = 1, X_i = x).$$

where $E(Y_i(1) | T_i = 1, X_i = x)$ is observable while $E(Y_i(0) | T_i = 1, X_i = x)$ is not and must be estimated with information from controls ($T_i = 0$). In the present paper, we assume strong ignorability of treatment (see Rosenbaum & Rubin 1983), which basically requires that there are no confounding (unobserved) characteristics of the individual that could confound the outcome beyond the observed covariates X_i. In addition, strong ignorability of treatment stresses the necessity of common support between

the treatment and control groups, e.g. $ATT(x)$ is only identifiable for the treated individuals for which we can find suitable controls.[8]

We estimate the average treatment effect for the treated employees:

$$ATT \equiv N_1^{-1} \sum_{i:T_i=1} ATT(x)$$

by means of a matching estimator which can be written in a general form as:

$$\hat{ATT} = N_1^{-1} \sum_{i:T=1} Y_i - \sum_{i:T=0} \omega_i Y_i.$$

where the weights ω_i are obtained as a function of the vector of treatment assignments and the matrix of covariates. The departure of weights from 1 reflects the extent to which the role of a particular control observation is manipulated by the matching procedure to correct for selection. We use propensity score kernel matching. Because of the moderate size of our sub-samples and in order to avoid bad matches, we restrict matches to a limited area around the treated employees. To do this, we use Epanechnikov kernel, such that each treated individual is matched to their closest control in terms of predicted participation. Standard errors are estimated using a bootstrap method.[9]

Table 4.1 Average treatment effect for the treated

Sector	Earnings 2006	Employment 2006
Wood processing industry	-8,293(20,163)	-0.018(0.015)
Furniture manufacturing	16,871(12,124)	0.031(0.016)**
Sale of motor vehicles	-14,332(13,266)	-0.012(0.018)
Repair of motor vehicles	9,440(11,170)	0.015(0.022)

Notes: ** Denotes signigicance at 5%.

Table 4.1 shows the impact of an increase in the number of establishments of the same type in the neighbourhood of the employee's workplace. The primary result is that agglomeration economies are detected in the case of Furniture manufacturing already one year after treatment. There is also some evidence that agglomeration economies may be present in the Repair of motor vehicles sector, but the ATTs are not significant. There is no evidence of agglomeration economies in the Wood processing industry and the Sale of motor vehicles sector.

The top row of table 4.1 presents the effect on employees in the Wood processing industry in terms of annual earnings and employment propensity. Earnings and

[8] In a preliminary draft, we attempted to estimate ATT within a broader set of industries, including Publishing, Machinery Manufacturing, manufacture of food and beverages and the Pharmaceutical industry. However, these samples did, in fact, suffer from serious overlap.

[9] We have used a psmatch2 stata module to perform propensity score kernel matching and to compute bootstrap standard errors.

employment average effects for employees of Wooden industry affected by an increase of establishments at the neighbourhood are negative, but statistically significant. The second row in this table shows the impact of agglomeration on the employees in Furniture manufacturing. The average earnings effect is 16,871 and borderline significant, suggesting that labour productivity increases as a consequence of an increased level of agglomeration.

In the case of employment propensity, the estimate is positive and significant, suggesting that agglomeration enhances the employability of individuals in clustered Furniture manufacture areas compared to those working at more isolated plants. Roughly, the arrival of new furniture plants increases in about 3% of employment frequency of employees of treated areas, suggesting that agglomeration improves facilitates employee-employer matches that would otherwise not take place without the new neighbours.

The third row presents the results for Sale of motor vehicles. In this case, earnings and employment estimates are negative and statistically insignificant. With regard to earnings, the ATT is negative and borderline significant, suggesting that the increase in number of neighbours may reduce employee earnings. Differently from the furniture industry, where most of production is exported or sold outside the boundaries of the cluster, in the case of the motor vehicle sales, similar establishments compete for local consumers, and therefore it is likely that a negative effect reflects downwards pressures on labour costs due to increased competitive environment.

Finally, the bottom row in table 4.1 shows the impact of agglomeration on the employees in the Repair of motor vehicles industry. The ATTs for earnings and employment are positive, but insignificant, suggesting that an increase in agglomeration level does not enhance productivity or labour market pooling for this sector.

Matching estimates of ATT parameter allow the analyses of heterogeneity of the treatment effects with respect to the observable characteristics of employees and their establishments, a possibility that we explore in the case of earnings and employment effects for the furniture sector and which enriches the interpretation of agglomeration effects. This is done by analysing the correlation of estimated individual effects on the characteristics of treatment, employees and establishments. The first column in table 4.2 presents the standardised OLS coefficients obtained from regressing the estimated treatment effects on all covariates included in the propensity score and on the characteristics of treatment, e.g. where the increase in the number of neighbours takes places. As can be seen, only four covariates are significant. The characteristics of earnings, seniority, staff member, high-ranking employee, and executive employee are all positively correlated with earnings effect, suggesting that more productive employees and managers benefit from agglomeration in a major extent than less productive workers, which explains that the average effect is borderline insignificant.

It is also interesting to assess whether productivity gains attenuate with geographical distance in the line of Rosenthal and Strange (2008). However, whether the increase in agglomeration occurs within 5 km or within 5-10 km is not significant for earnings effects, and therefore we conclude the agglomeration economies do not attenuate within 10 km road distance radius.

The central columns in Table 11 present the standardised OLS coefficients for employment effects. In this case, only three characteristics appear to be correlated with the employment effects. When the employee works at a downsizing establishment (in terms of machinery and equipment), the employment effect is lower than the average effect, which seems to suggest that effects of agglomeration are moderate for less healthy establishments.

Our heterogeneity analysis suggests, in addition, that employment effects are not enjoyed in the same extent by less mobile workers. Concretely, in case the employee has a partner or the employee resides close to the workplace, the employment effect is lower than the average effect.

Table 4.2 Heterogeneity of treatment effects with respect to ATT (furniture manufacturing)

	Earnings effect			Employment effect		
Covariate	Std.coef.	P(t)		Std.coef.	P(t)	
Increase of similar establishments within 5 km	-0.06	0.61		0.07	0.72	
Increase of similar establishments within 5-10 km	0.00	0.97		0.03	0.85	
Employee has partner	-0.03	0.61		-0.24	0.02	**
Days employed at current establishment	0.08	0.45		0.02	0.90	
Employee's previous unemployment	-0.06	0.35		0.08	0.40	
Earnings	0.62	0.00	***	0.09	0.48	
Low-educated employee	0.01	0.99		-0.08	0.67	
Medium-educated employee	0.05	0.71		0.02	0.99	
Establishment's full-year equivalent	-1.51	0.51		-1.95	0.58	
Establishment's outflow of machinery & equipment	-0.38	0.47		-1.41	0.08	*
Establishment's total investment	0.37	0.52		0.29	0.74	
Establishment's inventory variation	-0.23	0.39		0.16	0.68	
Establishment's machinery & equipment	-0.42	0.36		0.45	0.52	
Establishment's inflow of real property	-0.09	0.71		-0.55	0.13	
Establishment's energy purchase	0.07	0.84		0.49	0.35	
Turnover	0.02	0.95		-0.04	0.94	
Establishment's inflow of machinery & equipment	0.27	0.67		0.00	1.00	
Number of employees	1.85	0.44		2.03	0.58	
Multi-plant business	0.07	0.57		-0.07	0.71	
Establishment payroll	-0.08	0.97		0.2	0.95	
Seniority	0.12	0.07	*	0.03	0.81	
Employee kept job	-0.07	0.53		0.1	0.55	
Full-time employee	-0.05	0.57		-0.02	0.87	
White-collar worker	0.08	0.33		0.1	0.43	
Staff member	0.26	0.00	***	0.04	0.74	
High-ranking or executive employee	0.14	0.03	**	0.08	0.44	
Employee and establishment in same municipality	0.01	0.84		-0.18	0.08	*
Establishment located in Copenhagen County	0.04	0.71		-0.03	0.84	
Establishment located in Frederiksborg County	0.05	0.67		0.13	0.44	
Establishment located in Funen County	-0.07	0.57		-0.12	0.53	
Establishment located in Vejle County	0.04	0.76		0.03	0.87	
Establishment located in Viborg County	0.00	1.00		-0.13	0.69	
Establishment located in North Jutland County	-0.06	0.61		0.03	0.88	
Number of same establishments within 5 km	-0.13	0.44		0.1	0.69	
Number of same establishments within 5-10 km	0.14	0.42		0.08	0.77	
Number of related establishments within 5 km	0.14	0.45		0.05	0.85	
Number of related establishments within 5-10 km	-0.04	0.85		-0.01	0.97	

Note: Std. coef. denotes standardised regression coefficients of treatment effects on treated employees. P(t) denotes the p-values of t significance test.

Conclusion

This paper contributes to the empirical literature on agglomeration economies by estimating the effect of an exogenous increase in the level of industrial clustering on employees productivity and labour market pooling. We use a unique employee-employer data set in conjunction with road distance software data to identify and estimate the effects of agglomeration on annual earnings and employment propensity. We argue that our empirical strategy solves the important endogeneity issue arising from the fact that most productive establishments and employees are overrepresented in clustered areas when agglomeration enhances productivity. We consider two pairs of industries appearing within similar geographical locations and concentrations: wood related establishments which are highly concentrated at national level, and motor vehicle related business which are much more spread at national level but are highly concentrated at local level.

The results from the Wood processing industry, Sale of motor vehicles and Repair of motor vehicles provide no evidence of the presence of localisation economies. However, we find, in the case of Furniture manufacturing industry, evidence that localisation economies increase employee productivity and facilitate labour market matching between employees and employers. Our results suggest that the benefits of localisation economies are primarily enjoyed by the most productive and experienced workers, this including staff, high-ranking and executive employees.

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Appendix

Figure A1: Wood processing industry, distribution of 2004 employment share at postal code level

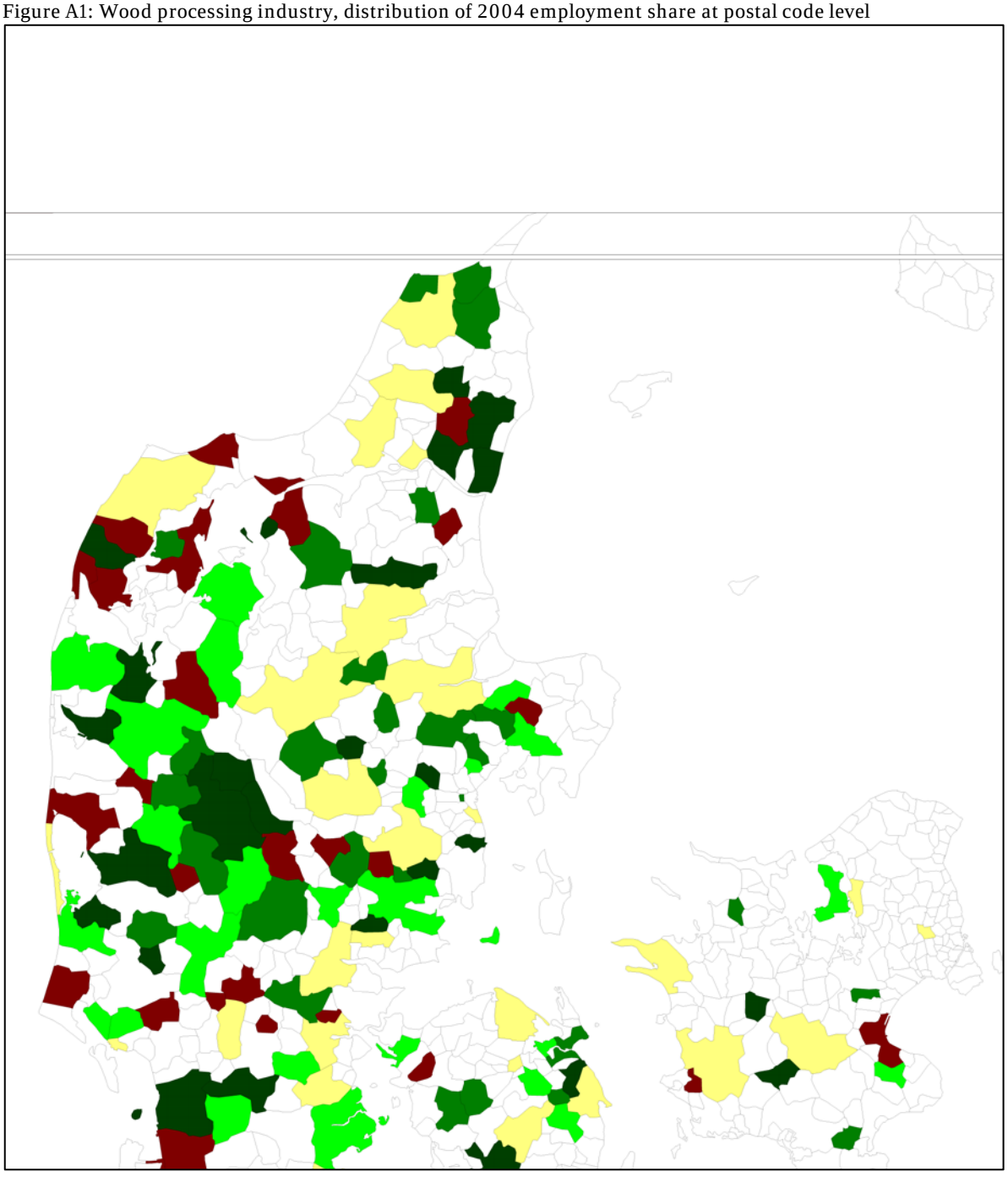

Figure A2: Furniture manufacturing industry, distribution of 2004 employment share at postal code level

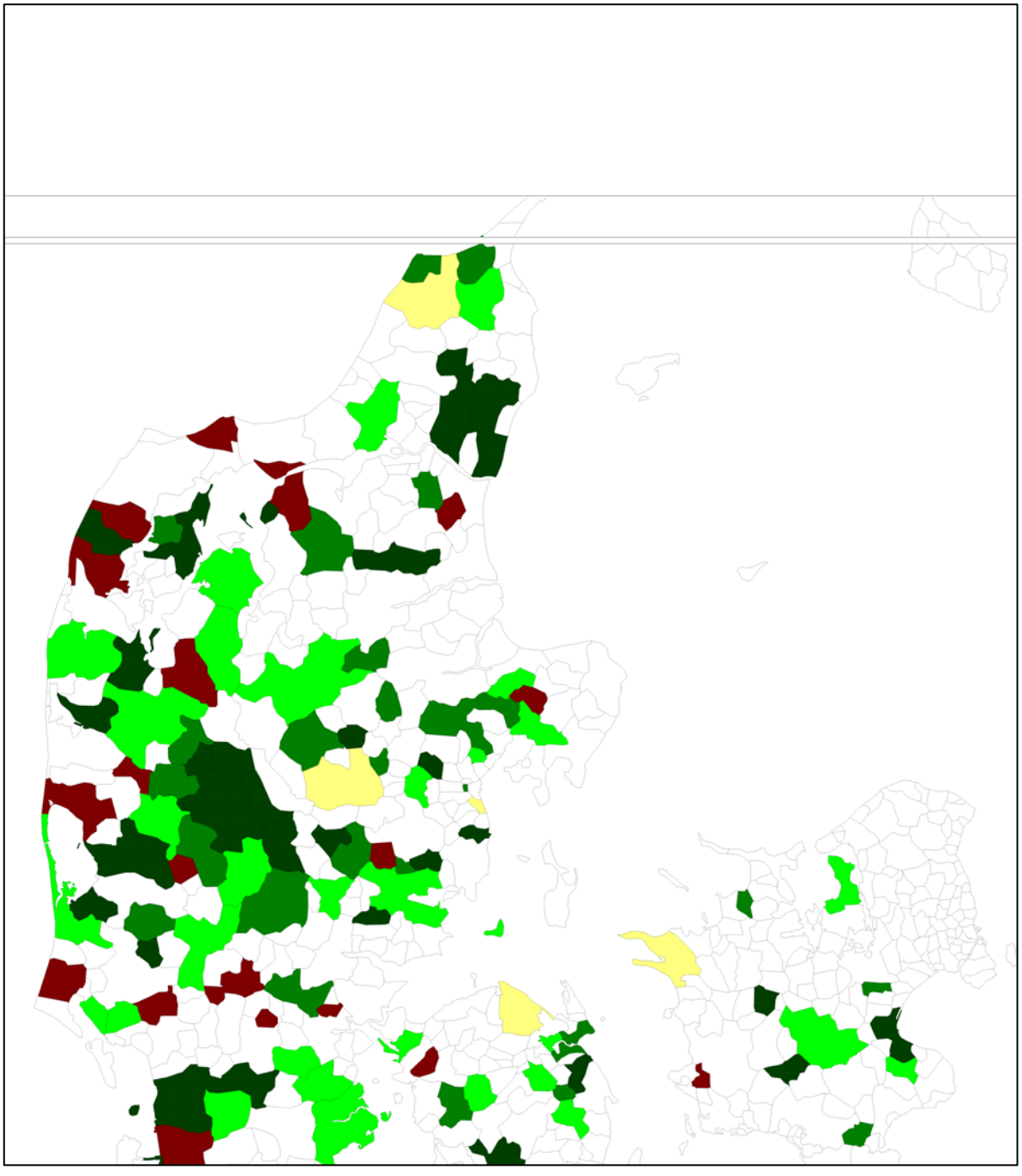

Figure A3: Sale of Motor Vehicles, Distribution of 2004 Number of Establishments at Postal Code Level

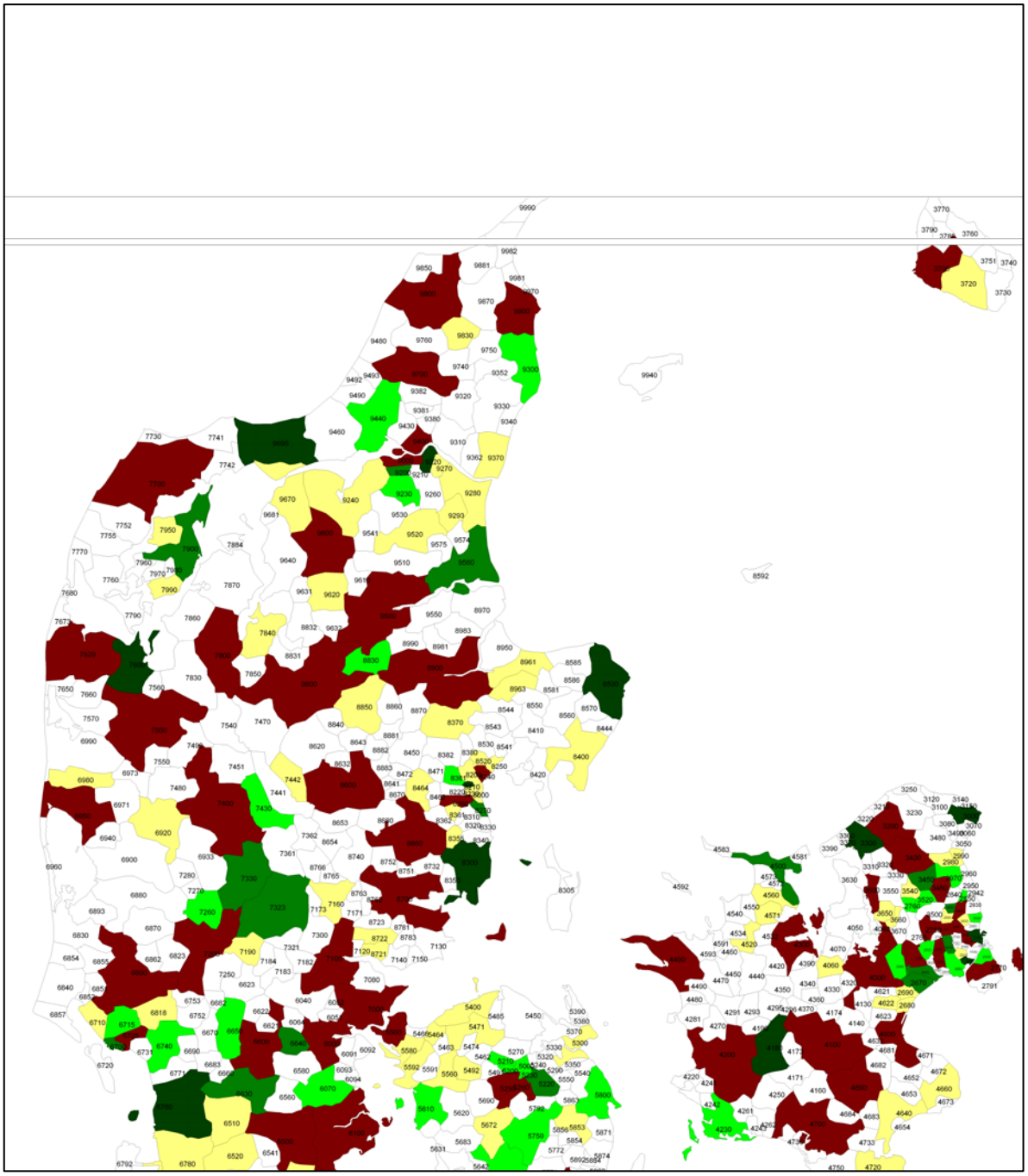

Figure A4: Repair and maintenance of motor vehicles, distribution of 2004 number of establishments at postal code level

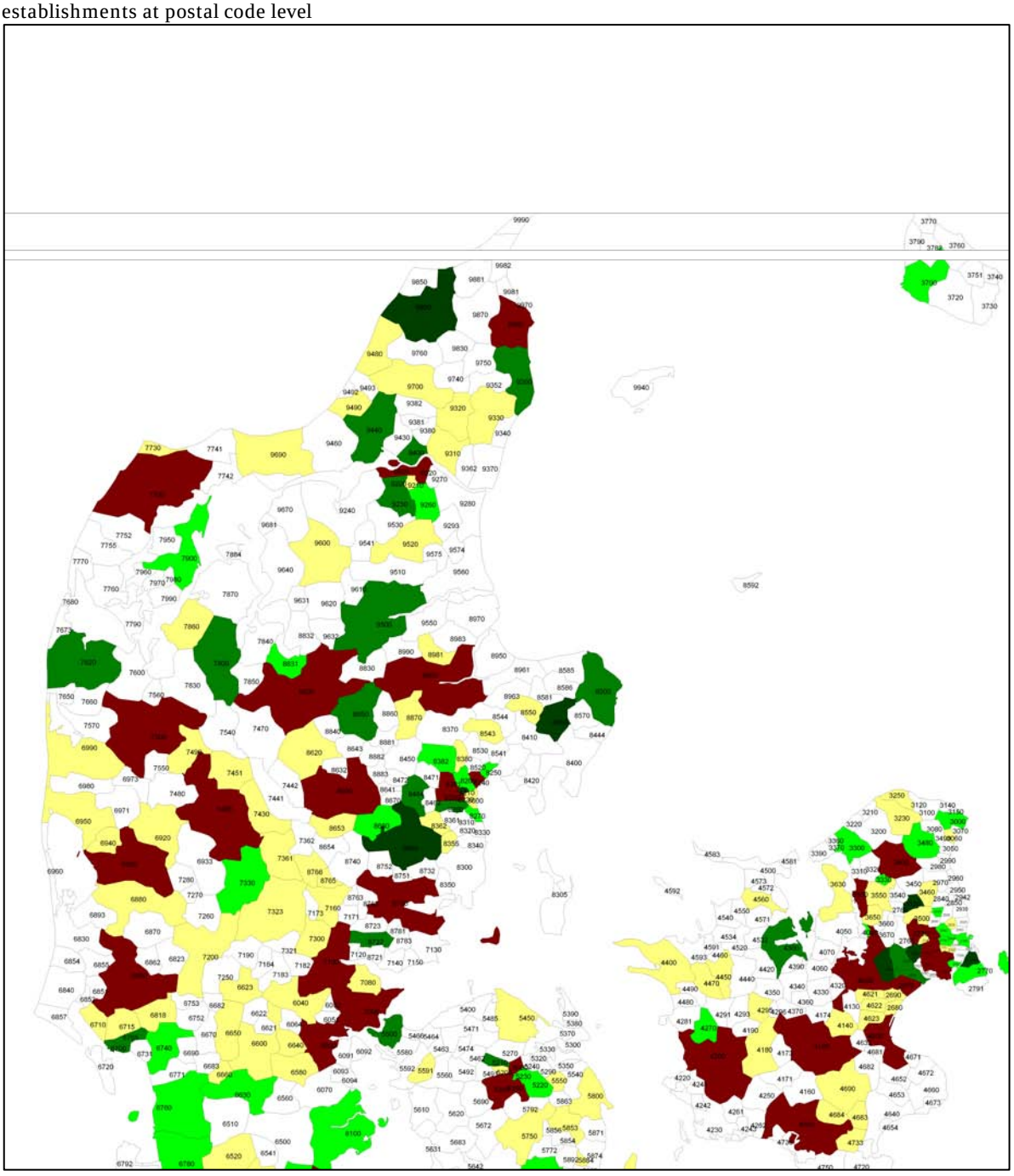

Table A1: Composition of selected industries and related Industries

Wood Processing Industry
Sawmilling and planing of wood; Impregnation of wood, etc.; Mfr. of veneer sheets; plywood, laminboard, particle board, fibre board and other panels and boards; Mfr. of mouldings; Mfr. of wooden goods to be used for buildings; Mfr. of prefabricated buildings or elements thereof, of wood; Mfr. of wooden containers; Wood turners; Mfr. of coffins; Mfr. of other products of wood n.e.c.; Mfr. of articles of cork, straw and plaiting
Related Sectors
Forestry ; Mfr. of furniture ; Mfr. of pulp, paper and paper products; Mfr. of plastics and synthetic rubber; Mfr. of rubber products and plastic packing goods etc.; Mfr. of glass and ceramic goods etc.; Mfr. of hand tools, metal packaging etc
Furniture Industry
Mfr. of chairs and seats except upholstery; Upholstery of chairs and seats; Mfr. of office and shop furniture except chairs; Mfr. of other kitchen furniture; Mfr. of other household furniture; Varnishing and acid washing of furniture, etc.; Mfr. of mattresses
Related Sectors
Wood processing industry; Construction Materials; Mfr. Of Metal Construction Materials
Sale of Motor Vehicles and Motorcycles, etc.
Wholesale and retail sale of Motor vehicle
Related Sectors
Repair and maintenance of motor vehicles, Ws. and commis. trade, exc. of m. vehicles; Mfr. of other electrical machinery and apparatus; Mfr. of other general purpose machinery; Renting of machinery and equipment etc.
Repair and Maintenance of Motor Vehicles
General repair shops; Bodywork repair (plate smiths); Motor vehicle electricians; Anti-rust treatment; Motor vehicle painters; Tyre and tube repair; Other motor vehicle services; Wholesale of motor vehicle parts and accessories; Retail sale of motor vehicle parts and accessories; Wholesale and retail sale, maintenance and repair of motorcycles and related parts and accessories
Related Sectors
Ws. and commis. trade, exc. of m. vehicles; Sale of motor vehicles, motorcycles etc.; Renting of machinery and equipment etc.; Mfr. of motor vehicles etc.; Mfr. of hand tools, metal packaging etc.

Table A2: Logit Estimates for Individuals Employed in the Wood Processing Industry

Covariate	Coef.	Std.Err.	
Employee has partner	-0.25	0.29	
Employee's age	-0.02	0.01	*
Earnings	0.00	0.00	
Low-educated employee	-0.37	0.27	
High-educated employee	-0.29	0.47	
Establishment's full-year equivalent	0.08	0.03	**
Establishment's outflow of machinery & equip.	0.00	0.00	**
Establishment's total disposal	0.00	0.00	
Establishment's total investment	0.00	0.00	***
Establishment's inventory variation	0.00	0.00	***
Establishment's machinery & equip.	0.00	0.00	
Establishment's inflow of real property	0.00	0.00	***
Establishment's energy purchase	0.00	0.00	***
Turnover	0.00	0.00	
Establishment's inflow of machinery & equip.	0.00	0.00	*
Number of employees	-0.07	0.03	**
Employee kept job	-0.85	0.38	**
Full-time employee	0.43	0.35	
Employee is wage earner	-0.51	0.56	
Blue-collar worker	0.69	0.55	
White-collar worker	0.40	0.34	
Staff member	0.92	0.56	*
Establishment did not change address in 2003-04	0.95	0.87	
Female employee	0.46	0.35	
Establishment located in Frederiksborg County	0.27	0.73	
Establishment located in Funen County	1.55	0.42	***
Establishment located in Vejle County	0.23	0.41	
Establishment located in Viborg County	-0.47	0.40	
Number of same establishments within 5 km	0.98	0.21	***
Number of same establishments within 5-10 km	0.50	0.15	***
Number of same establishments within 10-20 km	-0.04	0.06	
Number of related establishments within 5 km	0.05	0.02	**
Number of related establishments within 5-10 km	-0.01	0.02	
Number of related establishments within 10-20 km	-0.05	0.01	**
Constant term	-1.86	0.98	*
N_0			650
N_1			185

Note: The dependent variable takes the value 1 if the employee's workplace experiences an increase in the number of establishments in the same sector within a road distance radius of 10 km.

Table A3: Logit Estimates for Individuals Employed in the Furniture Industry

Covariate	Coef.	Std. Error	
Employee has partner	-0.18	0.20	
Days employed at current establishment	0.00	0.00	
Employee's previous unemployment	0.00	0.00	***
Earnings	0.00	0.00	
Low-educated employee	-0.53	0.37	
Medium-educated employee	-0.32	0.36	
Establishment's full-year equivalent	-0.03	0.02	
Establishment's outflow of machinery & equip.	0.00	0.00	***
Establishment's total investment	0.00	0.00	***
Establishment's inventory variation	0.00	0.00	
Establishment's machinery & equip.	0.00	0.00	***
Establishment's inflow of real property	0.00	0.00	***
Establishment's energy purchase	0.00	0.00	**
Turnover	0.00	0.00	**
Establishment's inflow of machinery & equip.	0.00	0.00	*
Number of employees	0.00	0.02	
Multi-plant business	-0.87	0.27	***
Establishment payroll	0.00	0.00	
Seniority	0.00	0.00	
Employee kept job	0.36	0.30	
Full-time employee	-0.40	0.25	
White-collar worker	-0.20	0.23	
Staff member	0.37	0.40	
High-ranking or executive employee	0.24	0.47	
Employee and establishment in same municipality	0.04	0.20	
Establishment located in Copenhagen County	2.82	0.92	***
Establishment located in Frederiksborg County	4.96	0.58	***
Establishment located in Funen County	4.27	0.46	***
Establishment located in Vejle County	5.08	0.52	***
Establishment located in Viborg County	3.25	0.46	***
Establishment located in North Jutland County	2.92	0.53	***
Number of same establishments within 5 km	0.16	0.07	**
Number of same establishments within 5-10 km	0.24	0.07	***
Number of related establishments within 5 km	0.04	0.02	**
Number of related establishments within 5-10 km	0.00	0.01	
Constant term	-5.04	0.65	***
N_0			1,258
N_1			288

Note: The dependent variable takes the value 1 if the employee's workplace experiences an increase in the number of establishments in the same sector within a road distance radius of 10 km.

Table A4: Logit Estimates for Individuals Employed in the Sale of Motor-Vehicles Industry

Covariate	Coef.	Std. Error	
Number of children	0.18	0.06	***
Employee's age	0.00	0.00	
Days employed at current establishment	0.00	0.00	
Employee's previous unemployment	0.00	0.00	**
Employee's ethnicity is Danish	0.72	0.35	**
Earnings	0.00	0.00	
Low-educated employee	-0.03	0.13	
Establishment's full-year equivalent	-0.07	0.02	***
Establishment's outflow of machinery & equip.	0.00	0.00	***
Establishment's total disposal	0.00	0.00	***
Establishment's total investment	-0.01	0.01	
Establishment's machinery & equip.	0.00	0.00	***
Establishment's inflow of real property	0.01	0.01	
Establishment's energy purchase	0.00	0.00	***
Turnover	0.00	0.00	
Establishment's inflow of machinery & equip.	0.01	0.01	
Number of employees	0.02	0.01	
Multi-plant business	-0.26	0.13	**
Establishment payroll	0.00	0.00	
Seniority	0.00	0.00	
Employee kept job	-0.18	0.16	
Full-time employee	-0.16	0.17	
Employee is wage earner	0.10	0.19	
White-collar worker	0.22	0.17	
Staff member	0.29	0.28	
High-ranking or executive employee	-0.40	0.33	
Establishment did not change address in 2003-04	-0.21	0.23	
Employee and establishment in same municipality	-0.11	0.11	
Establishment located in Copenhagen Municipality	-3.30	0.51	***
Establishment located in Roskilde County	-0.16	0.25	
Establishment located in South Jutland County	-1.03	0.20	***
Establishment located in Ringkøbing County	-1.73	0.23	***
Establishment located in Aarhus County	-1.17	0.20	***
Establishment located in Ribe County	-0.99	0.23	***
Establishment located in Vejle County	-1.37	0.19	***
Establishment located in Viborg County	-0.87	0.32	***
Establishment located in North Jutland County	-2.63	0.24	***
Number of same establishments within 5 km	0.16	0.02	***
Number of related establishments within 5 km	0.08	0.01	***
Constant term	-1.63	0.47	***
N_0			1,158
N_1			1,166

Note: The dependent variable takes the value 1 if the employee's workplace experiences an increase in the number of establishments in the same sector within a road distance radius of 5 km.

Table A5: Logit Estimates for Individuals Employed in the Repair of Motor Vehicles Industry

Covariate	Coef.	Std.	
Employee's age	0.00	0.01	
Days employed at current establishment	0.00	0.00	
Earnings	0.00	0.00	*
Low-educated employee	-0.19	0.16	
High-educated employee	0.14	0.29	
Establishment's full-year equivalent	0.03	0.05	
Establishment's outflow of machinery & equip.	0.00	0.00	**
Establishment's total investment	-0.04	0.01	***
Establishment's inflow of real property	0.04	0.01	***
Establishment's energy purchase	0.00	0.00	
Turnover	0.00	0.00	***
Establishment's inflow of machinery & equip.	0.04	0.01	***
Number of employees	0.07	0.03	**
Multi-plant business	0.63	0.15	***
Establishment payroll	0.00	0.00	*
Full-time employee	0.03	0.19	
Employee is wage earner	0.07	0.26	
Blue-collar worker	0.11	0.33	
White-collar worker	-0.30	0.23	
Staff member	0.22	0.37	
High-ranking or executive employee	-0.24	0.43	
Establishment did not change address in 2003-04	0.07	0.29	
Female employee	-0.23	0.22	
Employee and establishment in same municipality	-0.11	0.15	
Establishment located in West Zealand County	-0.60	0.43	
Establishment located in South Jutland County	-0.52	0.33	
Establishment located in Ringkøbing County	-0.47	0.45	
Establishment located Aarhus County	0.69	0.20	***
Establishment located in Storstrøm County	-0.16	0.35	
Establishment located in Funen county	-6.52	0.99	***
Establishment located in Vejle County	-0.11	0.26	
Establishment located in Viborg County	-0.05	0.33	
Establishment located in North Jutland County	0.03	0.26	
Number of same establishments within 5 km	0.02	0.03	
Number of related establishments within 5 km	0.07	0.01	***
Constant term	-2.97	0.42	***
N_0			1,836
N_1			511

Note: The dependent variable takes the value 1 if the employee's workplace experiences an increase in the number of establishments in the same sector within a road distance radius of 5 km.

Table A6. Imbalances Between treated (10 km) and Control Covariate Distributions for employees of Wood Processing Industry

	Treated	Control	SDIF	SDIF-M
Number of children	0.85	0.87	-2.1	6.6
Employee has partner	0.72	0.74	-5.4	-3.4
Employee's age	38.16	40.53	-21.5	-4.8
Days employed at current establishment	289.93	303.48	-11.7	6.9
Employee's previous unemployment	23.21	14.25	10.7	1.1
Earnings (DKK 103)	240.00	250.00	-7.7	-1.8
Low-educated employee	0.45	0.47	-4.1	-7.5
Medium-educated employee	0.48	0.47	2.7	8.4
High-educated employee	0.09	0.07	7.1	-2.5
Establishment's full-year equivalent	105.77	147.56	-29.4	4.4
Establishment's outflow of machinery & equip.	632.85	487.93	21.0	-13.7
Establishment's total disposal	702.15	618.56	10.2	-7.7
Establishment's total investment	4084.10	9974.80	-50.5	10.4
Establishment's inventory variation	621.69	-529.02	61.0	9.7
Establishment's machinery & equip.	1358.30	3144.30	-44.6	19.6
Establishment's inflow of real property	810.70	2512.80	-37.2	9.7
Establishment's energy purchase	1392.70	1707.20	-16.3	7.4
Turnover(DKK 103)	130.00	190.00	-26.0	2.4
Establishment's inflow of machinery & equip.	3262.30	4660.40	-29.4	16.1
Number of employees	110.22	161.43	-33.9	4.6
Multi-plant business	0.49	0.26	50.3	-17.5
Establishment payroll (DKK 106.)	290.00	44.00	-34.9	3.1
Seniority	36.86	27.37	4.1	-3.9
Employee kept job	0.61	0.67	-12.5	3.4
Full-time employee	0.48	0.45	6.4	5.4
Employee is wage earner	0.04	0.14	-33.1	2.2
Blue-collar worker	0.09	0.06	9.5	14.0
White-collar worker	0.54	0.50	7.5	3.8
Staff member	0.09	0.05	14.1	5.4
High-ranking or executive employee	0.03	0.04	-5.6	-14.2
Establishment did not change address in 2003-04	0.98	0.98	1.7	16.5
Female employee	0.22	0.16	14.0	5.4
Employee and establishment in same municipality	0.43	0.46	-4.6	14.1
Establishment located in Frederiksborg County	0.02	0.02	-3.9	-0.8
Establishment located in Storstrøm County	0.05	0.04	1.9	-23.8
Establishment located in Funen County	0.10	0.13	-9.2	3.6
Establishment located in Ribe county	0.08	0.15	-20.6	-15.8
Establishment located in Vejle County	0.13	0.25	-30.1	3.3
Establishment located in Viborg county	0.17	0.25	-19.5	5.0
Establishment located in North Jutland County	0.45	0.16	67.1	13.6
Number of same establishments within 5 km	1.14	0.31	108.0	4.9
Number of same establishments within 5-10 km	0.66	0.67	-0.8	1.2
Number of related establishments within 5 km	4.74	3.04	30.6	4.1
Number of related establishments within 5-10 km	4.14	4.75	-8.3	11.1

Notes: Treated denotes the mean of the covariate in the treated group, control denotes the mean of the covariate in the control group, SDIF denotes the standardised difference in means before matching and SDIF_M denotes the same statistic after matching.

Table A7. Imbalances Between Treated (10 km) and Control Covariate Distributions for Employees in Furniture Industry

	Treated	Control	SDIF	SDIF-M
Employee has partner	0.67	0.71	-8.0	2.5
Employee's previous unemployment	30.14	19.90	10.4	-13.6
Earnings (DKK 103)	250.00	240.00	3.6	3.8
Low-educated employee	0.41	0.45	-9.0	9.6
Medium-educated employee	0.48	0.47	2.6	-5.2
Establishment's full-year equivalent	111.05	117.57	-4.5	-5.9
Establishment's outflow of machinery & equip.	2191.20	406.93	74.1	-5.3
Establishment's total investment	10015.00	6308.80	24.5	-4.1
Establishment's inventory variation	4395.10	557.18	55.7	-8.7
Establishment's machinery & equip.	5427.70	1368.70	63.8	-1.9
Establishment's inflow of real property	1250.20	1260.90	-0.4	-1.9
Establishment's energy purchase	2236.00	1363.00	39.4	-6.6
Turnover (DKK 103)	220.00	150.00	24.9	-2.5
Establishment's inflow of machinery & equip.	7711.40	2102.40	64.7	-2.1
Number of employees	121.76	126.12	-2.8	-6.0
Multi-plant business	0.39	0.51	-24.3	-3.3
Establishment payroll (DKK 106)	32.00	35.00	-5.6	-5.0
Seniority	25.55	16.96	4.8	-3.1
Employee kept job	0.69	0.70	-0.8	-0.8
Full-time employee	0.51	0.55	-8.9	7.5
White-collar worker	0.46	0.56	-20.5	-8.7
Staff member	0.10	0.05	18.6	3.4
High-ranking or executive employee	0.05	0.04	3.9	6.6
Employee and establishment in same municipality	0.38	0.50	-24.3	3.6
Establishment located in Copenhagen Municipality	0.00	0.00	-9.8	-1.7
Establishment located in Copenhagen County	0.02	0.01	7.0	4.0
Establishment located in Frederiksborg County	0.11	0.01	43.1	8.9
Establishment located in Funen County	0.30	0.09	57.0	-2.0
Establishment located in Vejle County	0.15	0.04	39.4	3.0
Establishment located in Viborg County	0.18	0.17	1.4	6.9
Establishment located in North Jutland County	0.05	0.06	-3.6	4.8
Number of same establishments within 5 km	1.94	1.62	15.5	12.8
Number of same establishments within 5-10 km	2.16	1.69	22.4	-1.3
Number of related establishments within 5 km	6.27	4.43	21.5	1.4
Number of related establishments within 5-10 km	10.63	5.82	35.7	-2.7

Table A8. Imbalances Between Treated (10 km) and Control Covariate Distributions for Employees in Sale of Motor Vehicles Industry

	Treated	Control	SDIF	SDIF-M
Number of children	0.72	0.64	8.5	2.4
Employee has partner	0.69	0.68	2.7	-17.0
Employee's age	35.42	35.92	-4.0	-9.3
Days employed at current establishment	303.55	294.41	8.0	-1.1
Employee's previous unemployment	7.62	17.12	-13.1	0.2
Employee's ethnicity is Danish	0.98	0.97	2.8	11.6
Earnings	260.00	240.00	17.4	-8.7
Low-educated employee	0.27	0.30	-6.0	2.1
Medium-educated employee	0.67	0.65	4.5	2.9
High-educated employee	0.07	0.06	1.9	-7.5
Establishment's full-year equivalent	29.90	22.21	34.8	6.6
Establishment's outflow of machinery & equip.	868.16	1396.30	-15.6	-3.9
Establishment's total disposal	986.76	1456.60	-13.6	-2.1
Establishment's total investment	2102.60	2274.30	-3.5	2.7
Establishment's machinery & equip.	76.74	32.71	23.2	-4.4
Establishment's inflow of real property	311.49	176.51	17.2	13.7
Establishment's energy purchase	274.04	182.67	39.9	-1.3
Turnover	120.00	76.81	25.1	-5.8
Establishment's inflow of machinery & equip.	1790.60	2095.10	-6.7	0.5
Number of employees	32.27	24.61	35.9	4.6
Multi-plant business	0.43	0.34	19.5	11.9
Establishment payroll	9.20	6.50	34.2	1.7
Seniority	11.47	23.88	-7.7	0.8
Employee kept job	0.60	0.61	-3.3	1.2
Full-time employee	0.55	0.51	9.1	-9.4
Employee is wage earner	0.17	0.20	-7.6	-6.7
White-collar worker	0.48	0.44	7.3	12.6
Staff member	0.07	0.05	8.1	-12.4
High-ranking or executive employee	0.03	0.04	-4.3	-10.5
Establishment did not change address in 2003-04	0.94	0.93	2.3	31.8
Employee and establishment in same municipality	0.40	0.48	-17.0	11.3
Establishment located in Copenhagen Municipality	0.08	0.03	24.4	-11.9
Establishment located in Copenhagen County	0.09	0.08	5.1	-9.5
Establishment located in West Zealand County	0.12	0.05	23.7	4.3
Establishment located in Roskilde County	0.11	0.03	30.1	10.5
Establishment located in South Jutland County	0.05	0.11	-23.5	3.1
Establishment located in Ringkøbing County	0.06	0.08	-7.5	-12.0
Establishment located in Aarhus County	0.13	0.14	-2.8	23.9
Establishment located Frederiksborg county	0.08	0.07	3.7	15.8
Establishment located in Storstrøm County	0.04	0.05	-4.1	-4.5
Establishment located in Ribe County	0.04	0.07	-15.7	-3.0
Establishment located in Vejle County	0.13	0.11	7.4	6.1
Establishment located in Viborg County	0.04	0.04	2.5	9.6
Establishment located in North Jutland County	0.03	0.14	-39.9	-14.0
Number of same establishments within 5 km	9.32	3.79	113.5	-16.0
Number of related establishments within 5 km	15.09	5.90	85.0	-6.9

Table A9. Imbalances Between Treated (5 km) and Control Covariate Distributions for employees in Repair and Maintenance of Motor Vehicles Industry

	Treated	Control	SDIF	SDIF-M
Employee's age	38.14	36.97	9.4	-2.5
Days employed at current establishment	304.70	268.74	29.0	-3.4
Earnings	260.00	200.00	46.6	-6.6
Low-educated employee	0.29	0.33	-9.7	10.5
High-educated employee	0.08	0.05	14.9	-0.4
Establishment's full-year equivalent	31.79	8.61	82.2	4.6
Establishment's outflow of machinery & equip.	133.08	60.59	49.4	4.8
Establishment's total investment	946.95	492.42	39.8	4.9
Establishment's inflow of real property	209.54	116.96	27.6	-1.8
Establishment's energy purchase	321.63	94.81	71.2	-0.9
Turnover	62.10	22.77	37.0	5.3
Establishment's inflow of machinery & equip.	737.25	375.00	36.2	6.2
Number of employees	35.02	10.10	83.0	5.0
Multi-plant business	0.55	0.23	68.7	-2.0
Establishment payroll	9.50	2.50	78.4	3.9
Full-time employee	0.57	0.44	26.5	1.6
Employee is wage earner	0.16	0.19	-9.0	-2.5
Blue-collar worker	0.10	0.04	20.8	6.7
White-collar worker	0.40	0.44	-7.7	-6.4
Staff member	0.10	0.03	30.4	3.9
High-ranking or executive employee	0.06	0.02	18.8	9.6
Establishment did not change address in 2003-04	0.95	0.90	22.1	-7.3
Female employee	0.16	0.12	10.7	-5.2
Employee and establishment in same municipality	0.41	0.53	-24.0	16.7
Establishment located in West Zealand County	0.01	0.06	-22.8	1.7
Establishment located in South Jutland County	0.03	0.08	-19.8	-2.9
Establishment located in Ringkøbing County	0.01	0.05	-18.7	3.2
Establishment located in Aarhus County	0.27	0.13	35.5	23.4
Establishment located in Storstrøm County	0.03	0.06	-15.3	4.8
Establishment located in Funen County	0.01	0.11	-46.0	-4.1
Establishment located in Vejle County	0.07	0.09	-7.0	-2.7
Establishment located in Viborg County	0.07	0.05	8.8	8.8
Establishment located in North Jutland County	0.11	0.09	7.8	-1.6
Number of same establishments within 5 km	4.74	0.72	115.6	-11.8
Number of related establishments within 5 km	17.09	2.64	119.5	-11.1