Studies in Regional Dynamics and Disparities

Working Paper No. 2-2021

WAGES AND LABOUR SUPPLY

An empirical analysis of wage elasticities in different geographical locations of Denmark

Jesper Eriksen
Ina Drejer

Aalborg University Business School

Abstract

This short working paper explores the extent to which the wage elasticity of labour supply differs between geographical locations in Denmark. The analysis focuses on recent graduates only. This choice is primarily based on the assumption that recent graduates are more sensitive to wage incentives in their location decisions than individuals who have a more established position in the labour market. The analysis is based on register data from Statistics Denmark for the period 2008-2019. The analysis finds that the wage elasticity of labour supply is lowest in peripheral municipalities. The administrative regions with the lowest levels of wage elasticities are Southern and North Denmark.

Centre for Research on Regional Dynamics and Disparities (REDY)
Aalborg University
www.redy.aau.dk

Centre for Research on Regional Dynamics and Disparities Working Paper
Editor: Jørgen Goul Andersen
E-mail: goul@dps.aau.dk

The Centre for Research on Regional Dynamics and Disparities is co-financed by the Obel Family Foundation and the Faculty of Social Sciences, Aalborg University.

www.redy.aau.dk
Aalborg, June 2021

ISSN 2596-4208-2021-2

Introduction

This working paper explores the relationship between the changes in wages and labour supply of recent graduates in different geographical settings in Denmark. It is part of a sub-project on the geographical aspects of access to labour within the Obel Family Foundation-funded project, 'Regional Dynamics and Disparities' (ReDy). The analysis relates to a fundamental question in economics about the extent to which employment/labour supply reacts to changes in wages. More specifically, the analysis addresses the extent to which firms can use wages as a means to attract employees to the local labour market, and—if we do find indications of an elastic labour supply—whether the wage elasticity tends to vary across different geographical locations.

The analysis is based on register data from Statistics Denmark for the period 2008-2019. Previous studies have shown a clear relationship between, on one side, age, family situation (e.g. Geist & McManus, 2008) and years since graduation (e.g. Drejer et al., 2014), and on the other side, geographical mobility. Accordingly, the analysis focuses on recent graduates only based on the assumption that they are more sensitive to wage incentives in their location decisions than individuals who are more established in terms of employment (as well as family situation, although we do not control for factors expressing the latter in the analysis). Recent graduates are defined as individuals who have completed their highest level of education within a four-year period prior to the year studied.

Following a somewhat simplified, classical economic assumption, utility maximising economic agents operating under conditions of perfect competition will choose their location based on where their experienced utility will be as high as possible. This assumption is based on the ability to set a price on utility and the possibility to determine the price, e.g. a wage increase, which is necessary to make individuals relocate to another place than where they are currently residing (and working). However, there is a widespread acknowledgment of labour markets operating under conditions of imperfect competition (see e.g. Booth, 2004). Manning (2003) argues that labour markets are a monopsonistic, i.e., employers have market power over employees due to friction in the labour market. The main argument is that employees are likely to have imperfect information about alternative employment opportunities, and it is time-consuming and costly to change jobs. Legislative regulations and collective bargaining also affect the functioning of labour markets. These factors may play a crucial role in explaining why, as documented by Manning (2010), empirical studies tend to find relatively low elasticities of labour supply.

However, although the factors mentioned above can influence the level of wage elasticities, they are unlikely to have a major effect on what is of interest in the present paper, which is within-country differences in the wage sensitivity of labour supply. The labour supply within each geographical location is not only determined by the incumbent residents' willingness to participate in the labour market—which is assumed to be high among recent graduates—but also on the willingness of individuals to relocate to the location in question. In this case, differences in wage elasticity across geographical locations can provide indications of the attractiveness of different types of locations, and therefore also geographical differences in the effectiveness of wage compensation as a means to attract recent graduates.

The analysis shows, first, that wage elasticity of labour supply among recent graduates is relatively low in Denmark. But, more interestingly, the analysis also shows that there are considerable geographical differences in wage elasticities. The wage elasticity of labour supply is lowest in peripheral municipalities. From an administrative region perspective, Southern and North Denmark have the lowest wage elasticities. The concluding section discusses possible explanations for these findings.

Data and method

The analyses are based on register data from Statistics Denmark for the period 2008-2019 for a population of individuals aged 18 and above who have completed their highest degree of education within a four-year period prior to the year studied. The lowest level of education included is primary school. However, as illustrated in Figure 1, the analysis includes relatively few individuals who had primary school as their highest degree of education.

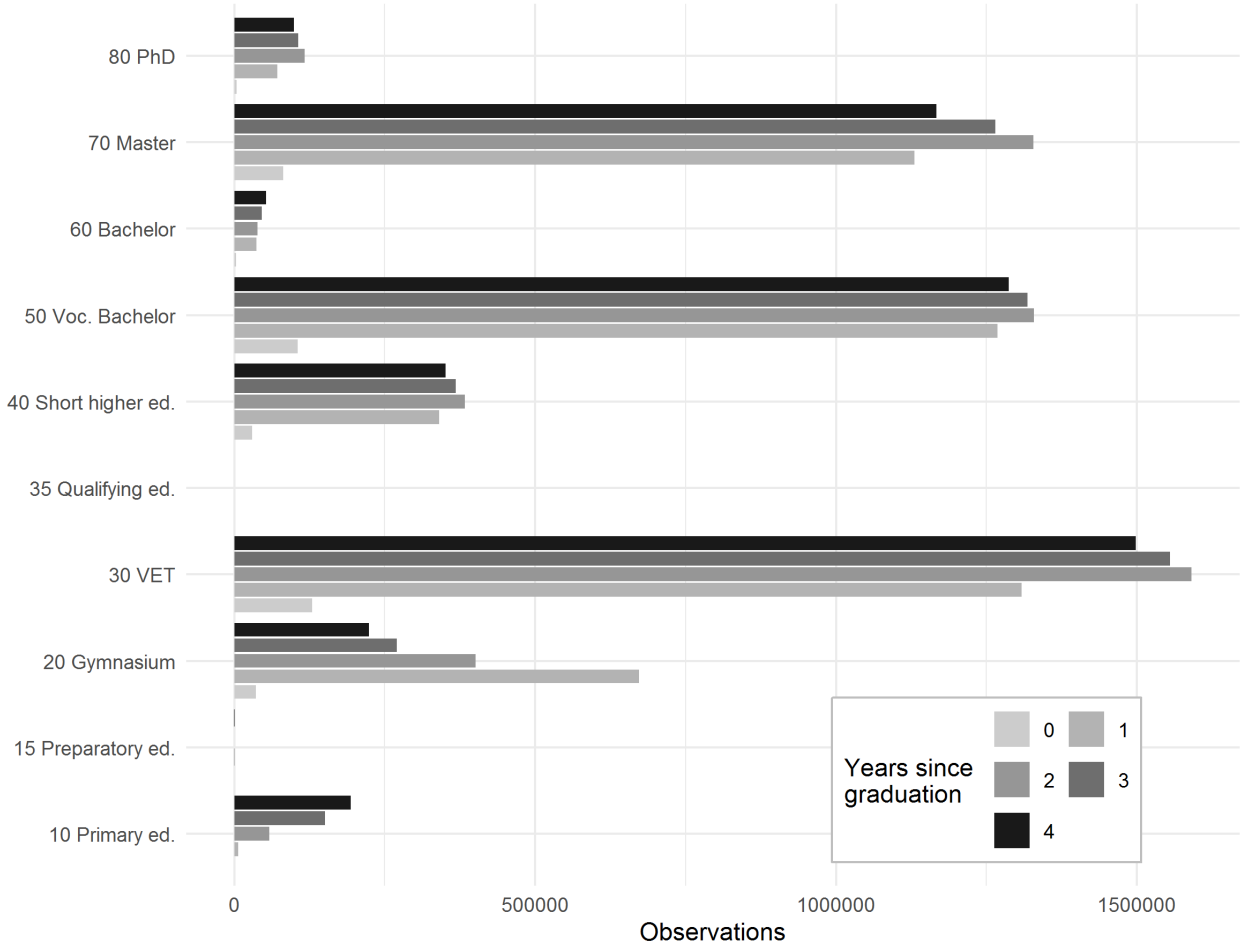

Figure 1. Observations distributed on highest level of education and years after graduation.

We apply regression analysis to explore the main relationship between the change in the number of residents within the defined population in a given municipality (dependent variable) and the change in salary levels of these residents. The population includes wage earners only.

Calculations are based on the municipality of residence and not where the workplace is located. The reason for this focus is that we are interested in the local attraction of individuals to a given geographical location, and not firm-location choices.

Salary is the primary explanatory variable and is measured as hourly salary. This includes A-income (salaries, wages, pensions, unemployment, sickness and parental leave benefits, etc., on which tax is withheld before the employee receives the income) and B-income (fees and remunerations on which no tax is withheld when they are paid, and profits from self-employed business activities and interest income).

Analyses are carried out step-wise, starting with a simple regression including only salary as the explanatory variable, and subsequently adding control variables (fixed effects). The control variables include the level of education, the industry of employing firm (public as well as private sector organisations), years since graduation, and year.

In the main models, we regress the changes in log values of the variables. However, as a robustness test, we replace changes in logs with percentage changes.

The aggregated data used for the regression analysis comes from individual-month-employment data constructed from the Danish register data. The datasets only contain observed employment spells, i.e., non-employment spells are not included. In the measurement of the hourly salary, we focus on the job where the individual is employed for the most hours. If an individual holds more jobs with the same number of hours, we focus on the job with the highest hourly salary of those jobs.

Because we are interested in full-time employment and salaries that can be traced to a specific firm-employment, observations are dropped if the individual:

- has worked less than 140 hours within the month of employment,
- has been employed less than 25 out of the 30 or 31 days within the month,
- has an hourly wage above 5000 DKK in 2015 values, or
- is pursuing any type of education at the time of observation.

Furthermore, observations are deleted if information on education level, number of years since graduation, industry of employing firm, or municipality of residence is missing.

The analysis is carried out on aggregated variables organised in cells defined as combinations of education level, industry, municipality, years since graduation, and year. In order to ensure that the analysis is not driven by outliers, cells with less than 10 observations per cell are omitted. This procedure reduces the number of aggregated observations from 485,064 to 344,024. The main variables of interest are the logs of the aggregate variables, the within-group yearly changes in the log variables, and the within-group percentage changes in the aggregated variables. When calculating changes, only year-to-year differences are calculated, and, accordingly, observations with missing year-to-year changes are omitted. This reduces the number of observations to 207,701.

Finally, observations with more than a 20 percent change in hourly salary or 100 percent change in

the number of graduates are omitted. This leads to a final number of 207,696 aggregated observations included in the analysis. Table 1 shows the summary statistics for the main variables used in the analysis before and after the removal of outliers.

Table 1. Summary statistics for main variables (N=207,696)

	Mean	Std. Dev.	Median
Log_population	3.469	1.034	3.178
Diff_population	0.012	0.641	0.000
Diff_population_pct	0.248	0.940	0.000
Log_salary	5.232	0.312	5.236
Diff_salary	0.001	0.216	0.002
Diff_salary_pct	0.025	0.251	0.002

The regional analyses are carried out at two levels of aggregation. The first level of aggregation is administrative regions, where the 98 Danish municipalities are divided into five regions: the Capital Region, Zealand, Southern Denmark, Central Denmark, and North Denmark. The second level of aggregation follows the Danish Ministry of Food, Agriculture and Fisheries (2011), which classifies municipalities as either peripheral, rural, intermediate, or urban. This classification is described in more detail in Eriksen (2017).

See Appendix 1 for an overview of how municipalities are classified in the two levels of aggregation.

Empirical findings

Table 2 describes the primary relationship between the change in the population of recent graduates in a given municipality and the change in wages. Model 1 shows the simple relation between change in log population of recent graduates and change in log wages. In Models 2-4, year fixed effects and fixed effects for graduation year, industry and educational level are added step-wise.

Table 2. Change in the population of recent graduates at municipality level as a function of change in wages (dependent variable: change in log population)

	(1)		(2)		(3)		(4)	
	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.
Change in log salary	0.115***	0.007	0.108***	0.007	0.107***	0.007	0.107***	0.007
Year Fixed Effects			Y		Y		Y	
Grad. Year Fixed Effects					Y		Y	
Industry Fixed Effects							Y	
Educational Level Fixed Effects							Y	
N	207,696		207,696		207,696		207,696	
R^2	0.002		0.116		0.116		0.118	

*** significant at the 1% level.

The regression results suggest a stable relation, where a one percent increase in the yearly percentage change in hourly wages is associated with a 0.1 percent increase in the annual percentage change in the population of recent graduates living in a given municipality. This relatively low wage elasticity of labour supply is in accordance with the international findings reported by Manning (2010).

Replacing changes in logs with percentage changes for the population of recent graduates and hourly salary variables results in similar findings concerning the relation between wages and population. Please see Appendix 2 for results of the models using percentage changes.

The models shown in Table 3 explore whether wage sensitivity is higher in some administrative regions than in others. The relation is estimated separately for each region. A regression model where the *difference_salary* variable is interacted with regions (with the Capital Region as the benchmark) has also been run, leading to similar results as the ones shown in Table 3. These results are available upon request.

Table 3 shows that the impact of wage changes is stronger in Zealand, the Capital Region, and Central Denmark than in Southern and North Denmark. This means that the change in the number of recent graduates residing in municipalities in Southern and North Denmark is less sensitive to wage changes than in other parts of Denmark.

These findings are also confirmed when changes in logs are replaced with percentage changes for the population of recent graduates and hourly salary variables, although the wage sensitivity in North Denmark is higher than in Southern Denmark in this alternative model specification.

Table 3. Change in the population of recent graduates at the municipality level as a function of change in wages. Models by administrative regions (dependent variable: change in log population)

	Capital Region		Zealand		Southern Denmark		Central Denmark		North Denmark	
	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.
Change in log salary	0.114***	0.011	0.167***	0.016	0.063***	0.014	0.114***	0.015	0.063***	0.022
Year Fixed Effects	Y		Y		Y		Y		Y	
Grad. Year Fixed Effects	Y		Y		Y		Y		Y	
Industry Fixed Effects	Y		Y		Y		Y		Y	
Educational Level Fixed Effects	Y		Y		Y		Y		Y	
N	64,575		31,318		44,981		46,202		20,620	
R^2	0.117		0.114		0.122		0.126		0.115	

*** significant at the 1% level.

Finally, the differences in wage sensitivity between different types of municipalities are explored in Table 4. Whereas there are only small differences between the groupings of urban, intermediate, and rural municipalities, the wage sensitivity for the group of peripheral municipalities is considerably lower than for the other three groups.

Table 4. Change in the population of recent graduates at municipality level as a function of change in wages. Models by type of municipality (dependent variable: change in log population)

	Urban		Intermediate		Rural		Peripheral	
	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.
Change in log salary	0.114***	0.009	0.109***	0.015	0.107***	0.012	0.062***	0.022
Year Fixed Effects	Y		Y		Y		Y	
Grad. Year Fixed Effects	Y		Y		Y		Y	
Industry Fixed Effects	Y		Y		Y		Y	
Educational Level Fixed Effects	Y		Y		Y		Y	
N	94,229		35,923		58,377		19,167	
R^2	0.130		0.118		0.113		0.093	

*** significant at the 1% level.

Again, the findings are confirmed when changes in logs are replaced with percentage changes for the population of recent graduates and hourly salary variables.

Concluding discussion

This paper shows that the findings from international studies concerning a relatively low wage sensitivity of labour supply also apply to Denmark. However, the analysis also shows that wage sensitivity is higher in the most centrally located regions in Denmark, i.e., the Capital Region, Zealand, and Central Denmark, compared to the more peripheral regions of Southern and North Denmark. Likewise, when municipalities are classified as either urban, intermediate, rural, or peripheral, the wage sensitivity is lowest in peripheral municipalities. Thus, the findings indicate that wages are not a very efficient tool for attracting labour to locations in Denmark, which are struggling with a declining workforce and challenges related to attracting qualified labour.

The findings could, at least to some extent, be driven by the 'thickness' of labour markets which varies with the degree of urbanisation. A 'thick' labour market is characterised as being large and diverse, thereby offering highly skilled and specialised employees better opportunities for finding jobs that match their skills than 'thinner' labour markets can offer. For highly skilled employees, such as university graduates, these features also lead 'thick' labour markets to be characterised by relatively high initial wages, fast wage growth, and frequent job switching, especially in the first years after graduation (Ahlin et al. 2014).

However, as discussed in another analysis related to the Obel Family Foundation-funded project on Regional Dynamics and Disparities — which explores the relationship between geographical

mobility, occupational choice, and outcome in metropolitan and peripheral areas in Denmark — career opportunities and prospects of a high wage or rapid wage increase are not the only factors affecting recent graduates' location choices (Drejer et al., forthcoming). Although economic factors play a role in location choices, social attachments to places and people tend to outweigh these factors (Dahl & Sorensen, 2010a; 2010b). Drejer et al. (forthcoming) find that graduates from the peripheral North Denmark region who stay to work in North Denmark after graduation are 'penalised' in terms of a lower wage growth compared to graduates from North Denmark that move to the Capital Region or the region of Zealand (the region adjacent to the Capital). Statistical matching shows no indications of the reasoning being that the 'weakest' graduates choose to stay in North Denmark. Thus, it can be assumed that the graduates accept a lower wage growth as the price to pay for remaining to work in the region to which they are socially attached.

In sum, the possibilities to influence recent graduates' mobility choices appear limited, and further research is needed in order to determine which types of graduates are most likely to be influenced in their location choice and by which means, wages or other.

References

Ahlin, L., Andersson, M. & Thulin, P. (2014). Market thickness and the early labour market career of university graduates: an urban advantage? *Spatial Economic Analysis*, Vol. 9, pp. 396–419.

Booth, A.L. (2014). Wage determination and imperfect competition. *Labour Economics*, Vol. 30, pp. 53-58.

Dahl, M.S. & Sorenson, O. (2010a). The social attachment to place. *Social Forces*, Vol. 89, pp. 633–658.

Dahl, M.S. & Sorenson, O. (2010b). The migration of technical workers, *Journal of Urban Economics*, Vol. 67, pp. 33–45.

Danish Ministry of Food, Agriculture and Fisheries (2011). The Danish Rural Development Programme 2007-2013. Report, http://bit.ly/2jCwXWl.

Drejer, I., Holm, J.R., & Nielsen, K. (2014). *Aalborg Universitets bidrag til udvikling i Region Nordjylland*. Report prepared for Growth Forum North Denmark. https://bit.ly/3z9BuSJ.

Drejer, I., Holm. J.R. & Nielsen, K. (forthcoming). University graduates in metropolitan and peripheral areas: mobility, occupational choice and outcomes. *Regional Studies*, DOI: 10.1080/00343404.2021.1905788.

Geist, C. & McManus, P.A. (2008). Geographical Mobility over the Life Course: Motivations and Implications. *Population, Space and Place*, Vol. 14, pp. 283-303.

Eriksen, J. (2017). Educated Cities and Regional Centralization. Spatial Trends in Students' Location in Denmark, 1982-2013. *ReDy Working Paper* No. 1-2017, https://bit.ly/2RwoGSw.

Manning, A. (2003). *Monopsony in Motion: Imperfect Competition in Labor Markets*. Princeton University Press

Manning, A. (2010). Imperfect competition in the labour market. *CEP Discussion Paper* (981). Centre for Economic Performance, London School of Economics and Political Science, London, UK.

Appendix 1: Overview of municipal classification

Municipality	Region	Type
Albertslund	Capital	Urban
Allerød	Capital	Urban
Assens	Southern	Rural
Ballerup	Capital	Urban
Billund	Southern	Rural
Bornholm	Capital	Peripheral
Brøndby	Capital	Urban
Brønderslev	Northern	Rural
Dragør	Capital	Intermediate
Egedal	Capital	Urban
Esbjerg	Southern	Rural
Fanø	Southern	Rural
Favrskov	Central	Intermediate
Faxe	Zealand	Intermediate
Fredensborg	Capital	Urban
Fredericia	Southern	Intermediate
Frederiksberg	Capital	Urban
Frederikshavn	Northern	Rural
Frederikssund	Capital	Urban
Furesø	Capital	Urban
Faaborg-Midtfyn	Southern	Rural
Gentofte	Capital	Urban
Gladsaxe	Capital	Urban
Glostrup	Capital	Urban
Greve	Zealand	Urban
Gribskov	Capital	Urban
Guldborgsund	Zealand	Rural
Haderslev	Southern	Rural
Halsnæs	Capital	Intermediate
Hedensted	Central	Rural
Helsingør	Capital	Urban
Herlev	Capital	Urban

Municipality	Region	Type
Herning	Central	Rural
Hillerød	Capital	Urban
Hjørring	Northern	Rural
Holbæk	Zealand	Intermediate
Holstebro	Central	Rural
Horsens	Central	Intermediate
Hvidovre	Capital	Urban
Høje-Taastrup	Capital	Urban
Hørsholm	Capital	Urban
Ikast-Brande	Central	Rural
Ishøj	Capital	Urban
Jammerbugt	Northern	Rural
Kalundborg	Zealand	Rural
Kerteminde	Southern	Rural
Kolding	Southern	Urban
København	Capital	Urban
Køge	Zealand	Urban
Langeland	Southern	Peripheral
Lejre	Zealand	Urban
Lemvig	Central	Peripheral
Lolland	Zealand	Peripheral
Lyngby-Taarbæk	Capital	Urban
Læsø	Northern	Peripheral
Mariagerfjord	Northern	Rural
Middelfart	Southern	Intermediate
Morsø	Northern	Peripheral
Norddjurs	Central	Peripheral
Nordfyns	Southern	Rural
Nyborg	Southern	Rural
Næstved	Zealand	Intermediate
Odder	Central	Intermediate
Odense	Southern	Urban
Odsherred	Zealand	Rural
Randers	Central	Rural
Rebild	Northern	Rural
Ringkøbing-Skjern	Central	Peripheral
Ringsted	Zealand	Intermediate
Roskilde	Zealand	Intermediate

Municipality	Region	Type
Rudersdal	Capital	Urban
Rødovre	Capital	Urban
Samsø	Central	Peripheral
Silkeborg	Central	Intermediate
Skanderborg	Central	Urban
Skive	Central	Peripheral
Slagelse	Zealand	Intermediate
Solrød	Zealand	Urban
Sorø	Zealand	Intermediate
Stevns	Zealand	Intermediate
Struer	Central	Peripheral
Svendborg	Southern	Rural
Syddjurs	Central	Rural
Sønderborg	Southern	Rural
Thisted	Northern	Peripheral
Tønder	Southern	Peripheral
Tårnby	Capital	Intermediate
Vallensbæk	Capital	Urban
Varde	Southern	Peripheral
Vejen	Southern	Rural
Vejle	Southern	Intermediate
Vesthimmerlands	Northern	Peripheral
Viborg	Central	Intermediate
Vordingborg	Zealand	Rural
Ærø	Southern	Peripheral
Aabenraa	Southern	Rural
Aalborg	Northern	Urban
Aarhus	Central	Urban

Appendix 2: Robustness tests – models with percentage changes

Table A.2.1. Change in population of recent graduates at municipality level as a function of change in wages (dependent variable: percentage change in population)

	(1)		(2)		(3)		(4)	
	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.
Pct. change in salary	0.128***	0.009	0.119***	0.009	0.118***	0.009	0.115***	0.009
Year Fixed Effects			Y		Y		Y	
Grad. Year Fixed Effects					Y		Y	
Industry Fixed Effects							Y	
Educational Level Fixed Effects							Y	
N	207,696		207,696		207,696		207,696	
R^2	0.001		0.099		0.099		0.103	

*** significant at the 1% level.

Table A.2.2. Change in population of recent graduates at municipality level as a function of change in wages. Models by administrative regions (dependent variable: percentage change in population)

	Capital Region		Zealand		Southern Denmark		Central Denmark		North Denmark	
	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.	Coef.	Std. Dev.
Pct. change in salary	0.121***	0.015	0.174***	0.022	0.054***	0.018	0.140***	0.022	0.097***	0.031
Year Fixed Effects	Y		Y		Y		Y		Y	
Grad. Year Fixed Effects	Y		Y		Y		Y		Y	
Industry Fixed Effects	Y		Y		Y		Y		Y	
Educational Level Fixed Effects	Y		Y		Y		Y		Y	
N	64,575		31,318		44,981		46,202		20,620	
R^2	0.098		0.108		0.106		0.112		0.102	

*** significant at the 1% level.

Table A.2.3. Change in population of recent graduates at municipality level as a function of change in wages. Models by type of municipality (dependent variable: percentage change in population)

	Urban		Intermediate		Rural		Peripheral	
	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.	Coefficient	Std.Dev.
Pct. change in salary	0.125***	0.013	0.106***	0.021	0.118***	0.017	0.065***	0.033
Year Fixed Effects	Y		Y		Y		Y	
Grad. Year Fixed Effects	Y		Y		Y		Y	
Industry Fixed Effects	Y		Y		Y		Y	
Educational Level Fixed Effects	Y		Y		Y		Y	
N	94,229		35,923		58,377		19,167	
R^2	0.110		0.106		0.100		0.081	

*** significant at the 1% level.