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Agglomeration Economies in the Netherlands

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Sadly, we have to inform you that Joeri Gorter unexpectedly passed away in October 2008, at the end phase of this paper. It is a loss of a great person and economist, we miss him.

The responsibility for the contents of this CPB Discussion Paper remains with the authors

Abstract in English

The drift to the city has been going on for hundreds of years. As a result, most economic activity is concentrated in small geographical areas. The advantages of proximity of people and firms go under the name 'agglomeration economies'. In this paper, we measure their strength on the basis of Dutch regional data. We regress regional labour productivity on a set of agglomeration indices, and find evidence for a productivity effect of concentration of production with a malus for industrial variety. Thus, the evidence supports Marschall-Arrow-Romer economies. The evidence does not support, however, Jacobs economies, nor variants of the Creative Class Hypothesis.

Key words: Agglomeration externalities, labour productivity, industrial concentration

JEL code: O18 - Regional, Urban, and Rural Analyses R11 - Regional Economic Activity: Growth, Development, and Changes R12 - Size and Spatial Distributions of Regional Economic Activity

Abstract in Dutch

De trek naar de stad is al honderden jaren bezig. Dientengevolge is de meeste economische bedrijvigheid geconcentreerd in kleine geografische gebieden. Het voordeel van nabijheid van mensen en bedrijven heten 'agglomeratievoordelen'. In dit paper meten we hun kracht op basis van Nederlandse regionale gegevens. We regresseren regionale arbeidsproductiviteit op een verzameling agglomeratie-indices, en vinden bewijs voor een productiviteitseffect van concentratie van productie, met een malus voor industriële verscheidenheid. Het bewijs ondersteunt derhalve Marschall-Arrow-Romer-voordelen. Het bewijs ondersteunt overigens niet Jacobs-voordelen, noch varianten van de Creatieve Klasse-hypothese.

Steekwoorden: agglomeratievoordelen, arbeidsproductiviteit, industriële concentratie

Contents

Summary[1]

This paper tests for the existence of different agglomeration advantages in the Netherlands. We distinguish between three kinds of agglomeration externalities: MAR economies (knowledge spillovers between proximate firms), Jacobs economies (cross-fertilization of knowledge), and variants of the creative class hypothesis. Their policy relevance is sketched in the introduction.

We construct and empirical model, in which we explicitly link different kinds of agglomeration advantages to the productivity effect of different agglomeration indices. This model is estimated for 40 Dutch COROP regions and 12 one digit industries for the period 1995 until 2001.

The estimation results support MAR economies, but not Jacobs economies nor variants of the Creative Class Hypothesis. In the conclusion, we round up and speculate on directions for future research.

1   Introduction

In the Netherlands, most people and firms are located in the urbanised western part of the country. There must be advantages of this spatial clustering, since otherwise people and firms would move out, and the Dutch economic distribution would converge towards a uniform distribution of economic activity over space.

The advantages of spatial clustering go under the name "agglomeration economies". Agglomerations have large local markets that allow for knowledge spillovers and savings on trade costs. Moreover, local producers of specialized intermediate inputs can find enough customers to reach their minimum efficient scale, just as people with specialized skills can find work in producing these inputs. And many inputs such as infrastructure can be shared. Finally, agglomerations tend to attract creative, highly educated and entrepreneurial people.

Agglomeration economies are relevant for both local and national regional policy. If the productivity of the incumbents in a region increases in spatial clustering, then local governments do wise, from their individual perspective, to attract other people and firms. Indeed, those who are believed to invoke agglomeration externalities, such as highly educated people or innovative firms, tend to be particularly welcome anywhere. Whether or not the national government should foster spatial clustering is unclear, since positive agglomeration externalities are accompanied by negative ones insofar location decisions are *re*location decisions. Moreover, spatial clustering also involves external costs, mainly related to congestion, and it may freeze existing regional disparities in wages and profits.

Because the welfare economics of regional policy is ambiguous, we abstain in this study from conclusions of the sort: there should be more or less spatial clustering. We confine the analysis to measuring the strength of agglomeration economies for the Netherlands by regressing labour productivity on a set of agglomeration proxies. We observe that MAR economies, where knowledge spills over between proximate firms within the same industry, contribute significantly to labour productivity. The effects of Jacobs economies with knowledge spillovers between firms of different industries and the mere clustering of creative people tend to be insignificant.

Related studies are Van Oort (2002) and Van Oort et al. (2004), where the dependent variables are the growth of R&D expenditure respectively ICT firm formation, and Frenken et al. (2004), where the dependent variables are the growth of (un)employment and labour productivity. Van Aalst et al (2005) and Marlet and Woerkens (2004) put human capital at centre stage in the vain of Glaeser and Florida. Our study contributes to this, as yet modest, empirical literature on agglomeration economies in the Netherlands. What sets our study apart from previous work is, however, its focus on the level of labour productivity broken down by regions and industries, and its tight link between theoretical agglomeration economies and empirical agglomeration proxies.

2 Empirical model

Geographical economists distinguish, roughly speaking, four kinds of agglomeration economies. Their common denominator is a positive relation between local productivity and local agglomeration. We fill in some details for Marschall-Arrow-Romer (MAR) economies (Marshall, 1890; Arrow, 1962; Romer, 1986), Jacobs economies (Jacobs, 1969), the New Economic Geography (NEG) (Fujita et. al, 1991), and variants of the creative class hypothesis ((Florida, 2002; Glaeser et al. 1992; Schumpeter, 1942). Data limitations led us leave the details of the New Economic Geography (Fujita et. al, 1991) untouched.

MAR economies hinge primarily on knowledge spillovers between proximate firms of the same industry, although input sharing and pooling of markets for specialized inputs is also important. MAR economies materialize as a positive relation between productivity and concentration of production within a given industry.

Jacobs economies hinge - like MAR economies - on knowledge spillovers between proximate firms. The focus is on cross-fertilization, namely knowledge spillovers between firms of different industries. Jacobs economies materialize as a positive relation between productivity and variety of industrial production.

According to Florida (2002), creative people tend to live in agglomerations. If these people are relatively productive, one observes a positive relation between productivity and agglomeration. Glaeser et al. (1992) make essentially the same argument, although they prefer to abandon the somewhat vague concept of creativity in favour of human capital, measured as educational attainment. In this study, we follow their practice. In the vain of Schumpeter (1942) we add, however, entrepreneurial spirit to human capital as a potential determinant of relatively high productivity levels in agglomerations.

A regression equation that captures these agglomeration economies is:

$$\log \frac{Y_{ir}}{L_{ir}} = \beta_{0r} + \beta_1 C_{ir} + \beta_2 S_r + \beta_3 A_r + \beta_4 H_r + \beta_5 E_r + \varepsilon_{ir} \tag{1}$$

where

Y_{ir}	production of industry i in region r
L_{ir}	labour input of industry i in region r
C_{ir}	concentration index of industry i in region r
S_r	specialization index of region r
A_r	agglomeration index of region r
H_r	human capital in region r
E_r	entrepreneurial spirit in region r
ε_{ir}	error term

The independent variable $\log\dfrac{Y_{ir}}{L_{ir}}$ is log labour productivity broken down by industry and region, where Y_{ir} is measured as value added, and L_{ir} as number of employees. From the perspective of MAR and Jacobs economies, total factor productivity would be better, as total factor productivity measures the state of technological know how, and MAR and Jacobs economies are primarily about knowledge spillovers. The choice for labour productivity was, however, easy due to data limitations: capital stocks are unavailable at the regional level, hence total factor productivity cannot be calculated.

The concentration index C_{ir} measures the extent of over or underrepresentation of industry i in region r. It is defined as the log difference between the share of region r in the production of industry i and the k share of region r in the production of all industries:

$$C_{ir} = \log\frac{Y_r^i}{Y^i} - \log\frac{Y_r}{Y} \tag{2}$$

MAR economies imply a positive first partial derivative of $\log\dfrac{Y_{ir}}{L_{ir}}$ with respect to C_{ir}, thus we expect $\beta_1 > 0$.

The specialization index S_r measures the extent to which the economic structure of region r is biased towards a subset of industries. It is defined as a weighted sum of differences between the share of industry i in the production of all industries in region r and the share of region r in the production of all industries. It is, in other words, a Theil index of industrial variety:

$$S_r = \sum_{i=1}^{I} \frac{Y_r^i}{Y_r}\left(\log\frac{Y_r^i}{Y_r} - \log\frac{Y_r}{Y}\right) \tag{3}$$

Since S_r decreases when regions become less specialized, that is, when the industrial variety increases, Jacobs economies imply $\beta_2 < 0$.

The agglomeration index A_r measures the density of economic activity of region r. It is defined as the log difference between the share of production of value added of all industries in region r and the share of region r in the surface of all regions:

$$A_r = \log\frac{Y_r}{Y} - \log\frac{km_r^2}{\sum_r km_r^2} \tag{4}$$

Considering the many agglomerations throughout the world density of economic activity is expected to be of positive influence; $\beta_3 > 0$. A combination of MAR and Jacobs economies as well as variants creative class hypothesis are also consistent with $\beta_3 > 0$.

The variables H_r and E_r capture the Glaeser and Schumpeter variants of the creative class hypothesis. Human capital is measured as the percentage of employees with higher education in the workforce, and entrepreneurial spirit as the percentage of new firms in the total number of firms. Obviously, we expect $\beta_4 > 0$ and $\beta_5 > 0$.

Region specific factors affecting productivity, such as open access to the sea, a fertile soil, etc. are captured by the region specific constant β_{0r}. Factors affecting productivity at random run into the error term ε_{ir}.
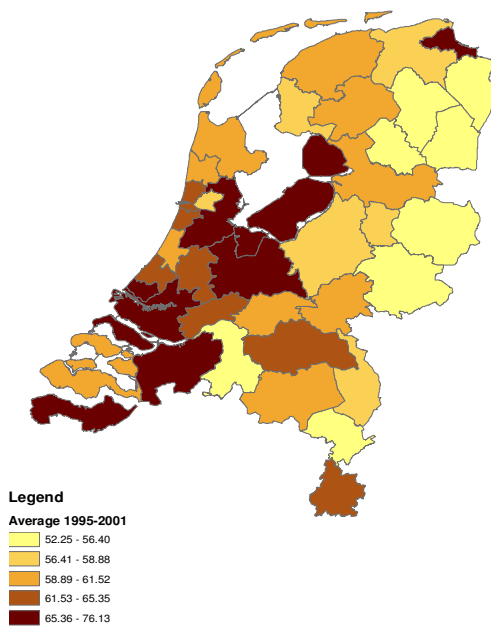
Thus, we have a simple regression equation that can put the strength of the different agglomeration economies to the test. A caveat is, however, that they are, to a certain extent, observationally equivalent. Different agglomeration economies can work in unison to produce one and the same empirical relation. We are, therefore, painting with a rough touch here.

3   Data and descriptive statistics

We exploit the regional database of the Dutch Central Bureau of Statistics.[2] It contains data on production of value added and labour input for 40 Dutch COROP regions and 13 industries at the one digit level for the period 1995 until 2001 (an average of this period is taken to exclude shock effects etc). We exclude, however, Mining and Quarrying on account of its exogenous location in East-Groningen, dictated by the presence of the Dutch gas reserves. It also contains data on the attainment. The EIM database on entrepreneurship[3] provides the data of firm turnover.

As an upshot for the regression analysis, we present the regional distribution of all variables, with the exception of the concentration index since this variable pertains to industry-region *combinations* rather than regions per se. Figure 3.1 displays labour productivity, averaged over industries and years. Clearly, the highest levels tend to be found in Western regions, with the exception of Zeeuws Vlaanderen in the far South-West and East-Groningen in the far North-East.

Figure 3.1 Regional distribution labour productivity

Legend
Average 1995-2001
52.25 - 56.40
56.41 - 58.88
58.89 - 61.52
61.53 - 65.35
65.36 - 76.13

[2] http://statline.cbs.nl
[3] http://www.ondernemerschap.nl

Figure 3.2 displays the regional distribution of the specialization and agglomeration indices. There is no clear spatial pattern for the specialisation index, but the centre of gravity of agglomeration lies in the Western regions.

Figure 3.2 Regional specialisation and regional agglomeration

Legend
Specialisation Index Score
- -0.0684 - -0.0195
- -0.0194 - 0.0398
- 0.0399 - 0.2078
- 0.2079 - 0.4089
- 0.4090 - 1.0095

Legend
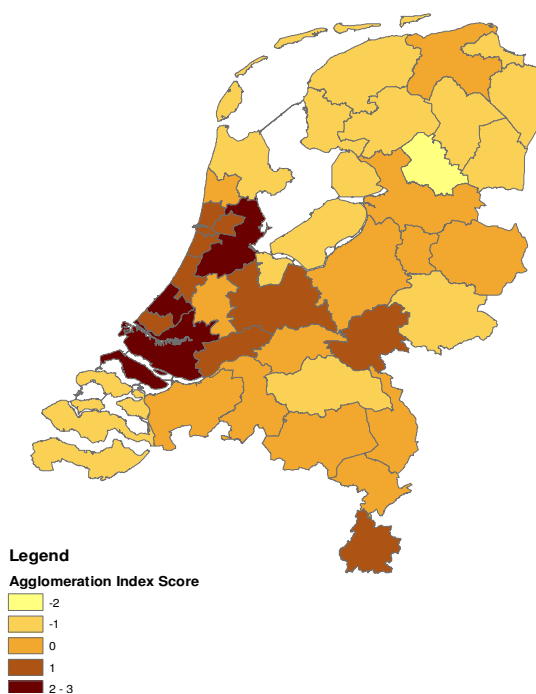**Agglomeration Index Score**
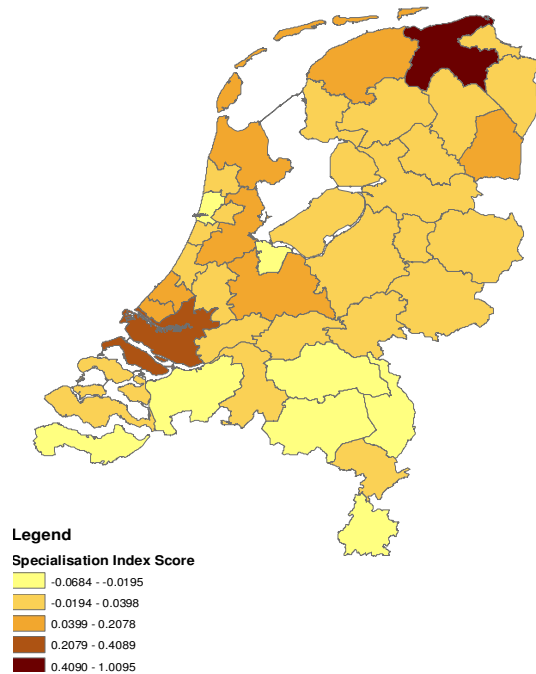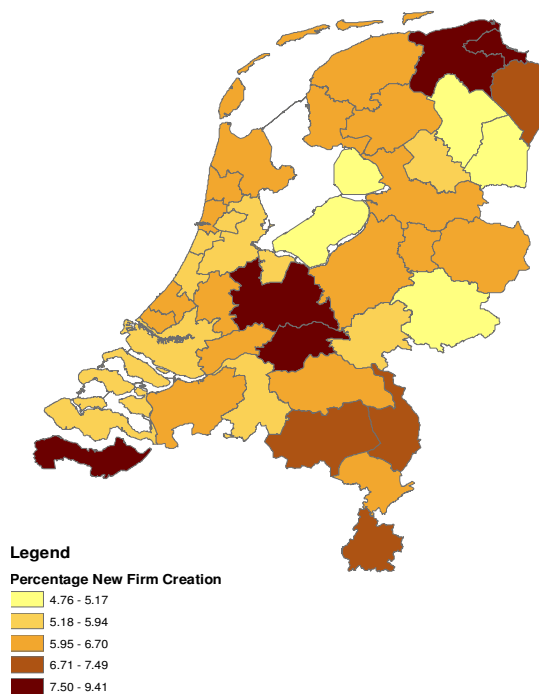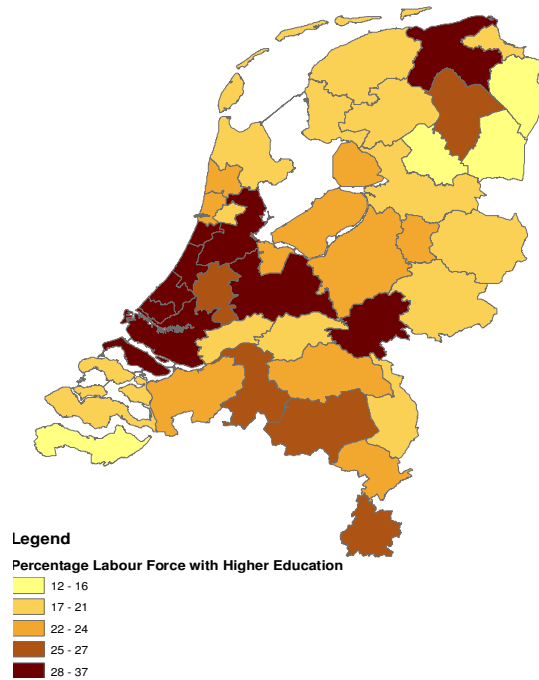- -2
- -1
- 0
- 1
- 2 - 3

Figure 3.3 displays the regional distribution of the highly educated and firm turnover. Again, the Western regions stand out, albeit with a few exceptions.

Figure 3.4 Regional distribution of highly educated and regional entrepreneurial spirit

Legend

Percentage Labour Force with Higher Education
- 12 - 16
- 17 - 21
- 22 - 24
- 25 - 27
- 28 - 37

Legend

Percentage New Firm Creation
- 4.76 - 5.17
- 5.18 - 5.94
- 5.95 - 6.70
- 6.71 - 7.49
- 7.50 - 9.41

From a simple eyeball analysis of these regional distributions, one can learn that there may be a positive relation between productivity and agglomeration, and between productivity and human capital or entrepreneurial spirit.

4 Regression results

We ran four regressions based on equation (1). The first regression, displayed in table 4.1, is the simplest of all, as it includes only the agglomeration index. The second adds the impact of concentration and specialization. The third focuses on the creative class hypothesis, as it includes only shares of highly educated and new firms. The fourth is comprehensive, as it includes all variables. In all regressions, we ignore the time dimension in our panel because there is little inter-temporal variation in any of the variables. We use industry fixed-effects to control for industrial differences in productions, caused by differences in capital input etc.

Table 44.1   Effect agglomeration economies on labour productivity

	Model 1	Model 2	Model 3	Model 4
Constant	3.871 (49.231)	3.940 (177.897)	3.270 (16.979)	4.475 (21.134)
Agglomeration A_r	0.233 (10.479)	0.233 (12.381)		0.312 (9.784)
Concentration C_{ir}		0.624 (13.086)		0.626 (13.225)
Specialisation S_r		0.305 (2.573)		0.541 (3.780)
Entrepreneurs E_r			-0.007 (-0.300)	-0.017 (-0.808)
Human Capital H_r			0.027 (6.905)	-0.018 (-3.115)
Number of Observations	478	478	478	478
R square	0.323	0.508	0.243	0.518

Note: T-values are in parentheses

As expected, density of economic activity shows a clear positive effect on labour productivity. The results further provide evidence for the MAR economies, as the coefficients on C_{ir} are positive and statistically significant in all regressions where this variable features. Evidence for Jacobs economies and the creative class hypothesis is, however, absent. The coefficients on S_r and H_r have unexpected signs, while the coefficient on E_r is never statistically significant.

The mean value of the coefficient on A_r is 0.26. It is easy to verify that this implies an elasticity of regional labour productivity with respect to regional production of 0.18. Thus, double production in a region, and the labour productivity of all industries in that region increases with 18% on average. Similarly, the mean value of the coefficient on C_{ir} is 0.62. This implies an elasticity of labour productivity of an industry in a region with respect to the production of that industry in that region of 0.43. Thus, double production of an industry in a region, and labour productivity of that industry in that region will increase with 43% on average.

It is difficult to compare these implied elasticities to the findings of the related literature. Our dependent variable is the level of labour productivity, whereas the dependent variables in the related literature tend to be growth rates of employment or ICT innovation. Thus, unless one has a theory that maps, for example, the growth rate of employment to the level of labour productivity, little can be said about the consistency of the. Nevertheless, the implied elasticies

of 0.18 and 0.62 are reasonable from an intuitive perspective, both in terms of their absolute as well as their relative size.

Eye-catching is the absence of evidence for the Jacobs and the creative class hypothesis, which is also in contrast with previous Dutch studies (Broersma and Oosterhaven, 2004; van Aalst et al, 2005). The contrast is most likely caused by a different dependent variable. Our results show that diversity in economic activity and possession of a large creative class do not influence labour productivity on this aggregation level. It is, however, expected that these agglomeration externalities operate on a lower regional and industrial aggregation level. Unfortunately, data limitations hinder us to test this hypothesis.

Agglomeration externalities are expected to differ between industries. Especially industries which are knowledge intense, such as ICT, are more likely to be influenced by Jacobs externalities and the possession of a large creative class. The more capital intense industries are more likely to be influenced by MAR-externalities. The industry fixed-effects are significant in the regressions which suggest industries differences matter. A too small sample generates insignificant results for industry separated regressions.

As a robustness check, we tested for non-normality of the residuals, but could not reject the null-hypothesis. Moreover, we excluded the own production of a region from the agglomeration index, or the own production of an industry in a region from the concentration index for the sake of ruling out possible endogeneity. Both the estimates and their standard errors stay roughly the same. Finally, we ran a random effects regression as suggested by Moulton (1990), in order to asses possible underestimation of the standard errors in a fixed effects regression where industries are clustered by region. Again, the results do not change substantially.

5   Conclusion

There is evidence supporting agglomeration advantages in the Netherlands. We find a positive labour productivity effect of geographical concentration of production. The effect is particularly pronounced if the concentration is of firms of the same industry, but also occurs if the concentration is of firms of any industry, although the positive effect decreases in industrial variety. This is consistent with MAR-economies. It is, however, inconsistent with Jacobs economies. In addition, we test variants of the creative class hypothesis by including human capital and entrepreneurial spirit as regressors. They do not invoke, however, a statistically significant labour productivity effect on this aggregation level.

Although the analysis is fairly straightforward, we do spot two major drawbacks, one theoretical, the other empirical. Instead of sweeping them under the carpet, we choose to present them as directions for future research. First, the different agglomeration economies are, to a certain extent, observationally equivalent, that is, they predict the same empirical relation between labour productivity and concentration of production. In order to device a test in which the different economies are pitted against each other in a pure manner, it is necessary to work out more precise, distinguishing predictions. Second, regional data are often of poor quality, or lack essential variables. This problem increases if one chooses to do the analysis at a lower level of regional and industrial aggregation. Advances in this research program are therefore conditional on better and more appropriate data.

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