Regional Science and Urban Economics 42 (2012) 595–606

Contents lists available at SciVerse ScienceDirect

Regional Science and Urban Economics

journal homepage: www.elsevier.com/locate/regec

Is there a limit to agglomeration? Evidence from productivity of Dutch firms

Marian Rizov [a,b,*], Arie Oskam [b], Paul Walsh [c]

[a] Middlesex University Business School, United Kingdom and SPU Nitra, Slovakia
[b] Wageningen University, The Netherlands
[c] University College Dublin, Ireland

ARTICLE INFO

Article history:
Received 8 December 2010
Received in revised form 11 February 2012
Accepted 26 February 2012
Available online 3 March 2012

JEL classification:
D24
R11
R30

Keywords:
Agglomeration
Factor prices
Total factor productivity
Structural estimation
The Netherlands

ABSTRACT

We compute aggregate productivity of three categories of regions, classified by the level of urbanization and density of economic activity in the Netherlands, from firm-specific total factor productivity (TFP) measures. TFP measures are estimated by a semi-parametric algorithm, within 2-digit industries, covering agriculture, manufacturing, construction, trade and services, using AMADEUS data over the period 1997–2006. We analyse the productivity differentials across urbanization categories by decomposing them into industry productivity effect and industry composition effect. Our analysis indicates that there is non-linear net effect of agglomeration on productivity growth but in levels agglomeration is associated with higher productivity.

1. Introduction

Agglomeration and thus, the geographic concentration of economic activity in urbanized regions can result in a snowball effect, where firms tend to agglomerate to benefit from higher diversity and specialization in production processes. There are also benefits to firms from co-locating in close proximity to other firms in the same industry (Marshall, 1920; Henderson, 1974, 2003). Both urbanization and localization economies can be considered centripetal (agglomeration) forces leading to concentration of economic activity. Theoretical models (e.g., Glaeser et al., 1992; Ciccone and Hall, 1996) and empirical studies (e.g., Carlino and Voith, 1992; Ciccone, 2002; Combes et al., 2009, 2010; Graham, 2009) show that agglomeration associated with high density of economic activity positively affects productivity.

Agglomeration can affect productivity in several ways. If technologies have constant returns themselves, but the transportation of products from one stage of production to the next involves costs that rise with distance, then the technology for the production of all goods within a particular geographical area will have increasing returns – the ratio of output to input will rise with density. If there are positive externalities associated with the physical proximity of production, then density will contribute to productivity for this reason as well. A third source of density effects is the higher degree of beneficial specialization possible in areas of dense economic activity.

A second branch of the literature on agglomeration hypothesises economies of scale internal to firms (e.g., Fujita, 1988; Hanson, 1996; Davis and Weinstein, 2008). Models with internal increasing returns build on theories of the firm and its market and commonly employ the formalisation of monopolistic competition suggested by Spence (1976) and Dixit and Stiglitz (1977) to demonstrate that non-transportable intermediate inputs produced with increasing returns imply agglomeration. In a related model, Krugman (1991) demonstrates that agglomeration will result even when transportation costs are small, if most workers are mobile. The essence of all these models is that when local markets are more active, a larger number of producers of the differentiated intermediate inputs break even and the production of final goods is more efficient when a greater variety of intermediate inputs is available.

However, Henderson (1974) building on work by Mills (1967) demonstrates that, in an equilibrium, disamenities from agglomeration and high density may offset the productivity advantages thus acting as centrifugal forces.[1] For example, these include increased costs resulting from higher wages driven by competition among firms for skilled

* Corresponding author at: Department of Economics and Statistics, Middlesex University Business School, London NW4 4BT, United Kingdom.
E-mail address: m.rizov@mdx.ac.uk (M. Rizov).

[1] Alonso-Villar (2008) using features of Forslid and Ottaviano's (2003) framework analytically shows that when considering the effects of congestion costs, the dispersion of economic activity is possible not only at high, but also at low transport costs which suggests limits to agglomeration.

0166-0462/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
doi:10.1016/j.regsciurbeco.2012.02.006

labour, higher rents due to increased demand for housing and commercial land, and negative externalities such as congestion. Recent studies (e.g., Rappaport, 2008; Broersma and Oosterhaven, 2009) confirm that there are limits to agglomeration and point to a negative effect of congestion (crowdedness) on productivity growth.[2] Furthermore, evidence suggests that increases in estimated productivity are insufficient to sustain the high levels of crowdedness in heavily urbanized areas (Rappaport, 2008).

In this paper we study the net impact of agglomeration (accounting both for agglomeration and congestion) on total factor productivity (TFP) using Dutch firm level data for the 1997–2006 period. The Netherlands is particularly suitable for studying agglomeration-congestion effects given the fact that the country is one of the most urbanized and densely populated in the world but it clearly exhibits diversity in the degree of urbanization. Three main categories of regions can be distinguished, according to their level of urbanization and population density, characterised by increasing aglomeration and congestion effects. Analysing the effects Broersma and Oosterhaven (2009) find non-linear net impact of agglomeration on labour productivity growth in the Dutch regions. We extend their analysis by taking a production function approach as in Henderson (2003) and related studies to directly account for the net efect of agglomeration on productivity. We contribute to the literature by applying an advanced TFP estimation technique following modelling ideas in Olley and Pakes (1996) and Ackerberg et al. (2007).[3] We explicitly model unobservable productivity utilising unique disaggregated land price and wage data and incorporate directly the effects of these and other location characteristics into the structural estimation algorithm. Our results add robust empirical evidence to the small but growing literature on the limits of agglomeration. In line with Mitra's (1999), Rappaport's (2008) and Broersma and Oosterhaven's (2009) results we find a non-linear relationship between net agglomeration and productivity growth.

The paper is organised as follows. In Section 2 we characterize the three urbanization categories used in the analysis and introduce a simple economic geography model to motivate the link between agglomeration, land prices and productivity. Next, in Section 3, we describe our econometric framework and develop the model of unobservable productivity. In Section 4 we describe the AMADEUS data used in our empirical analysis and report results from estimating production functions. In Section 5 we analyse aggregate productivity in levels and changes by the means of decompositions. We also analyse samples of manufacturing and service industries separately as agglomeration effect are likely to differ across industies. Section 6 concludes.

2. Agglomeration effects in the Dutch regions and theoretical considerations

The territory of the Netherlands is subdivided into 40 COROP (Coördinatie Commissie Regionaal Onderzoeks Programma) regions, based on functional regionalization principles, which form the NUTS3 (Nomenclature of Units for Territorial Statistics) level EU classification. For the analysis of regional differentiation, a functional typology based on degree of urbanization and population density is used by the CBS (Het Centraal Bureau voor de Statistiek) and other government departments. According to the typology the 40 COROP regions are divided into three categories: less urbanized, urbanized and highly urbanized. Given that the meaning of the concept of rural economy is largely a misnomer in the Netherlands, the typology based on degree of urbanization is quite appropriate for the analysis of the socio-economic developments in the Dutch regions.[4]

A comparative analysis of main characteristics of the three urbanization categories, for the 1996–2003 period, summarised in Table 1 reveals that employment growth, usually associated with productivity growth, in all three categories was positive as the growth rates were the highest in the less urbanized regions.[5] Population growth in less urbanized regions also exceeded that of the highly urbanized regions. However, economic growth in the less urbanized regions was of about 2.2% annually which was lower compared to the growth in the other two urbanization categories. Age distribution was quite similar in all categories. Unemployment rates in the less urbanized regions were slightly higher compared to other urbanization categories while disposable income per capita was below that in the urbanized and highly urbanized regions.

The comparative analysis based on summary statistics shows that socio-economic differences across the three urbanization categories were relatively small and population density and land prices seem to be the main characteristics of difference.[6] Therefore, next, we focus on the relashinship between population density and land prices reflecting the strength of agglomeration and find a nonlinear relationship which is depicted graphycally in Fig. 1. This is an important first evidence for presence of congestion and other negative externalities from agglomeration in the Netherlands. The finding is consistent with results of Broersma and Oosterhaven (2009) who find negative impact of extreme agglomeration on labour productivity growth in the Dutch regions.

Next, to understand better agglomeration-congestion effects in the Netherland we employ a simple economic geography model that casts light on above facts. The model is based on neoclassical trade theory and assumes equality of output prices for each industry across all regions. Individual firms in each industry have constant returns to scale and make zero profits, so the equality of output price to unit cost holds for all regions. Furthermore, the weak form of factor price invariance with respect to endowments implies that the number of industries operating in each region should be at least as great as the number of inputs with region-specific prices (Leamer, 1984). The solution to the system of equations for price equality to unit cost within industries leads to the result that relative factor productivities are exactly equal to relative factor prices across regions (e.g., Rice et al., 2006). This result places the non-linear relationship between land prices and population density presented in Fig. 1 in the context of productivity differences across the Dutch regions.

Another important implication of the model result is that although the spatial variation in factor prices is determined entirely from the production side of the economy the model is consistent with perfect mobility of some factors such as labour across regions – an important feature of the Dutch labour market. If there is perfect labour mobility,

[2] In somewhat different but related context Saito and Gopinath (2009) and Combes et al. (2009) study the impact of firm self-selection and agglomeration on regional or city productivity. The first paper finds that firm's self-selection outweighs the contribution of agglomeration economies in increasing a region's productivity level in Chile while the second paper finds the opposite for the case of French cities.

[3] Previous studies attempting to link agglomeration and productivity apply a two-stage analysis. In the first stage authors estimate firm productivity, and in a second stage they proceed to link productivity to agglomeration measures. In our view testing for a relationship between agglomeration and (unobservable) productivity, *ex post*, is admitting that there is omitted information that should have been used while estimating the production function in the first instance.

[4] There is also a separate geographical classification of the Randstad urban zone (Amsterdam, Rotterdam, The Hague and Utrecht) which has resulted in fourty subregions: large and medium-sized cities and designated growth towns are treated as separate units, whereas for each of the functional urban regions in the Randstad all other municipalities are aggregated into one subregion.

[5] We acknowledge that the analysis at aggregate urbanization categories may mask differences at more disaggregated level such as municipalities (gemeenten). It is important to point out, however, that Terluin et al. (2005) who focussed on a number of selected municipalities did not find any substantial differences in socio-economic indicators from the national average, employment growth being the exception.

[6] The data source for land prices is the Cadastral Land Sales Database (CLSD) that contains information on land transactions, transaction prices, and the location of each parcel sold in the Netherlands. From the CLSD we obtained the transaction prices at 4-digit postcode level per hectare in 2003.