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Measuring revealed localisation economies

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Abstract This note proposes a method for measuring revealed external economies due to regional specialisation, distinct from localised external economies of diversity across industries. We show how regional differences in economic growth or productivity levels can be decomposed into differences due to: (1) differences in regional sector structure, (2) revealed localisation economies, and (3) the remaining difference at the level of the weighted average regional industry. The method is illustrated by means of Dutch data. Specialisation is shown to have a clear positive effect on the level of productivity and a clear negative effect on the growth of output and jobs.

Keywords Localisation economies · Productivity · Growth · Sectoral specialisation · The Netherlands

JEL Classification D24 · J24 · O18 · R11

1 Introduction

Localised external economies of scale and knowledge spillovers play an important role in new growth theory (Romer 1990) as well as in new spatial economics (Krugman 1991; Fujita et al. 1999). The origin of the concept of economies of localisation can be traced back to Marshal (1890), who observed that the spatial concentration of an industry produces specialised local supplying industries, local labour market pooling and local knowledge spillovers between firms. To this, one may add the innovative effect of a critical local demand and competition among local firms (Porter 1990). Besides economies of localisation at the industry level, old spatial economics

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(Hoover 1948; Isard 1956) distinguishes local external economies of scale across industries and labels these as urbanisation economies. Jane Jacobs (1969) adds to this that the diversity of industries found in most large agglomerations is specially inductive to product innovation, whereas process innovations are stimulated more by the spatial concentration of a single industry. In fact, a whole continuum of economies of spatial concentration may be distinguished, from those at the level of a single firm (internal economies of scale), via those at the level of an industry (localisation economies) or a group of strongly interacting industries (which we propose to label as cluster economies), to those for the economy as a whole (urbanisation economies).

Empirical studies test the existence of these economies in a variety of ways. Testing for urbanisation economies is relatively simple as economic size (with city data) or economic density (with regional data) are generally accepted as good proxies of the causes of such economies. Testing for localisation and cluster economies is more problematic. First, the choice of sectoral classification and regional delimitation poses problems, but these may be solved by testing for different sectoral aggregations and by testing for spatial dependence (e.g. Van Oort 2004). Second, static localized external economies that mainly impact productivity levels need to be distinguished from dynamic localized external economies that primarily impact output and job growth (e.g. Frenken et al. 2004).

Third, the absence of sectoral specialisation of a local economy is mostly used as a measure of the diversity of that local economy. As a result—almost by definition—one excludes the co-existence of localisation economies with urbanisation economies due to diversity. Partly due to this choice of indicator, the empirical literature tends to support either the urbanisation economies hypothesis (e.g. Glaeser et al. 1992; Bivand 1999) or the localisation economies hypothesis (e.g. Henderson et al. 1995; Feldman and Audretsch 1999) (see also Duranton and Puga 2000).

We propose to measure localisation economies in a new way, namely as part of a decomposition of regional differences in productivity levels (static economies) or as part of a decomposition of regional differences in economic growth (dynamic economies). Thus, an explicit distinction is made between static and dynamic localisation economies, while the measure of revealed localisation economies no longer equals that of having a specialised local economy. The latter property allows for the use the inverse of any measure of regional specialisation as an independent measure of regional diversity[1] and its subsequent use for testing for urbanisation economies due to diversity as distinct from localisation economies.

Section 2 discusses how our static and dynamic measures of revealed localisation economies are derived from an extension of structural decomposition analysis known as shift-and-share analysis in spatial economics and as constant-market-share analysis in international economics. Section 3 illustrates the method by an application to

[1] In our opinion, a good diversity index is 100 minus the *specialization index*, which runs from 0% to 100% and equals $50 * \sum_i |S_{ir} - S_{in}|$, with S_{ir} = employment or output share of industry i in the analyzed region r and S_{in} = the comparable share in norm region n (in the literature mostly the nation at hand). This index can be found in most textbooks on regional economics (already in Hoover 1948), but nowadays unjustly ascribed to Krugman (e.g. (Brakman et al. 2001)). There is an interesting link with the measurement with Revealed Comparative Advantage in international economics and the Location Quotient in spatial economics (Balassa 1965; Hoen and Oosterhaven 2006).

the regional differences in productivity levels and the growth rates of output and employment, for the Netherlands over the period 1990–2001. In the concluding section we briefly discuss the major objection against decomposition analysis, namely its deterministic character, and how it can actually be turned into an advantage.

2 Decomposition methodology

The decomposition of any aggregate is almost never unique (Dietzenbacher and Los 1998). The decomposition of regional differences in productivity levels, and in output and job growth is relatively simple, but still a choice has to be made. For a single region, the difference with the national value is mostly decomposed into a sector structure component that measures whether e.g. fast growing industries are over-represented, and a regional component that measures the regionally weighted difference between regional and national industry growth rates (see Perloff et al. 1960, for a first major application).

This standard decomposition, however, represents only one of five possible alternatives (Oosterhaven and van Loon 1979). If the research purpose is to compare the same phenomenon over several different regions, then each component needs to be weighed or measured with the same (in the literature mostly national) reference weights or values. Consequently, for interregional comparisons only one of the five alternatives is acceptable, namely:

$$\begin{aligned} V^r - V^n &= \sum_i (S_{ri} - S_{ni}) V_{ni} + \sum_i (S_{ri} - S_{ni})(V_{ri} - V_{ni}) + \sum_i S_{ni}(V_{ri} - V_{ni}) \\ &= SS + LE + RC \end{aligned} \tag{1}$$

In (1), the aggregate regional value of the variable at hand, V^r, equals the correctly weighted sum of its sectoral values, $\sum_i S_{ri} V_{ri}$. The aggregate national value, V^n, is defined analogously. In the case of a decomposition of labour productivity, where $V = Y/L$ (with $Y =$ output and $L =$ employment), the correct weights equal the employment shares: $S_i = L_i/(\sum_i L_i)$, as can easily be verified. In the case of output growth ($V = \Delta Y/Y_0$), the correct weights equal the output shares in the base period. Analogously, jobs shares in the base period have to be used for decomposing job growth.

In the case of productivity levels, the three components of (1) have the following interpretation:

- $SS =$ *sector structure* (*or industry mix*) *component*. SS is positive if regionally over-represented sectors, $(S_{ri} - S_{ni}) > 0$, have a nationally high productivity and/or if regionally under-represented sectors, $(S_{ri} - S_{ni}) < 0$, have a nationally low productivity. Note that $\sum_i (S_{ri} - S_{ni}) = 0$.
- $LE =$ *revealed localisation* (*or cluster*) *economies component*. LE is positive if regionally over-represented sectors have a value that is regionally higher than nationally, $(V_{ri} - V_{ni}) > 0$, and/or if regionally under-represented sectors have a value that is regionally lower than nationally, $(V_{ri} - V_{ni}) < 0$. Thus, LE may rightfully be

interpreted as indicating either localisation economies or cluster economies, where the adjective depends on the empirical sector classification used.[2]

- *RC* = *regional* (*or residual*) *component*. *RC* is positive if the (nationally weighted) average regional sector has a productivity that is regionally higher than nationally. Thus, *RC* captures all region-specific factors not included in *SS* or *LE*.

Note that the above comparison of regional sector shares with national sector shares is not without problems, as it implicitly assumes that the national shares represent some kind of ideally diversified sector structure. In large nations where climate and resources differ considerably, it may not be appropriate to use national sector shares, as certain sectors may not be economically viable in all regions.

3 Empirical decomposition outcomes

The nature of decomposition (1) is empirically illustrated with yearly data for 40 regions and 21 sectors, for the Netherlands for the period 1990–2001. Output is measured by gross value added in market prices, and employment by the labour volume of employees in full time equivalents (CBS 1990–2001a). The exploration of the huge natural gas field in the province of Groningen is excluded from the analysis. Only in the case of agriculture, the labour volume of employees could be increased with the labour volume of the employers (CBS 1990–2001b) (see Broersma and Oosterhaven 2004, for further details on the data). Table 1 summarises the results of the 480 decompositions of productivity levels, and the 2×440 decompositions of the two growth rates.

The first row shows that 25% of the average difference of 6.9% between the regional and the national level of Dutch labour productivity may be attributed to *static* localisation (dis)economies. A positive value of the LE component indicates that positive externalities dominate over negative externalities. The first row further shows that the average Dutch region's specialisation results in a 1.6% higher level of labour productivity. The average absolute value of 2.5% indicates that regional specialisation does not always pay off, but the positive values outnumber and outweigh the negative ones in the total of the 480 decompositions.

When we turn from static to *dynamic* localisation economies, the picture changes dramatically. Still about a quarter of the average difference between regional and national growth may be attributed to localisation (dis)economies, but now specialisation no longer pays off. In terms of output growth, on the average, specialisation results in a 0.24%-point lower yearly growth, and in terms of job growth it results in a reduction of 0.23%-point yearly. This may be taken as an indication of a diminishing marginal

[2] A fine sector classification, in general, would justify the label 'localisation economies', whereas a coarse classification would justify to talk of 'cluster economies', as clusters of strongly related industries often, but not necessarily, combine industries that belong to the same more aggregate sector grouping. However, if cluster economies are the real cause of the external economies, using a fine sector classification also produces positive localisation economies. On the other hand, as one of the referees pointed out, positive cluster economies detected at a high level of aggregation may very well be caused by localisation economies in a large sub-sector. Hence, a strict delimitation between localisation and cluster economies cannot be given, also because we are dealing with a continuum of external economies.

Table 1 Summary of the yearly decomposition analyses, averages in %-points, 1990–2001

	Average regional deviation from national total	Contribution of sector structure (*SS*), regional component (*RC*), localisation economies (*LE*)			Size of revealed localisation, c.q. cluster economies	
	Absolute	*SS*	*RC*	*LE*	Aver.	Abs.
Level of labour productivity	6.87	23%	52%	25%	+1.60	2.49
Growth of value added	0.81	27%	47%	26%	−0.24	0.36
Growth of labour volume	0.60	23%	50%	27%	−0.23	0.28

return to specialisation. These negative values also indicate that the over-represented sectors are growing slower than their national average, whereas the under-represented sectors are growing faster. The Dutch regional sector structures are clearly converging to the national average (see Oosterhaven and Pellenbarg 1994, for comparable results for earlier periods and different sector classifications).

4 Conclusion: proceed with regression analysis

We have shown both theoretically and empirically that localisation economies may be measured by means of the interaction component from a well defined structural decomposition analysis. The major disadvantage of decomposition analysis is its deterministic character (Houston 1967; Richardson 1978). This disadvantage, however, is easily remedied by adding the localisation economies component—and the sector structure component for that matter—to a regular regression analysis. This then allows for testing the statistical significance of both components in explaining differences in productivity and growth among regions. In this way it also becomes possible to test whether or not localisation economies do co-exist with diversification economies, as proves to be the case in Broersma and Oosterhaven (2004).

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