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Sectoral Diversity in Regions and Market Size, Empirical Tests

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Abstract:

The present paper discusses industry economies of scale and market potential for the manufacturing-, the natural resource- and the service sector in Swedish functional regions between 1993 and 1998. The degree of scale economies and market potential are assumed to determine the location of industries. They are also supposed to determine whether industries are dependent on market size over time. Firms within the manufacturing sector are likely to reach a stage of maturity and product standardization and are hence assumed to be less dependent upon regional size over time. Evidence of the manufacturing sector being relatively less dependent on market size than the service sector seem to be the case from the statistical analysis. The relationship also seems to be strongest for the manufacturing sector when comparing the difference between ordinary firms and micro-firms with less than 5 employees. The natural resource dependent sector seems to have the strongest impact from past diversity when it comes to ordinary firms, suggesting a strong dependence upon primary materials.

Keywords: Scale-Economies, Sectoral Diversity, Market Potential, Logistic Growth

1. Introduction

The regional economy is frequently advocated to benefit from well-developed networks of industries sustaining agglomeration of economic activity.

The important strand concerning the geographical distribution of economic activity is regional science. Market potential analysis is one sub-section of regional science and was introduced by Harris (1954) in his study of the location pattern of the U.S. manufacturing industry. It contains sub-divisions such as external economies by Marshall (1920) and Hoover (1948). Mills (1967) and later on Henderson (1974) brought the effect of the agglomeration utility for the household into the analysis. According to those authors, agglomeration effects from households and firms would have to be weighed against each other before one could state possible positive rewards to the regional economy. Mills brought forward the idea of a monopolistic market structure and more recently authors such as H.M. Abdel-Rahman (1988), Rivera-Batiz (1988) and Krugman (1990, 1991) have relaxed the strict monopolistic argument to allow for monopolistic competitive firms with a production process being subject to scale economies.

In the spatial modelling by Fujita, Krugman and Venables (1999), the location of industries are dependent on transaction costs. Scale effects in their modeling work through product variety. Price indices in regions are assumed negatively affected from the continuous introduction of new varieties depending on the elasticity of substitution between differentiated products. So large regions will have more sectors overall and especially sectors in the introductory part of the product life cycle.

The purpose of this paper is to analyze to what extent market size and past sectoral diversity are beneficial to the establishment and agglomeration of firms.

The outline of the paper is as follows. In Chapter 2 we present theory of spatial economies and regional evolution of economic life and diversity. Chapter 3 presents the results building upon the derived hypothesis in chapter 2. Finally, chapter 4 suggest conclusions and ideas for future research.

2. Sectoral Diversity

2.1 Sectoral diversity across regions

The present paper discusses agglomeration economies from a market potential argument. Most importantly, we are interested in describing the self-reinforcing effects of a regional market. The primal driving force to these

effects is a desire of firms to either maximize their profits or their revenues. One can assume that the over-all intention of firms is to maximize their welfare through either market shares or through margin shares.

When it comes to the growth of sectoral diversity in regions, theory supports the idea that there is an upper level threshold of growth. That is, decreasing returns to scale set in at a certain level of regional size. This is supposed to be due to congestion costs like the one described in basic production economics. If one considers the immobile proportion of resources in a region in due course contributing sharply to decreasing returns of agglomeration. For instance, increasing land rents and the cost of commuting are, if you will, a type of accelerators of such decreasing returns.

There is also a lower limit to sectoral diversity due to the fact that small regions contain a bundle of basic industries that are most often not dependent upon large consumer areas (i.e. that do not experience large scale economies in production; health care, dentists, groceries etc). Those industries are thus not restricted to any particular region and are also named lower-order industries according to central place theory.

The above arguments for the distribution of sectoral diversity therefore seem to support a logistic growth approach.

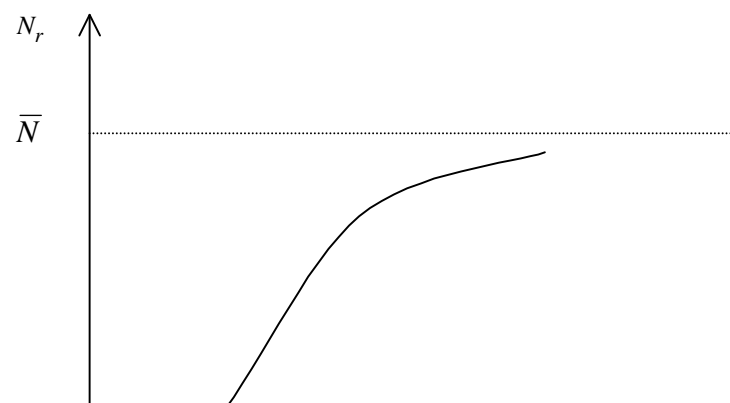
$$N_r = \left(\frac{\bar{N}}{1 + Ae^{-\beta L_r}} \right) \quad \text{for some constant A.} \quad (1)$$

Where β is the rate of increase (or adoption), N_r is number of industries in region r , \bar{N} is the upper boundary number of industries and L_r is regional population. Since we know from (1) that,

The rate of increase of the stock of sectors over population is described by

$$\frac{\partial N_r}{\partial L_r} = \frac{\beta \bar{N} (Ae^{-\beta L_r})}{(1 + Ae^{-\beta L_r})^2} = \beta N_r \left(1 - \frac{N_r}{\bar{N}} \right) \quad (2)$$

Since the difference in (2) consists of $\frac{N_r}{\bar{N}}$, that is, region r 's share of diversity. As N_r approaches either its limit \bar{N} or zero, the rate of increase approaches zero. Figure 2.1 demonstrates this relationship between number of sectors and population.



$$N = \left(\frac{\bar{N}}{1 + Ae^{-\beta L_r}} \right)$$

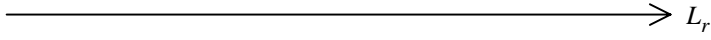


Figure 2.1. Logistic relationship between number of sectors and population.

In the monopolistic competition modelling by Fujita, Krugman and Venables (1999) they define a type of market that is the Dixit-Stiglitz mechanism that refers to a product-market in which the introduction of new varieties are unlimited. The assumptions are that firms that are equally large are part of a monopolistic competition market category, where they produce differentiated goods. However, new firms can freely enter the market. This free entry makes new firms choose continuously among new varieties and it also generates a zero-profit output equilibrium.

Consumers are supposed to have taste for variety, with $\gamma > 1$, which is the elasticity of substitution between two types of goods. Firms are also assumed to follow a production scheme of internal scale economies.

The result in the model of Fujita, Krugman and Venables (1999) is that all firms are equally large, all products have similar price and zero-profit are made.

When it comes to trade in this type of model, the total demand for (net) shipments, x , from one region, say region r to another region, s , is

$$x_{rs} = (p_r t_{rs})^{-\gamma} G_s^{\gamma-1} m_s, \quad (3)$$

where p_r is the fob- or mill price in region r , m_s is market potential in the destination region s and G_s is the price-index such that $G_s = [\sum_r n_r (p_r t_{rs})^{1-\gamma}]^{1/(1-\gamma)}$, which decreases with the number of varieties, n_r , and increases with the size of the so-called iceberg transport cost $t_{rs} > 1$ ($1/t_{rs}$ of 1 unit of a good arrives in region s).

Total market potential of the industries in region r , M_r , becomes

$$M_r = \sum_s (p_r t_{rs})^{-\gamma} G_s^{\gamma-1} m_s \quad (4)$$

The more differentiated products (lower γ), the greater will be the decrease of the price index in region s , G_s , from an increase of the varieties, n and hence the higher will be the market potential in formula (4). This type of modelling basically states the fact that larger regions with more sectors would have a lower price index from an increased number of differentiated industries competing on different levels of substitution. According to equation (4) we would expect that a region with a large market potential would have large numbers of firms with differentiated output (more industries), than smaller regions. If the products are distance sensitive (larger t), that is, if transport costs are much higher outside than inside the region, concentration of the production is likely to occur. The opposite is likely to be the case if the products and/or the transactions are standardised and thereby much less distance sensitive. As a special case, one could also imagine the situation of “tapered” freight rates where longer hauls are less expensive per mile than shorter hauls (see for instance Button (1993)). One approximation of this would be the case of t being a logarithmic function of distance. This could allow an even stronger decentralisation to occur, not uniquely determined by the degree of distance sensitivity.

2.2 Sectoral Diversity Across Time

Cumulative- or self-reinforcing effects of economic diversity is supposed to follow a pattern of regions with a large market potential attracting industries enjoying scale economies of production. The self-reinforcing effects set in when these industries create a larger market and thus a growing regional market potential. As is the case with regional distribution, the self-reinforcing effects is supposed to concern in particular the producer- and consumer service sectors based on the fact that these types of industries handle a large proportion of so-called non-tradables and are therefore directly oriented towards the local (functional) market.

Kaldor (1970) displayed what he considered to be various scale-effects derived from the concept of Myrdal's (1957) cumulative causation. These scale effects are not solely derived from large-scale production but also through, among other things, the own-growth of the industry, the specialization in skill and development, the simplification of communication and the differentiation of production-stages. The cumulative effects do in reality consist of falling ‘efficiency wages’ (nominal wage index/productivity index) due to a sharper productivity increase than national average. This in turn causes high growth regions to gain even larger comparative advantage compared to stagnating regions.

Suarez-Villa (1988) discusses 6 phases of evolution with respect to Metropolitan general and sectoral factors. Employment shares in the service-sector goes through phases of slow decrease, decreasing at increasing rate, decreasing at decreasing rate, slow increase, increasing at increasing rate and finally stagnant increasing. Employment shares in the manufacturing sector follows an stagnant/slow increase, increasing at increasing rate, increasing at decreasing rate, slow decrease, decreasing at increasing rate and finally decreasing pattern. The difference between the sectors is due to lagging effects in the shift of employment to the manufacturing sector in the second and third phase. The services employment share becomes more important in stages three and four (maturing phase). Decreasing returns to agglomeration and faster growth of employment in the service sectors

eventually shift the shares between the sectors. Basically the scenario describes the manufacturing industry maturing and not any longer that dependent on metropolitan or urban market areas.

The above reasoning leads to the following hypothesis:

Hypothesis 1: By reaching a threshold level of maturity and product standardization, the share of industries within the manufacturing sector ought to be relatively less dependent upon regional size than past sectoral diversity relative to the private service sector.

Hypothesis 2: The natural resource dependent sector ought to be relatively less dependent on regional size than the service sector due to its dependence on primary materials.

Hypothesis 3: Regional industries that only consist of micro-firms (i.e. workplaces with less than 5 employees) ought to be less dependent of regional size than past sectoral diversity due to a reduced amount of scale in production. This relationship ought to be relatively more significant within the manufacturing sector than for the private service sector.

3. Changes in Sectoral Diversity

The data used in this paper is Swedish statistics on employment on a 5-digit SIC-code level for the years of 1993 and 1998. We use the NUTEK classification of 81 labor market (functional) regions. In table 3.1 we present the classification for the various industrial sectors. We also offer some examples of industries that the various classifications represent.

Table 3.1 Sectors and SIC-codes

Sector (i)	SIC-code	Examples of industries
Natural resource dependent sector	1111-14500	Agriculture Forestry Fishing, Mining of coal and lignite Extraction of crude petroleum and natural gas
Manufacturing sector	15111-37200	Manufacture of motor vehicles, trailers and semi-trailers Manufacture of basic metals
Private Service sector	40100-74849, 91111-99000	Wholesale trade Retail trade Hotels and restaurants Land transport Water transport
Public Service sector	75000-90008	Public administration and defence Social security Education

Source: Swedish Statistics

In chapter 2 we mentioned that a reasonable theoretical approximation of the growth of sectoral diversity was a logistic growth nature of distribution. We therefore estimate the data with the aid of a logistic function,

$$\ln\left(\frac{z_{ri}}{1-z_{ri}}\right) = \ln(\sigma_{ri(t)}) = \alpha + \beta\sigma_{ri(t-1)} + \delta L_{r(t-1)} + \phi D_{metro} + \varepsilon \quad (5)$$

Where z_{ri} is the regional share of a particular sector (i) (N_{ri} / N_i). The structure of past sectoral diversity $\sigma_{ri(t-1)}$, past regional size proxy $L_{r(t-1)}$ and the dummy for metropolitan regions, D_{metro} , are explanatory variables.

We measured formula (5) by weighted-least-squares (WLS) method. To construct a weight, we choose to estimate formula (5) excluding the dummy for metropolitan regions. We then obtain the residual and ran the following regression;

$$|\hat{v}| = a + b\sigma_{ri(t-1)} + cL_{r(t-1)} + u$$

Where our estimated parameters are obtained and our weight is,

$$1/w = 1/(\hat{a} + \hat{b}\sigma_{ri(t-1)} + \hat{c}L_{r(t-1)})$$

The results of running the WLS-regression can be found in table 3.2.

Table 3.2 Size distribution of sectoral diversity (ordinary firms, t-values in brackets)

Sector	Constant	Past diversity	Population 1993	D_{metro}
Natural resource	-3.03 (-33.3)	5.73 (9.2)	0.0000021 (2.6)	-5.13 (-3.1)
Manufacturing	-2.67 (-36.1)	4.04 (10.1)	-0.00000026 (-0.2)	-5.88 (-4.6)
Private Service	-1.41 (-16.2)	-1.93 (-6.2)	0.000028 (7.8)	-4.32 (-4.1)
Public Service	-0.72 (-11.8)	-0.25 (-9.6)	0.000013 (12.1)	-5.46 (-6.0)

Source: Swedish Statistics

Private service sector has the smallest impact from past sectoral diversity and it also has the largest impact from population in 1993. In other words, it is non-rejection of hypothesis 1 in the sense that the natural resource- and the manufacturing sector are relatively more dependent upon past diversity or sectoral structure. The manufacturing sector obtains high values from past diversity and insignificant values from past regional size. One could interpret this as a sign of both decentralization of the industry and dependence of past sectoral diversity. The natural resource dependent sector is highly affected by past diversity and it has an low effect from past regional size. In other words, implications of dependence for primary materials and thus former locations prevail for the distribution of this sector.

In table 3.3 below we present results from running similar regressions separately for regional sectoral shares of industries that only contains micro-firms. According to what we have assumed about micro-firms and their production-scale they ought to be less dependent overall on regional size. The effect on the manufacturing sector still has an insignificant effect from past regional size. It is also still the only sector that is insignificantly affected by regional size. Past diversity is now more important for the manufacturing sector than the private service sector and the latter is still (but to a smaller degree) affected by regional size. Thus hypothesis 2 about micro-firms being less dependent on regional size than past diversity cannot be rejected.

Table 3.3. Size distribution of sectoral diversity (micro-firms, t-values in brackets)

Sector	Constant	Past diversity	Population 1993	<i>Dmetro</i>
Natural resource	- 2.15 (-26.5)	3.47 (7.3)	0.0000021 (3.2)	-2.14 (-1.9)
Manufacturing	-2.96 (-40.8)	6.97 (13.9)	-0.000000014 (-0.4)	-0.76 (-0.8)
Private Service	-1.94 (-27.6)	2.80 (13.1)	-0.00000067 (-7.0)	-0.64 (-0.4)
Public Service	-2.44 (-19.5)	4.24 (5.4)	-0.0000022 (-3.5)	2.29 (1.6)

Source: Swedish Statistics

4. Conclusions and suggestions for future research

The aim of the present paper was to analyze how the concept of sectoral diversity adjusts over time and which of the factors regional size and past diversity determine present sectoral diversity. From the results derived there are implications that past sectoral diversity is an important factor in determining future establishment of firms within manufacturing industries. Regional size is less important for this sector due to the fact that it reaches a maturity phase and it is, due to product standardization, subject to some degree of transfer and further location to smaller market regions. Another implication of the results is that ordinary firms within this sector are more depending on market size than are micro-firms in the sense that micro-firms obtain lower influence from region size (except for the natural resource dependent sector) in our regressions.

It would be interesting to further analyze how firms within consumer service- and producer service sectors separately adjust their location-pattern over time. The assumption of market size dependence in the present paper concerns in particular the consumer service sector even if this category of industries is not independently controlled for.

The assumption of micro-firms being subject to minor scale economies is also a rather crude statement. It would depend on how capital- versus labor intensive a particular production process prove to be.

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