Dynamic externalities and regional manufacturing development: an exploration of the Polish experience before and after 1989*

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Abstract

The impact of localization and urbanization economies on regional manufacturing development in Poland 1976-96 is assessed in terms of employment and the regional convergence or divergence of the economy. We examine current research on the role of dynamic production externalities in regional manufacturing development, starting with a review of recent literature on the nature of such externalities in manufacturing location, and how positive externalities may influence the spatial clustering of manufacturing industries. While much of the current literature is focussed on US experience, we analyse manufacturing employment data for Poland, in order to explore to what extent conclusions drawn from US experience may illuminate a regional economy in transition. The analysis also pays attention to the integration of a number of different methods from differing traditions, from economic geography, regional science, and new economic geography, including location quotients, Gini indices, shift-share, analysis of variance, Poisson regression, and Poisson regression for panel data. We find that radical changes have occurred in patterns of Polish regional manufacturing employment, both with regard to sectors and regions. Transition is refocussing the regional economy on strong regional centres, and on sectors regarded with little favour in the planned economy, such as food processing and wood products, including furniture.

1 Introduction

The analysis of regional aspects of an economy in transition from central planning to market forces challenges both the theories and hypotheses that may be deployed, and the methods that can be applied to explore and test them in the light of empirical data. Poland began early in her transition processes, and has a relatively large manufacturing sector, despite the continuing importance of agriculture in occupational terms. Both private agriculture, and the presence of an entrepreneurial second economy of increasing size since at least the 1970s provided sources of market players willing to make a start when conditions permitted, as did the experience gained by temporary illegal migrants to OECD countries during the 1980s, and indeed the business ability displayed by surprisingly many former state firm managers. These factors contribute to the choice of Poland as a suitable example of regional manufacturing change during transition.

A weakness of theories and hypotheses about regional change is that manufacturing industry has dominated both existing and newer models, and is typically better represented in official reporting than other sectors. Despite this reservation, and because of access to data on manufacturing rather than other sectors, attention will here be focussed on regional manufacturing change, rather than regional economic change across all sectors. In the case of transition economies, this may lead to distorted conclusions, since sectors such as agriculture and services

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respond differently to transition at the aggregate scale, and are subject to differential impacts regionally, depending on specific local conditions. Among these are the clear links between urbanization and growth in the service sector, and between agrarian structure, both size and ownership, and development in agriculture.

A further problem not treated explicitly in this analysis is that of firm size, since under central planning regional development, or rather industrialization, policies were often pursued by locating large plants in remote rural areas previously not characterized by such employers. Transition is seeing the restructuring and downsizing of former state firms, the vigorous growth of private firms, and in some cases the decay and bankrupcy of state firms unable to meet business challenges. Foreign direct investment is involved directly or indirectly in restructuring state firms through acquisition, and private firm growth through joint ventures and the establishment of wholly-owned subsidiaries. These trends are changing the national and regional distributions of firm sizes radically, also in manufacturing industry. The same remark also applies to establishment sizes, with many former monolithic state units being restructured into many separate business entities, also trading outside their former institutional boundaries.

Within these limitations, our analysis is intended to demonstrate that transition is influencing both regional and sectoral patterns of manufacturing employment change in Poland, and that examination of dynamic externalities before and during transition may reveal changes of interest. It could be felt that central planners cannot reasonably be compared with entrepreneurs in allocating investment by sector and location, in that the planners were not driven by return on investment at the granularity of the individual plant, whereas entrepreneurs are. It can however be assumed that the central planners were trying to optimize some criteria, not necessarily return on particular investments, but return on planned activities at some broader aggregation, or not infrequently a return measured rather in political influence or prestige, a criterion not foreign to most mixed economies. Consequently, we assume that hypotheses derived under market economy conditions can be extended to the pre-transition period both for the sake of comparison, and because both entrepreneurs and central planners can be taken as trying to optimize some form of return on investment.

Following a brief review of the growing literature on dynamic externalities and regional manufacturing development, we will present in some detail a range of alternative approaches to measurement related to employment in manufacturing industry. These span from indices of specialization, such as the location quotient, through the Hirschman-Herfindahl index of diversity, and lead on to measures of change, based on traditional shift-share analysis, and a range of statistical techniques. Among these are analysis of variance and Poisson regression using offsets, both applied here, and a discussion of further alternatives for the analysis of panel and time series employment data. After a presentation of Polish manufacturing employment data, the results of analysis are discussed in the context of the transition process, and a number of conclusions are drawn both for policy and for future research.

2 Externalities and manufacturing development

Geographical concentration in manufacturing industries has attracted increasing attention since the early 1980s, when newer approaches to uncertainy, information, and competition gained favour in economics, and empirical phenomena, in particular the growth of Silicon Valley, drew attention to the potential importance of endogenous growth. The key concepts involved include increasing returns (Romer, 1986, Krugman, 1991), which in turn lead to path dependency and potential lock-in to some, rather than other multiple optima (Arthur, 1994).

David and Rosenbloom (1990) ask why people and firms tend to congregate spatially. They explore in a stylised way Marshallian pecuniary externalities “that tend to reduce the prices at which primary inputs can be purchased as more and more of those inputs come to be assembled at the locale in question” (p. 349). They find that “the existence of multiple equilibria in models of this kind, and the sensitivity of the ultimate dynamic outcome to small differences in initial conditions, or to relatively small shocks, allows realistic scope for historical events to play a role in the dynamics of spatial systems. Thus the same forces that promote the agglomeration of footloose industries allow the details of seemingly transient and adventitious circumstance to exert an enduring influence upon the spatial distribution of economic activity and population” (p. 368).

Ellison and Glaeser (1997) formalise a model-based index of concentration, based on a sequence of profit-maximizing decisions made by individual plants: “natural advantages of some locations and industry-specific spillovers lead plants to cluster together, and idiosyncratic plant-specific considerations provide the counterbalance that keeps the entire industry from concentrating at a single point” (p. 892). Using data for the 50 US states at the four-digit classification level, they report that 446 of 459 industries examined were more clustered than would be expected to arise randomly, and only 13 were more evenly distributed. Of the 446 more clustered industries, 369 could be taken as being significantly more clustered, while none of the 13 more evenly distributed industries differed significantly from a random distribution (p. 907). Using three-digit industry data, they find that county-level concentration is weaker than the state-level results, leading to the conclusion that while within-county spillovers are stronger than nearby-county spillovers, 'localized' spillovers are still quite substantial at a range beyond that of counties (p. 914).

The 'spillovers' in question have been identified as dynamic information externalities of the kind refered to by David and Rosenbloom (1990), and arise from both intended and unintended communications between economic agents over time (Henderson et al., 1995, p. 1068). Applying this specifically to growth in cities, Glaeser et al. (1992) view "externalities (and particularly externalities associated with knowledge spillovers) as the 'engine of growth'. If geographical proximity facilitates transmission of ideas, then we should expect knowledge spillovers to be particularly important in cities" (p. 1127). These two papers open up a fascinating discussion of two flavours of dynamic information externalities, termed Marshall-Arrow-Romer externalities, and Jacobs externalities. A further contribution has also been made by Henderson (1997), using augmented data. All of them use manufacturing employment data as a measurement of activity, although other variables, such as regional wage levels, are also included without changing the major conclusions.

Static externalities are seen as being based on immediate information spillovers abour current market conditions, and may be divided between localization economies, in which a firm benefits from local firms in its own industry, and urbanization economies, where a firm benefits from the diversity of local firms outside its industry. Henderson et al. describe dynamic externalities as dealing "with the role of prior information accumulations in the local area on current productivity and hence employment" (1995, p. 1068). In common with Glaeser et al. (1992), they divide dynamic externalities into Marshall-Arrow-Romer externalities, "which derive from a buildup of knowledge associated with ongoing communications among local firms in the same industry", and Jacobs externalities, "which derive from a buildup of knowledge or ideas associated with historical diversity" (p. 1068).

The empirical conclusions reached in the literature vary substantially, partly because of the use of different data and methods. Glaeser et al. (1992) conclude that: "at the city-industry level, specialization hurts, competition helps, and city diversity helps employment growth" (p. 1150), that is that for their data set of 170 cities and six two-digit industries, and comparing 1956 with 1987, Jacobs externalities seem to be more important than MAR externalities. Henderson et al. (1995) examined five key capital goods industries at the two-digit level for 224 standard metropolitan statistical areas, comparing 1970 with 1987, and found "a very high degree of persistence in employment patterns. While persistent regional demand and comparative advantage explain some of this, MAR dynamic externalities are critical also" (p. 1083). They find further that: "employment growth in traditional manufacturing industries is higher in cities with past high employment concentrations in the own industry. A history of industrial diversity did not have a significant effect on any of these traditional industries . . . suggesting that Jacobs externalities are not so important for mature industries" (p. 1083). Having also considered the role of Jacobs externalities in relation to the high-technology sector, they conclude that: "while Jacobs externalities are important in attracting new industries, MAR externalities, rather than Jacobs externalities, are important for retaining the industry" (p. 1084).

In a subsequent paper, Henderson extends this analysis to examine the lag structure of the dynamic externalities, by employing annual data sets for the years 1977–1990 for the 742 urban counties of the USA, once again modelling five capital goods industries at the two-digit level. His intention was to find out how the impact of MAR and Jacobs externalities is distributed through time. The principal finding for this data set was that "increased concentrations of own industry activity appear to affect employment levels for five or six years afterwards. For diversity measures, effects appear to persist beyond the seven year horizon examined" (1997, p. 469). This would appear to imply that two-period studies, such as Hernderson et al. (1995) and Glaeser et al. (1992) over 17 and 31 years respectively, would tend to pick up stronger Jacobs externalities than MAR externalities, if these results can be generalised. It further suggests that where no suitable time series of regional manufacturing employment data are accessible, a periodization to five or six year periods should permit the dynamic externalities effects to be detected.

It is natural to wonder how could one expect dynamic externalities to manifest themselves in a transition economy, or in regional transition economies. It is likely that it will be possible to observe tendencies for both new private sector manufacturing firms and restructuring state firms to adapt to market forces, including potentially both MAR externalities and Jacobs externalities. It is also likely that new industries will 'flow' to fill gaps created by central planning distortions, and that restructuring of state firms will be more successful in some settings than others. As has already been mentioned, it is unreasonable to model central planners as profit-maximizers, although they can be taken as optimizing some planning function. Political decision makers can however realistically be seen as attempting to optimize a return on influence, also known as voluntarism, a major feature of manufacturing investment location decisions in Poland in the Gierek period between 1971 and 1980.

A tentative conclusion is that manufacturing employment could be examined either over a time series spanning the onset of economic transition, or in a sequence of about five year steps, comparing the values of coefficient estimated on indices operationalizing MAR and Jacobs externalities. One would perhaps not expect the pre-transition period estimates to bear sustained interpretation, given the absence of effectively market-based economic agents, but transition period estimates may give insight into the initial locational choices forming the contemporary regional economy.

3 Measures of manufacturing employment

A shared simplification is that our conceptual discussions began from manufacturing activity, but moved to manufacturing employment as the most convenient and comprehensive operationalization. Haynes and Dinc (1997) discuss some ways of circumventing difficulties arising in the analysis of change over time, but make use of an aggregated data set. Using employment as an operationalization of activity is also complicated by the wide variety of methods used for its measurement: annual average, quarterly or monthly averages, or number employed at the start or close of a period. Further, the number employed may or may not be adjusted for part-time working and/or overtime, leading some analysts to prefer the number of hours worked to the number of employees as a measure. Finally, sectoral and regional registration may be made at the firm or at the plant level, leading to potential distortions in the classification of employees of firms with plants in different sectors or different regions.

Employment data forms a three-way table of counts of persons or hours, with no values under zero. Here, e_{ijt} is employment in sector i in region j in year t, where the aggregations to sectors and regions could possibly be modified. Over longer periods, it is typical that changes in the economy, and in the needs of government for statistics, lead to changes in sectoral definitions. Changes may also occur where mergers between firms lead to the transfer of employees from one sector to another, when the sectoral classification is based on the new firm's chief activities; the same can apply to the effect of mergers on regional totals. Given these weaknesses, we will now proceed to review briefly a number of indices and other representations or models of manufacturing employment.

Glaeser et al. (1992, p. 1140) have been criticized for re-inventing the location quotient as a measure of specialization, operationalizing a source of MAR externalities. The measure is:

$$\mathrm{LQ}_{ijt} = \frac{e_{ijt}/e_{*jt}}{e_{i*t}/e_{**t}}, \tag{1}$$

where $*$ denotes summation over the index or indices in question: for instance $e_{i*t} = \sum_j e_{ijt}$, and $e_{**t} = \sum_i \sum_j e_{ijt}$. In fact, it might be more suitable to reflect on why a simple index of this kind is not more widely known. In addition to the location quotient, the Gini coefficient:

$$\mathrm{Gini}_{it} = 0.5 \sum_j |e_{ijt}/e_{*jt} - e_{i*t}/e_{**t}|, \tag{2}$$

can give an economy-wide picture of distribution by unit of analysis, being based on the same ratios.

Another well-known measure partitions employment change between the region's share of sectoral change, and the shift due to factors specific to the region (shift-share analysis). Here, regional share is given by the national rate of change by sector, mutiplied by base year employment in that sector in the region:

$$r_{ijt} = e_{ij0} \frac{e_{i*t}}{e_{i*0}}; \tag{3}$$

it is also possible to partition out total national change as a separate term in the regional share calculation. The remaining change between that observed and the region's share in sectoral change, is its shift:

$$s_{ijt} = e_{ijt} - r_{ijt}. \tag{4}$$

This obviously does not explain why sector i has performed better or worse in region j than in the economy as a whole between the base year and year t. It does however show that this has happened. Total regional shift is the sum of these sectoral differences; this is frequently termed regional differential shift:

$$s_{*jt} = \sum_i s_{ijt}. \quad (5)$$

Shift-share analysis is currently enjoying a renaissance, albeit in somewhat modified forms in some cases. It is just a calculation based on very simple assumptions, but has proved capable of drawing attention to interesting tendencies. Fingleton (1994) has recently used it to examine the location of high-technology manufacturing in Britain, where Townsend (1993) has also found it useful in the investigation of the urban-rural cycle of manufacturing change.

In the US, it has been used recently by Barff and Knight (1988) to study the New England employment turnaround, by Knudsen (1992b) in an extended probabilistc form to examine manufacturing employment change in the Midwest, and by Nissan (1992) in analysing metropolitan and nonmetropolitan change in population and personal income. Further, Rigby (1992) has extended shift-share analysis to take account of the fact that regional shift can be confounded by regionally differential changes in productivity by sector, and used it to study annual employment change in two-digit sectors for the nine US census regions. Using trade data in addition to employment, Hayward and Erickson (1995) and Noponen et al. (1996) partition changes in regional output by sector to take into account imports and exports, despite difficulties with the data sets used. Finally, Knudsen et al. (1997) have used probabilistic shift-share analysis, based on Berzeg's proposals (1978, 1984), to assess the regulationist view of US employment change over the 1940–1989 period, at the state level for eight industry divisions.

Berzeg (1978, 1984) finds that shift-share models can readily be represented as fixed effects analysis of variance models, taking the rate of change as the dependent variable, and sectoral and regional dummies as the explanatory factors. Buck and Atkins (1983) have also, independently of Berzeg, shown how the analysis of variance can be used to examine the significance of sectoral and regional changes in employment, and it is their version that will be used below. Defining percentage change as

$$y_{ij} = 100(\frac{e_{ijt}}{e_{ij0}} - 1) \quad (6)$$

for given base year and t, they model

$$y_{ij} = \alpha + \beta_i + \gamma_j + \varepsilon_{ij}, \quad (7)$$

weighting with $w_{ij} = \frac{e_{ijt}}{e_{*jt}}$, again for given t; weights are needed because rates of change are typically larger for small e_{ijt}. From this, they derive a composition component, relating employment change in the region to sectoral factors:

$$C_j = \sum_i (w_{ij} - (\frac{e_{i*t}}{e_{**t}}))\beta_i. \quad (8)$$

Finally, the growth component is:

$$G_j = \gamma_j - \sum_j \gamma_j \frac{e_{*jt}}{e_{**t}}. \quad (9)$$

Berzeg's approach is essentially similar, but uses different weights:

$$w_{ij} = \frac{e_{ij0}}{e_{**0}}, \quad (10)$$

and interprets the coefficient estimates of the sectoral and regional dummy variables directly.

Knudsen (1992a, cf. also 1990) has drawn attention to the fact that the use of the analysis of variance on a rate of change:

$$\frac{e_{ijt}}{e_{ij0}} = \alpha + \beta_i + \gamma_j + \varepsilon_{ij}, \quad (11)$$

can be rewritten, taking logarithms of the left hand side, as:

$$\log(e_{ijt}) = \log(e_{ij0}) + \alpha + \beta_i + \gamma_j + \varepsilon_{ij}, \tag{12}$$

with an assumed coefficient of unity on the first term on the right hand side, the logarithm of the base year employment level. This term is taken as a priori information included in the model, which assumes a multiplicative form if we return to the first notation:

$$e_{ijt} = e_{ij0}(\exp(\alpha + \beta_i + \gamma_j + \varepsilon_{ij})). \tag{13}$$

The prior information term is known as an offset, while estimation requires the use of weights specified in the form given after Berzeg (1978) above.

As Knudsen also points out with some justification, in a model of this kind, the individual e_{ijt} are just counts in a large frequency table, and as such ought to be modelled in a way that constrains predictions to non-negative numbers. A commonly used representation for such models is that of Poisson regression, summarised by Knudsen (1992a), and described in more detail in geographical contexts by Flowerdew and Aitkin (1982), Lovett et al. (1985), Flowerdew and Lovett (1988), and Lovett and Flowerdew (1989). The possible use of Poisson regression for analysis of panel data economic relationships is also mentioned in passing by Baltagi (1995), although he devotes much more attention to general method of moments estimators, such as those used by Henderson (1997). The role of offsets in Poisson regression is described by McCullagh and Nelder (1983) as: "a quantitative variable whose regression coefficient is known to be 1" (p. 138). Poisson models are also described in Venables and Ripley (1997, p. 238–242)[1].

In order to calculate Poisson regression regional shift results, it is necessary to estimate the restricted model omitting the regional dummy term, using Berzeg's weights (equation 10):

$$e_{ijt} = e_{ij0}(\exp(\alpha + \beta_i + \varepsilon_{ij})), \tag{14}$$

and calculate its residuals, summed over sectors:

$$s'_{*jt} = \sum_i e_{ijt} - (e_{ij0}(\exp(\alpha + \beta_i)). \tag{15}$$

It is also advisable to check the assumption that the offset variable has a coefficient of unity, done below by estimating:

$$\log(e_{ijt}) = \alpha + \beta_i + \zeta \log(e_{ij0}) + \varepsilon_{ij}, \tag{16}$$

to observe the empirical value of ζ. All Poisson regressions reported here were estimated using the logarithm link function.

Models of dynamic externalities used by Glaeser et al. (1992) and Henderson et al. (1995) overlap a good deal with these, but have not been integrated. They typically model employment in sector i in region j at year t as a function of employment in the base year e_{ij0}, of specialization in that sector:

$$S_{ijt} = \frac{e_{ijt}}{e_{*jt}}, \tag{17}$$

and of an index of sectoral diversity in region j outside sector i. This index is a modified Hirschman-Herfindahl index, defined as:

$$\mathrm{HHI}_{ijt} = \sum_{k,k \neq i} S^2_{kjt}. \tag{18}$$

Low values indicate great diversity, high values little diversity. The model estimated is typically:

$$\log e_{ijt} = \alpha + \delta_{1i} \log e_{ij0} + \delta_{2i} S_{ij0} + \delta_{3i} \mathrm{HHI}_{ij0}, \tag{19}$$

[1] All statistical computations were carried out using R, version 0.62.2 (Ihaka and Gentleman, 1996)

estimated separately for selected sectors i.

It is easy to see that this model can readily be combined with the Poisson regression shift-share model (equation 12), since the $\log e_{ij0}$ is the offset, and the specialization and diversity indices can be added as extra explanatory variables. Interactions between these and the sectoral dummy variables can also be added, giving an augmented Poisson regression with base year employment offset, estimated using Berzeg's weights (equation 10):

$$\log(e_{ijt}) = \log(e_{ij0}) + \alpha + \beta_i + \gamma_j + \delta_2 S_{ij0} + \delta_3 \mathrm{HHI}_{ij0} + \phi_{1i}(S_{ij0} \times i) + \phi_{2i}(\mathrm{HHI}_{ij0} \times i) + \varepsilon_{ij}. \qquad (20)$$

Before moving on, two further applications of shift-share analysis should be mentioned. Keil (1997) has analysed British data for 11 standard regions for the period 1952–89 using econometric methods to test to what extent the shift series could be attributed to a range of models, including random walk models. He concludes that: "the tests for stationarity and cointegration of the regional shifts with changes in national employment suggest that regional employment shares will continue to change in ways that are accummulative and permanent" (p. 23). Finally, Bivand (1986) analysed Norwegian manufacturing employment data for 19 regions and 20 sectors for the period 1951–82 using recursive regression in order to detect significant break points in shift series both for the regions and for disaggregated sectors by region, as a test for regional policy effects. Both of these approaches require access to time series, as does that of Knudsen et al. (1997), and cannot be used with the Polish data to hand.

The uses to which the models to be estimated: regional differential shift (equation 5, Buck and Atkins' growth component (equation 9), offset checks for Poisson regression modelling (equation 16), Poisson regression shift (equation 15), the augmented Poisson regression model including specialization and diversity variables (equation 20), and finally sector estimates of specialization and diversity coefficients using Poisson regression (equation 19), will be covered after we have introduced the data set to be analysed.

4 Polish manufacturing employment 1976–96

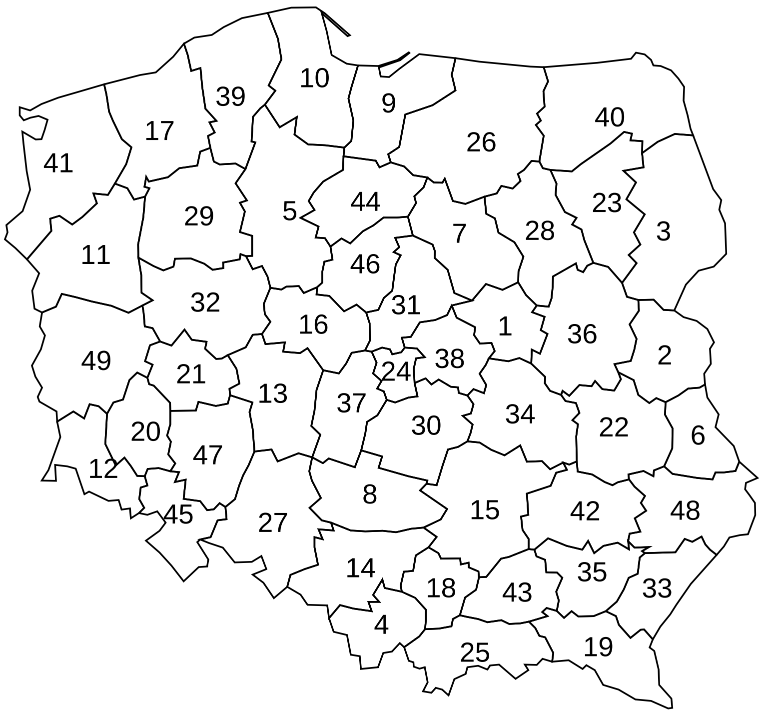

Figure 1: Voivodeships by identifying number; see Table 1 for names.

In *Rocznik Statystyczny Województw*, manufacturing employment is available for nine sectors only, before 1994, when NACE was introduced in Poland. After 1994, sectoral data is not given in *Rocznik Statystyczny*

Table 1: Total manufacturing employment by voivodeship, thousands, 1976–1996.

	Voivodeship	1976	1981	1986	1991	1996
1	Warszawskie	306.9	294.2	250.4	244.0	247.4
2	Bialskopodlaskie	15.3	16.6	14.7	10.7	9.4
3	Białostockie	59.5	62.9	57.8	45.6	39.4
4	Bielskie	161.5	150.1	120.9	112.3	95.5
5	Bydgoskie	137.4	135.2	124.9	110.5	105.8
6	Chełmskie	19.9	19.5	17.6	12.8	10.0
7	Ciechanowskie	22.4	24.1	23.1	19.6	19.1
8	Częstochowskie	111.3	107.5	90.8	66.5	62.1
9	Elbląskie	41.4	42.6	39.8	30.5	31.2
10	Gdańskie	157.4	154.6	138.6	117.0	108.5
11	Gorzowskie	51.3	50.2	44.5	39.5	38.0
12	Jeleniogórskie	100.3	93.8	78.9	57.3	38.1
13	Kaliskie	83.6	83.9	75.6	58.9	67.2
14	Katowickie	820.5	855.6	823.1	669.7	559.6
15	Kieleckie	149.5	145.8	128.5	98.0	77.5
16	Konińskie	37.9	42.5	44.8	37.5	27.1
17	Koszalińskie	36.7	38.5	35.2	29.1	30.0
18	Krakowskie	148.6	143.8	122.0	102.1	100.2
19	Krośnieńskie	54.0	57.7	53.2	42.7	35.8
20	Legnickie	69.4	75.2	75.8	63.0	34.6
21	Leszczyńskie	27.6	28.9	27.1	21.1	27.4
22	Lubelskie	95.9	99.0	94.7	86.6	67.9
23	Łomżyńskie	16.9	17.9	16.1	11.4	12.7
24	Łódzkie	274.8	249.6	195.5	148.9	124.2
25	Nowosądeckie	47.2	50.7	47.3	36.1	30.0
26	Olsztyńskie	55.3	59.1	55.3	46.0	51.2
27	Opolskie	142.1	139.3	127.6	96.3	81.7
28	Ostrołęckie	22.7	24.7	24.8	18.9	18.0
29	Pilskie	38.7	40.1	36.1	31.6	38.0
30	Piotrkowskie	86.5	85.1	86.7	71.2	52.6
31	Płockie	49.6	52.8	49.3	43.3	28.0
32	Poznańskie	148.6	142.3	123.5	131.1	135.0
33	Przemyskie	28.3	29.4	28.6	22.4	16.6
34	Radomskie	84.1	85.1	79.2	66.6	46.0
35	Rzeszowskie	73.9	83.1	81.5	68.4	56.4
36	Siedleckie	39.8	41.3	39.0	34.3	30.3
37	Sieradzkie	31.6	34.1	31.1	23.9	26.3
38	Skierniewickie	41.0	38.9	33.8	27.1	24.8
39	Słupskie	36.4	38.1	34.7	28.5	28.8
40	Suwalskie	27.3	28.3	27.0	23.1	17.9
41	Szczecińskie	100.1	101.5	92.1	77.0	72.0
42	Tarnobrzeskie	67.2	71.2	65.2	53.9	36.5
43	Tarnowskie	67.9	69.0	58.7	55.0	48.9
44	Toruńskie	74.3	75.2	66.8	58.1	57.5
45	Wałbrzyskie	157.7	144.3	123.8	93.1	64.8
46	Włocławskie	33.9	35.7	33.3	28.9	24.6
47	Wrocławskie	155.1	147.3	127.4	102.8	90.2
48	Zamojskie	27.9	27.2	26.5	19.4	18.5
49	Zielonogórskie	85.5	83.1	73.8	63.6	53.5

Województw, and was acquired directly from Główny Urząd Statystyczny. The regional division used is that of the 49 voivodeships introduced in 1975, and due to be replaced in 1999; they are shown in Figure 1, and a key to their names in Table 1.

Table 2: Manufacturing employment by sector in Poland, thousands, 1976–1996

sector	1976	1981	1986	1991	1996
fuels and energy	519	567	636	562	466
basic metals	260	247	212	178	153
electromechanical	1536	1555	1368	1077	807
chemical products	327	304	272	253	229
mineral products	288	262	228	199	154
wood products	278	256	226	211	285
textiles & clothing	825	770	671	526	459
food products	516	520	398	449	486
other products	169	233	251	96	72
sum	4722	4716	4266	3555	3116

The published data series from 1975 to 1993 has gaps for 1985 and 1987–1989, before 1991 only records public sector firms, and from 1991 includes firms employing over five persons. For 1994–96, NACE data apply to firms employing over three persons, and have been aggregated to approximate the standard planned economy groupings of: fuels and energy (NACE $\simeq$ C10–11, D23, E40), basic metals (NACE $\simeq$ D27) electromechanical (NACE $\simeq$ D28–35), chemical products (NACE $\simeq$ D24–5), mineral products (NACE $\simeq$ D26), wood products (NACE $\simeq$ D20–21, D36), textiles & clothing (NACE $\simeq$ D17–19), food products (NACE $\simeq$ D15–16), other products (NACE $\simeq$ D22, D37).

It has been chosen here to examine four five-year periods: 1976–81, 1981–86, 1986–91, and 1991–96. The changes in definition affecting ownership, size, and the assignment of employees to region, and in the definition of sectors are felt to be unavoidable, and the better quality data classified by NACE sectors are too recent to permit analysis at present. It is also clear that the quality of reporting has varied greatly over the whole period, not only in the turbulent years of the beginning of transition, but also during central planning, when statistical publications were subject to censorship, leading to possible distortion where strategically sensitive sectors were involved.

Manufacturing employment has declined from 4.7 million in 1976 and 1981 to 3.1 million in 1996, as shown in Table 2. Some of the increase in wood products is caused by changes in sectoral definitions, particularly including all of D36 in wood products, and other sectors are also affected by the break of series between 1991 and 1996 with the transfer to NACE. It is interesting to look at some of the earlier changes too, particularly for the period of stagnation from 1981 to 1986, partly during the state of war, when political motives dominated what remained of central planning. In this period, only the key fuels and energy sector, including coal mining, grew in employment, apart from other products, which defies reasonable interpretation, and seems to have been used as a catch-all for otherwise unclassifiable activities. The first turnaround sector was food products, with growth already in the 1986–91 period, continuing firmly in 1991–96, the second wood products, growing in 1991–96.

Concentrating on the last of the four five-year periods, 1991–96, and recalling possible difficulties caused by the introduction of NACE, we can examine the regional and sectoral patterns of change shown in Figure 2[2]. The sizes of the symbols indicate the relative sizes of emplyment by sector in 1991, while their shadings show percentage change over the five year period. The fuels and energy is clearly strongly concentrated in Katowickie, together with voivodeships with open-cast lignite mines. Major urban areas see employment growth in the electricity supply component of this sector. Basic metals are also focussed on Katowickie, Krakowskie, and Legnickie, as would be expected, with many voivodeships not represented at all. The vast electromechanical sector follows urban density closely, with most major cities clearly visible. In chemical and mineral products, rural voivodeships with large 1991 employment levels have tended to do worse than urban areas, with large state owned cement, glass, and fertilizer plants in trouble, while urban-focussed private new entrants in pharmaceuticals, building materials and cosmetics doing much better. Something of the same can be seen for wood products, textiles and clothing, and food products. Pulp mills, major textile firms — especially in Łódzkie, and sugar refineries in rural voidodeships have done poorly, while more agile restructured state firms and new entrants have been able to compete very successfully with imports since the economy began growing in 1991–2.

[2]For other descriptions of the distribution of manufacturing employment in Poland, and issues involved in transition in Polish regions, see

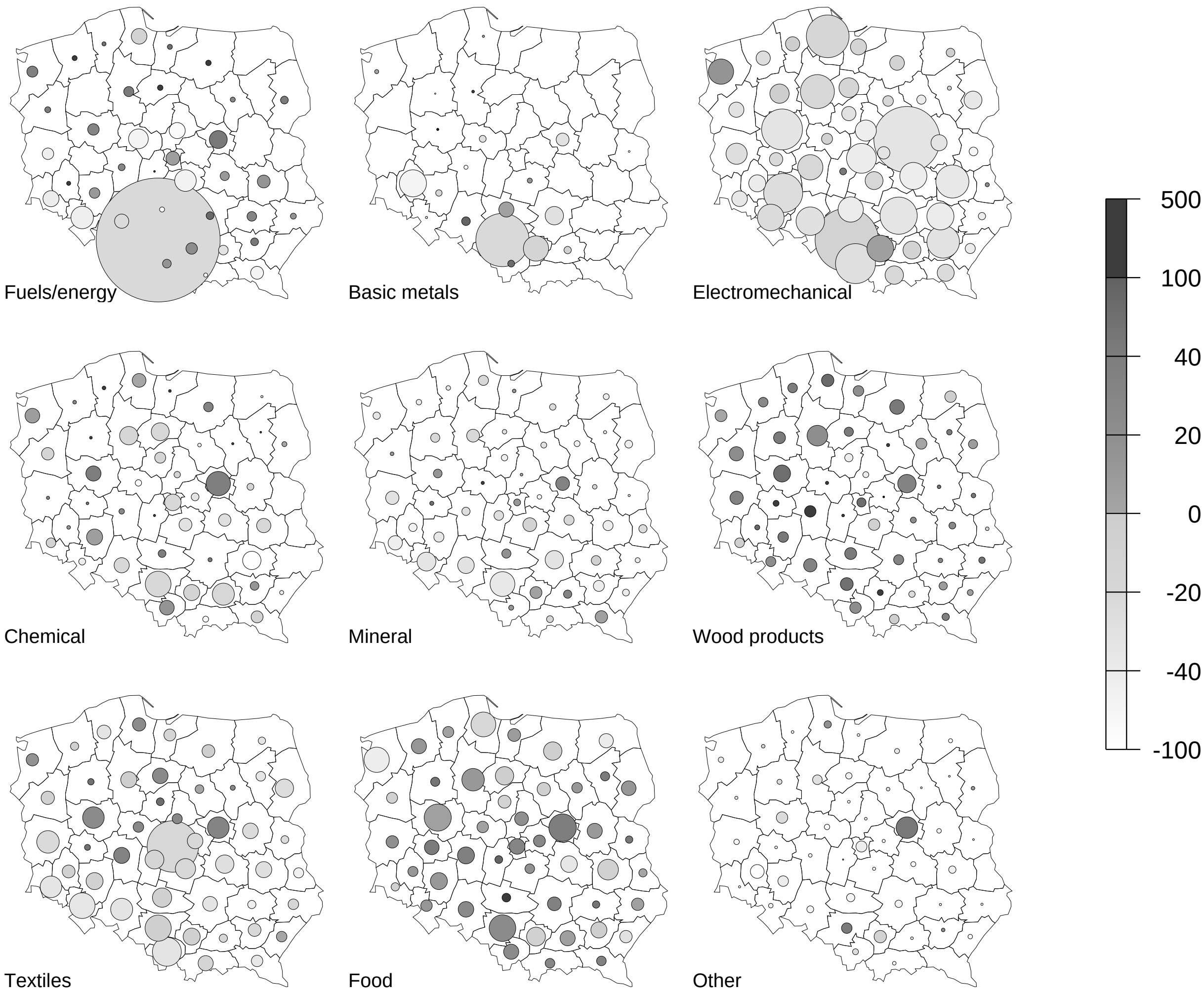

Figure 2: Percentage change in manufacturing employment by sector, 1991–96. Symbol radius proportional to 1991 employment levels.

Table 3: Gini coefficients by sector in Poland, 1976–1996

sector	1976	1981	1986	1991	1996
fuels and energy	0.55	0.56	0.52	0.51	0.44
basic metals	0.57	0.56	0.55	0.59	0.50
electromechanical	0.17	0.16	0.17	0.18	0.14
chemical products	0.25	0.27	0.28	0.27	0.27
mineral products	0.27	0.27	0.28	0.26	0.27
wood products	0.28	0.31	0.32	0.31	0.28
textiles & clothing	0.32	0.32	0.30	0.31	0.27
food products	0.25	0.25	0.28	0.26	0.19
other products	0.20	0.19	0.18	0.32	0.37

Gini coefficients (equation 2, Table 3) show general declines with some exceptions. Some sectors record systematically higher levels, probably related directly to transport costs from sources of raw materials, particularly fuels and energy, and basic metals for obvious reasons, but at a lower level also mineral products, chemical products, and wood products.

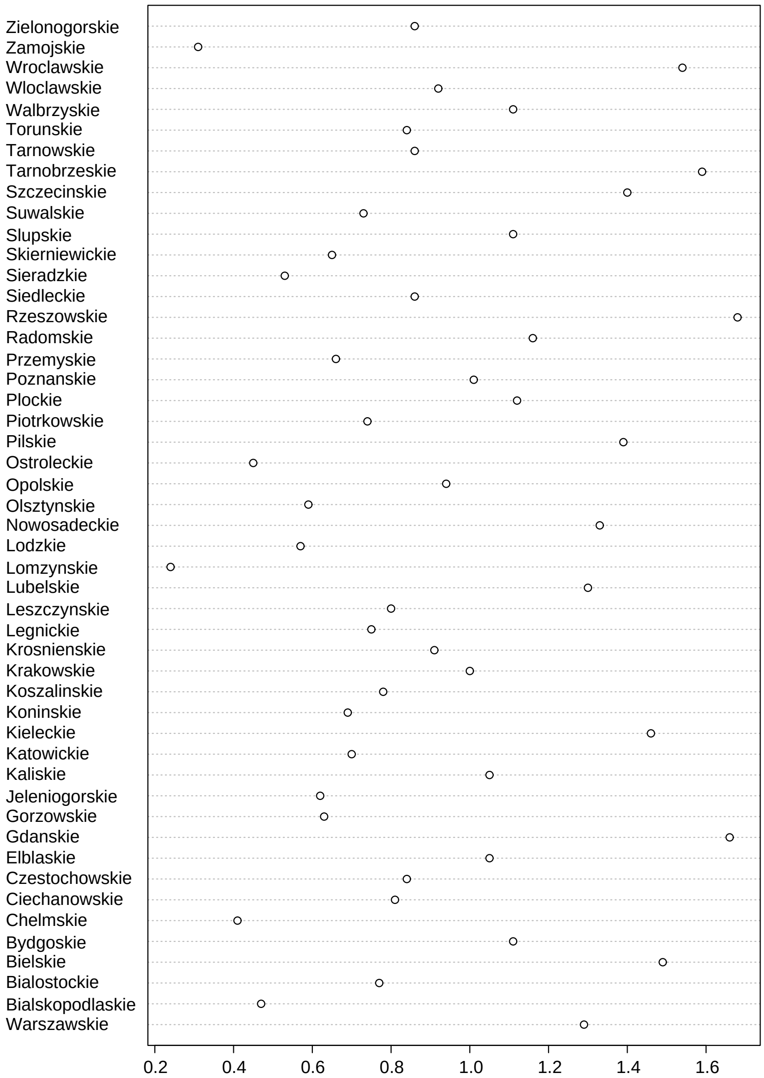

Figure 3: Dotplot of location quotients for manufacturing employment for the electromechanical sector, 1996.

The next three figures explore the specialization by voivodeship of manufacturing employment in 1996, for the data aggregated to nine sectors, using equation 1. Figure 3 provides a key to the results for all nine sectors shown in Figure 4. These dotplots show the value of the location quotient on the x-axis, and the voivodeships by number up the y-axis, starting from 1 Warszawskie at the bottom, and rising to 49 Zielonogórskie at the top.

In Figure 3, we can see that the values are scattered to both sides of unity, with Łomżyńskie clearly lowest, and Gdańskie and Rzeszowskie highest. This sector has a Gini coefficient of 0.14, the lowest of the analysed sectors, and represents a relatively even spread. This is not surprising, given the very mixed nature of firms within it, including shipyards, car assembly plants, kinescope manufacturers, computer assembly plants down to small craft metalworking firms. If we turn to Figure 4, we find again the electromechanical sector, but without voivodeship names.

We can easily see that the Gini coefficients do give a good representation of the specialization by sector of the voivodeships, with the electromechanical sector being the most ‘even’, with the smallest range in location quotient values. The largest values are observed for basic metals and mineral products, with voivodeships scoring

Węcławowicz (1996) and Stryjakiewicz (1996).

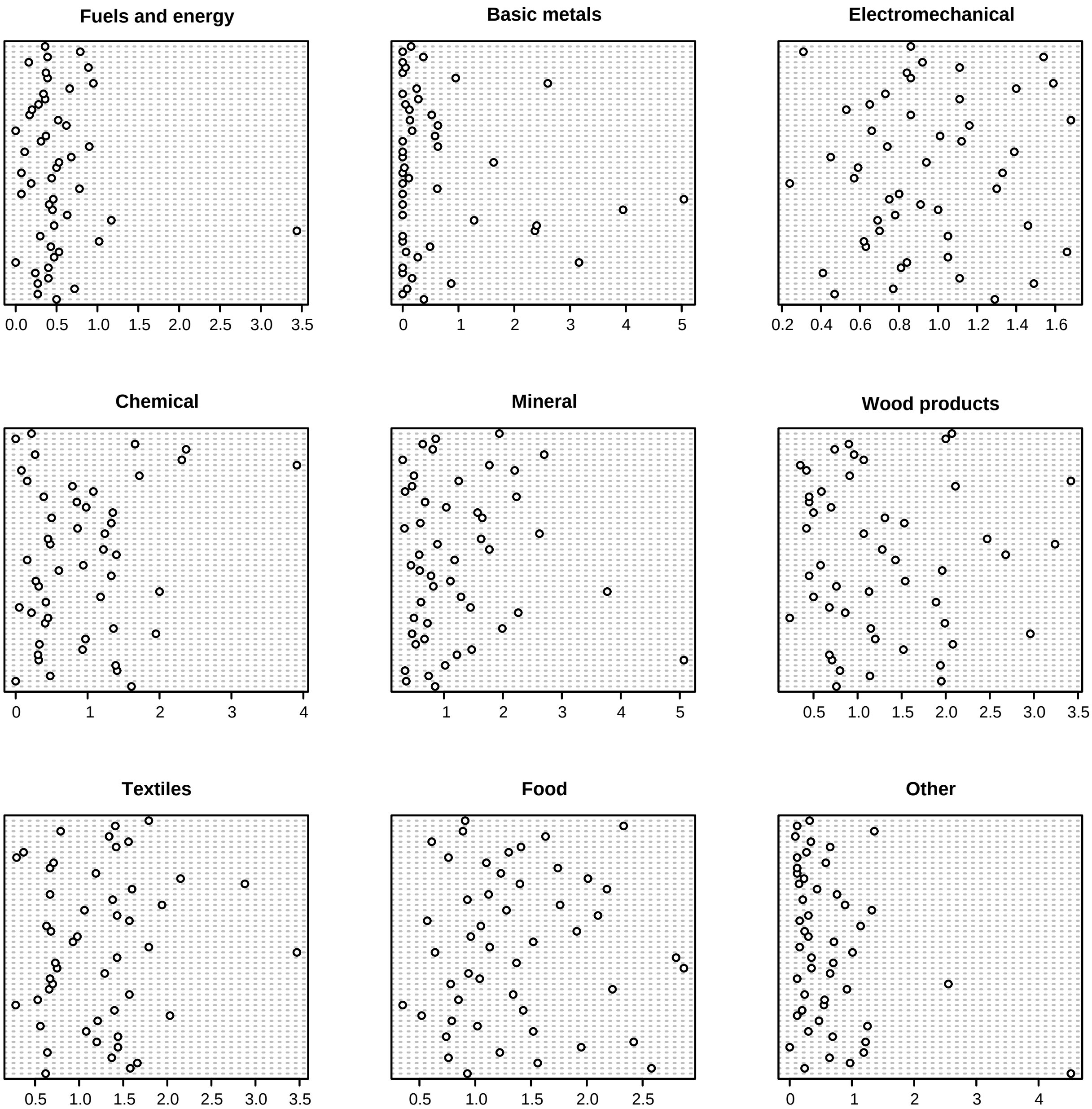

Figure 4: Dotplots of location quotients for manufacturing employment by sector, 1996.

5; in chemical products the situation is similar. In these three sectors, and in other products and chemical products, a majority of voivodeships have scores under unity, while for the remaining four sectors: electromechanical, wood products, textiles and clothing, and food products, the distribution is more even, not to the same extent dominated by a dense band of dots to the left of unity on the plots.

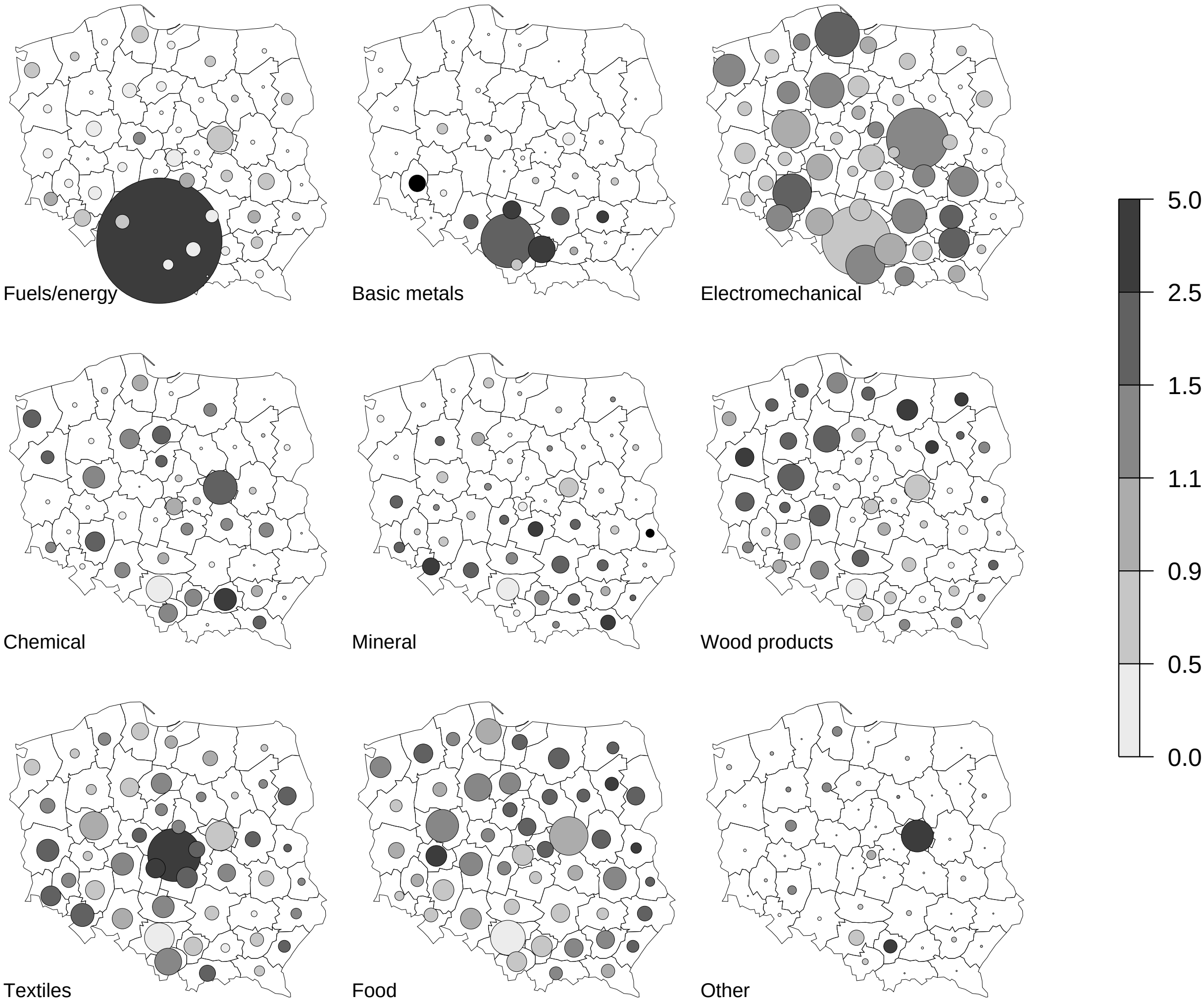

Figure 5: Location quotients for manufacturing employment by sector, 1996. Symbol radius proportional to 1996 employment levels.

Finally, Figure 5 shows the location quotient values by shading on symbols scaled to be relative in size to sectoral employment in 1996. We see clearly how dependent Katowickie is on the fuels and energy sector, and also on basic metals. Given the imminent removal of trade protection for these sectors, and indeed changes that have already made themselves felt, it will be of interest to follow this voivodeship's performance in the analyses below. Location quotients in the electromechanical sector bring out the role of shipbuilding, on the coast in Gdańskie and Szczecińskie, and motor vehicle assembly in Bielskie in the south. Concentrations of defence industries are evident in the south east, in Tarnobrzeskie and Rzeszowskie. As indicated above, chemical, mineral and wood products seem to be tied to their raw materials to a noticable extent, although an urbanization effect is observable as well. The traditional textile and clothing voivodeships still have the highest location quotients, although, as we saw above in Figre 2, this does not correlate with growth. Voivodeships have high location quotients in the food products sector near the major urban centres in central Poland, particularly around Poznańskie and Warszawskie — this observation will help us to understand the 1991–96 regional shift results below.

Having described the data set to be analysed, we will now turn to examine the results of the application of the models described above, bearing in mind the weaknesses implicit in the data itself.

5 Results

We begin by checking the assumption that the coefficient of the offset variable, the logarithm of base year employment, can be taken as unity (equation 16). From Table 4, it can be seen that the assumption holds for all four periods, and that both the offset variable and the sectoral dummies contribute significantly to accounting for the deviance of the response variable. In a linear model, we would present an analysis of variance table to show the successive contribution of variables, or groups of dummy variables (factors), in accounting for the variance of the response variable, using estimates of the F statistic as a measure. In Poisson regression, we speak rather of analysis of deviance, and have here used estimates of the χ^2 statistic in the same way. The lower part of Table 4 shows the level of null model residual deviance, that is the deviance remaining after a model with just an intercept term has been estimated. Next it shows the deviance accounted for by the sectoral dummies, then that accounted for by the logarithm of base year employment, and finally the residual deviance not accounted for by the model. It can be seen that the models fit very well, although the fit of the first two periods is better than that of the last two. In addition, both factors are highly significant in accounting for the deviance of the response variable.

Table 4: Analysis of deviance for Poisson regression models including only sectoral dummies and explicit offset variables (prob. values: *** $<$ 0.001, ** 0.001–0.01, * 0.01–0.05).

	1976-81		1981-86		1986-91		1991-96	
Offset coefficient estimate	0.998	***	0.962	***	0.979	***	1.013	***
Null model residual deviance	112611		129676		120555		92129	
Sectoral dummies deviance	66279	***	86163	***	80243	***	57347	***
Offset deviance	46200	***	43395	***	39936	***	33889	***
Residual deviance	131		118		376		892	

On this basis, the model given by equation 14 was estimated for the four periods, and the voivodeship differential shifts were calculated from its residuals, using equation 15. These were then converted to annual percentage changes in relation to base year voivodeship total manufacturing employment, and are displayed in Figure 6, and shown in the final columns of Tables 5–8. It will be recalled from Table 4 that the sector dummy only models achieve very good fits, with residual deviance varying from 0.1% to 1.0% of null model residual deviance. Nonetheless, the patterns that the residuals reveal are quite clear, and will be commented on more fully below. In addition, Fingleton's comments about the need to test residuals for spatial dependence are clearly justified (1994), although after adding variables in reaching the augmented model, this need is reduced.

In addition to estimating the residuals from the model given by equation 14, standard regional differential shifts (equation 5) were calculated, and analysis of variance growth components (equation 9) were estimated. Tables 5–8 show these values for comparison, ranked by the Poisson regression shift results, and omitting voivodeships near the centre of the ranking to save space. There are some differences between the three measures, chiefly that the growth component results seem to overestimate changes, although it should be noted that they specifically exclude the residual error in their calculation, which the other two methods do not. An empirical confirmation of the patterns shown in the 1976–81 map in Figure 6, and in Table 5 is that the voivodeships with stronger positive shifts are chiefly rural and nonmetropolitan voivodeships that were the focus of an active policy of industrialization at this time, as described by Bivand (1979). Negative shifts in this period prior to the 1980 birth of the "Solidarity" movement seem to be associated with established dense urban areas with manufacturing traditions in sectors not necessarily at the top of contemporary political agendas.

Table 6, and the corresponding map in Figure 6, show a stagnation, with little change from the previous period. From the late 1970s, the Polish economy was plagued with power shortages, and the commissioning of the large open-cast lignite-based power station at Bełchatów, in Piotrkowskie voivodeship, was seen as being of cardinal importance. The remaining regions with high shift results are all rural, nonmetropolitan, and with state investments in large manufacturing plants in the preceeding periods. Employment was more likely to hold up in these kinds of labour markets, with very few alternatives in a period of decline for manufacturing nationally, including substantial emigration of younger workers from more central urban areas.

Table 7, and the accompanying map on Figure 6 show dramatic changes in the distribution of regional differential shift — once again the three estimation methods are in close agreement. It is not quite a full reversal, but most of the voivodeships with positive shifts in the preceeding period have gone negative, and two key metropolitan areas, Warszawskie and Poznańskie, have burst through to lead positive shift with high annual percentage values.

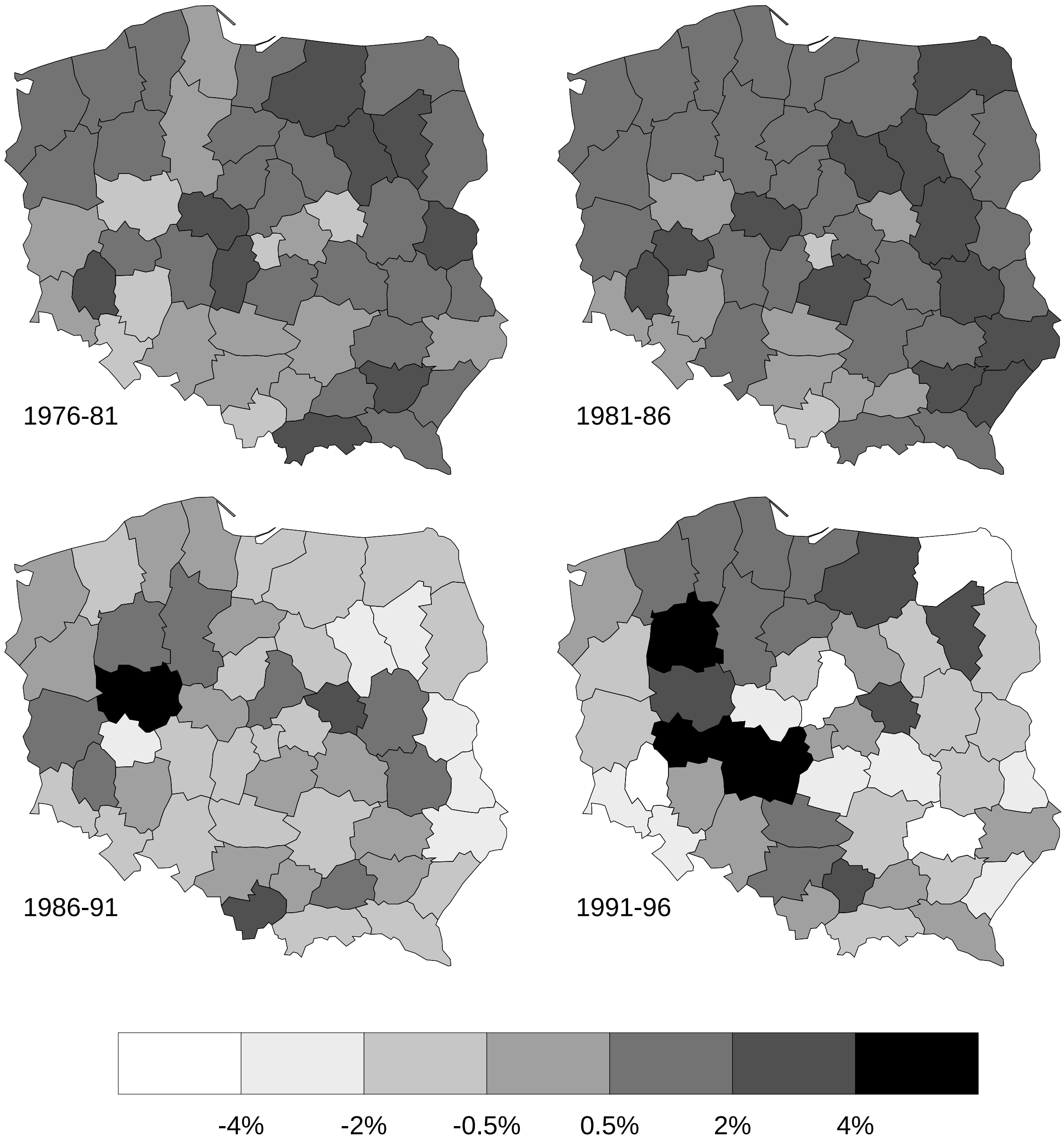

Figure 6: Percentage regional shift per year calculated from Poisson regression sectoral model predictions, 1976–81 to 1991–96.

Table 5: Percentage regional shift per year for 1976–81 using standard shift-share, analysis of variance, and Poisson regression methods, ranked by Poisson regression shift, and omitting voivodeships with central shift values.

	Voivodeship	Differential shift	Growth component	Poisson regression shift
35	Rzeszowskie	2.49	2.46	2.84
37	Sieradzkie	2.31	2.49	2.77
20	Legnickie	2.08	4.33	2.36
2	Bialskopodlaskie	1.81	2.34	2.32
28	Ostrołęckie	1.97	1.76	2.27
23	Łomżyńskie	1.57	2.04	2.16
25	Nowosądeckie	1.58	1.39	2.09
26	Olsztyńskie	1.60	1.48	2.08
16	Konińskie	1.80	2.91	2.05
	...			
10	Gdańskie	-0.37	-0.32	-0.04
18	Krakowskie	-0.64	-0.82	-0.21
12	Jeleniogórskie	-0.74	-0.52	-0.40
32	Poznańskie	-0.95	-1.35	-0.51
47	Wrocławskie	-1.04	-1.39	-0.64
24	Łódzkie	-1.23	-1.41	-0.69
1	Warszawskie	-1.23	-4.54	-0.69
4	Bielskie	-1.24	-1.61	-0.76
45	Wałbrzyskie	-1.39	-1.29	-1.15

Table 6: Percentage regional shift per year for 1981–86 using standard shift-share, analysis of variance, and Poisson regression methods, ranked by Poisson regression shift, and omitting voivodeships with central shift values.

	Voivodeship	Differential shift	Growth component	Poisson regression shift
30	Piotrkowskie	2.56	9.71	3.33
20	Legnickie	2.48	3.44	2.94
48	Zamojskie	2.32	2.76	2.92
28	Ostrołęckie	2.40	3.52	2.72
16	Konińskie	2.02	1.31	2.59
35	Rzeszowskie	2.10	2.78	2.58
7	Ciechanowskie	2.04	2.86	2.50
33	Przemyskie	1.79	2.51	2.40
40	Suwalskie	1.72	2.66	2.13
36	Siedleckie	1.45	1.91	2.06
21	Leszczyńskie	1.58	2.23	2.03
22	Lubelskie	1.48	2.09	2.02
	...			
14	Katowickie	-0.58	-2.13	-0.06
43	Tarnowskie	-0.59	-0.22	-0.17
45	Wałbrzyskie	-1.12	-1.47	-0.32
8	Częstochowskie	-0.97	-0.62	-0.34
18	Krakowskie	-0.82	-0.74	-0.35
1	Warszawskie	-0.88	-3.49	-0.40
12	Jeleniogórskie	-1.28	-1.31	-0.43
24	Łódzkie	-2.00	-1.81	-0.90
4	Bielskie	-1.68	-1.47	-0.99

Further, Bielskie is the location of Fiat car assembly plants, a very early foreign direct investment following up decades of cultivation of the state owned vehicle sector. Voivodeships with positive shifts in this pre-transition period seem either to have been able to react very promptly to the formal introduction of market rules from the beginning of 1990, giving just two years to restructure, or more possibly the figures reflect the move from 1986 data for public sector manufacturing employment only to 1991 data including the nascent private sector. These shift results are very reminiscent of the earliest figures for new firm formation for the same voivodeships (Bivand, 1996).

Table 7: Percentage regional shift per year for 1986–91 using standard shift-share, analysis of variance, and Poisson regression methods, ranked by Poisson regression shift, and omitting voivodeships with central shift values.

	Voivodeship	Differential shift	Growth component	Poisson regression shift
32	Poznańskie	4.62	5.05	4.50
1	Warszawskie	3.66	7.96	3.52
4	Bielskie	2.58	3.32	2.55
22	Lubelskie	1.70	1.93	1.64
43	Tarnowskie	1.16	1.22	1.02
49	Zielonogórskie	0.93	1.29	1.01
	...			
3	Białostockie	-1.04	-1.08	-1.04
37	Sieradzkie	-1.29	-0.49	-1.10
25	Nowosądeckie	-1.09	-1.12	-1.11
38	Skierniewickie	-1.13	-0.98	-1.13
8	Częstochowskie	-1.07	-1.29	-1.16
15	Kieleckie	-1.09	-1.18	-1.18
33	Przemyskie	-1.16	-0.11	-1.24
45	Wałbrzyskie	-1.61	-2.72	-1.34
13	Kaliskie	-1.40	-1.34	-1.44
27	Opolskie	-1.64	-2.28	-1.63
12	Jeleniogórskie	-1.83	-1.96	-1.63
9	Elbląskie	-1.83	-2.11	-1.93
21	Leszczyńskie	-2.11	-1.25	-2.27
2	Bialskopodlaskie	-1.98	-1.11	-2.27
28	Ostrołęckie	-2.40	-2.06	-2.48
6	Chełmskie	-2.88	-2.58	-2.76
48	Zamojskie	-3.02	-2.04	-3.09
23	Łomżyńskie	-3.11	-1.48	-3.16

The table for the final period, Table 8, and its map in Figure 6, continues the turnaround already observed between 1976–81 and 1981–86 on the one hand, and 1986–91 on the other. However, we now see that positive shift is appearing not just in the favoured early starters of Poznańskie and Warszawskie, but particularly now in voivodeships neighbouring them. Looking at the sectoral components of these shift figures, it is clear that three sectors contribute markedly to these results: food products, wood products, and textiles and clothing, followed by the highly aggregated electromechanical sector. Comparing these results with other variables (Bivand, 1996), we can see that new firm formation is clearly related to these patterns, and that on the other side of the labour market, unemployment is associated with negative shift results. Unemployment is however also driven by changes in agriculture, in particular the collapse of state farms, so that for example the situation of Suwalskie is doubly challenging: it has both a strong negative shift in manufacturing employment, and the eradication of employment on state farms. Perhaps happily, the number remaining in manufacturing was only 17.900 in 1996, so that the percentage rate does not mean as many jobs as it would in a larger voivodeship. Further, this particular region has great potential in services, in particular in tourism in its unspoilt forests and lakes.

Having presented the results of regional differential shift analyses for the three chosen estimation methods and four periods, we will now return to the analysis of dynamic externalities in the context of Polish manufacturing employment. Table 9 presents the results of the estimation of the augmented model (equation 20) for the four periods using Poisson regression and the logarithm of base year employment as the offset variable. This table differs from Table 4 in only showing residual deviance following the inclusion of the named factor. The table can thus be read by taking the null model residual deviance, say for 1976–81 112611, and then reading down the column to see the residual deviance remaining. In the 1976–81 model, the offset variable and the sectoral factor account for most of the deviance, leaving a residual deviance of 131, with the regional factor only achieving

Table 8: Percentage regional shift per year for 1991–96 using standard shift-share, analysis of variance, and Poisson regression methods, ranked by Poisson regression shift, and omitting voivodeships with central shift values.

	Voivodeship	Differential shift	Growth component	Poisson regression shift
21	Leszczyńskie	7.04	8.04	6.95
29	Pilskie	5.71	5.93	5.28
13	Kaliskie	4.73	5.60	4.99
37	Sieradzkie	4.37	7.51	4.95
1	Warszawskie	3.34	8.73	3.10
18	Krakowskie	2.37	0.80	2.71
32	Poznańskie	2.64	8.59	2.63
26	Olsztyńskie	2.49	2.58	2.63
23	Łomżyńskie	2.42	3.47	2.23
	. . .			
22	Lubelskie	-1.58	-3.38	-1.95
46	Włocławskie	-1.75	-0.62	-1.96
30	Piotrkowskie	-2.84	-4.20	-2.31
16	Konińskie	-2.97	3.26	-2.53
45	Wałbrzyskie	-3.15	-4.46	-2.67
6	Chełmskie	-2.77	-3.64	-3.00
34	Radomskie	-3.45	-4.93	-3.66
12	Jeleniogórskie	-4.31	-6.33	-3.75
33	Przemyskie	-3.85	-4.42	-3.84
31	Płockie	-4.55	-1.45	-4.23
42	Tarnobrzeskie	-3.09	-0.64	-4.67
20	Legnickie	-5.98	-3.02	-5.71
40	Suwalskie	-5.19	-6.14	-5.88

marginal significance, bringing residual deviance down to 66. The dynamic externalities variables, both as factors and in interaction terms with the sectoral factor are not significant, improving the fit of the model very little, and ending up with a residual deviance of just 48.

Table 9: Analysis of deviance for augmented Poisson regression models including sectoral and regional dummies, specialization and diversity indices, and interaction terms between sectoral dummies and specialization and diversity indices; values indicate residual deviance, while the Chi-squared significance test applies to reduction in residual deviance due to the term in question (prob. values: *** < 0.001, ** 0.001–0.01, * 0.01–0.05).

	1976-81		1981-86		1986-91		1991-96	
Null model	112611		129676		120555		92129	
Sectoral dummies	131	***	151	***	383	***	895	***
Regional dummies	66	*	68	***	202	***	592	***
Specialization	66		65		195	**	486	***
Diversity	65		65		194		483	
Sectoral:specialization	52		53		175	*	399	***
Sectoral:diversity	48		52		151	**	357	***

In the second period, the regional factor becomes more significant, while the dynamic externalities factors remain insignificant. By 1986–91, when as we have seen above, things do start happening in terms of regional shift, the specialization factor becomes significant in the reduction of residual deviance, as do the interaction terms between both the specialization and sectoral factors, and the diversity and the sectoral factors. By the final 1991–96 period, all factors and interactions are significant with the exception of the diversity factor (prob. value 0.097). For the first and second periods, the Akaike Information Criteria values of the augmented model are greater than those of the restricted model (equation 14), while for the 1986–91 period the value for the augmented model is AIC = 312.80, for the restricted model 413.06, and by the final period, the augmented model (AIC = 518.51) clearly outperforms the restricted model (AIC = 924.24). These models thus firstly confirm the detection of a clear turnaround at or about the onset of economic transition, and secondly suggest that at the same time factors operationalized from dynamic externalities concepts begin to bite in terms of significance.

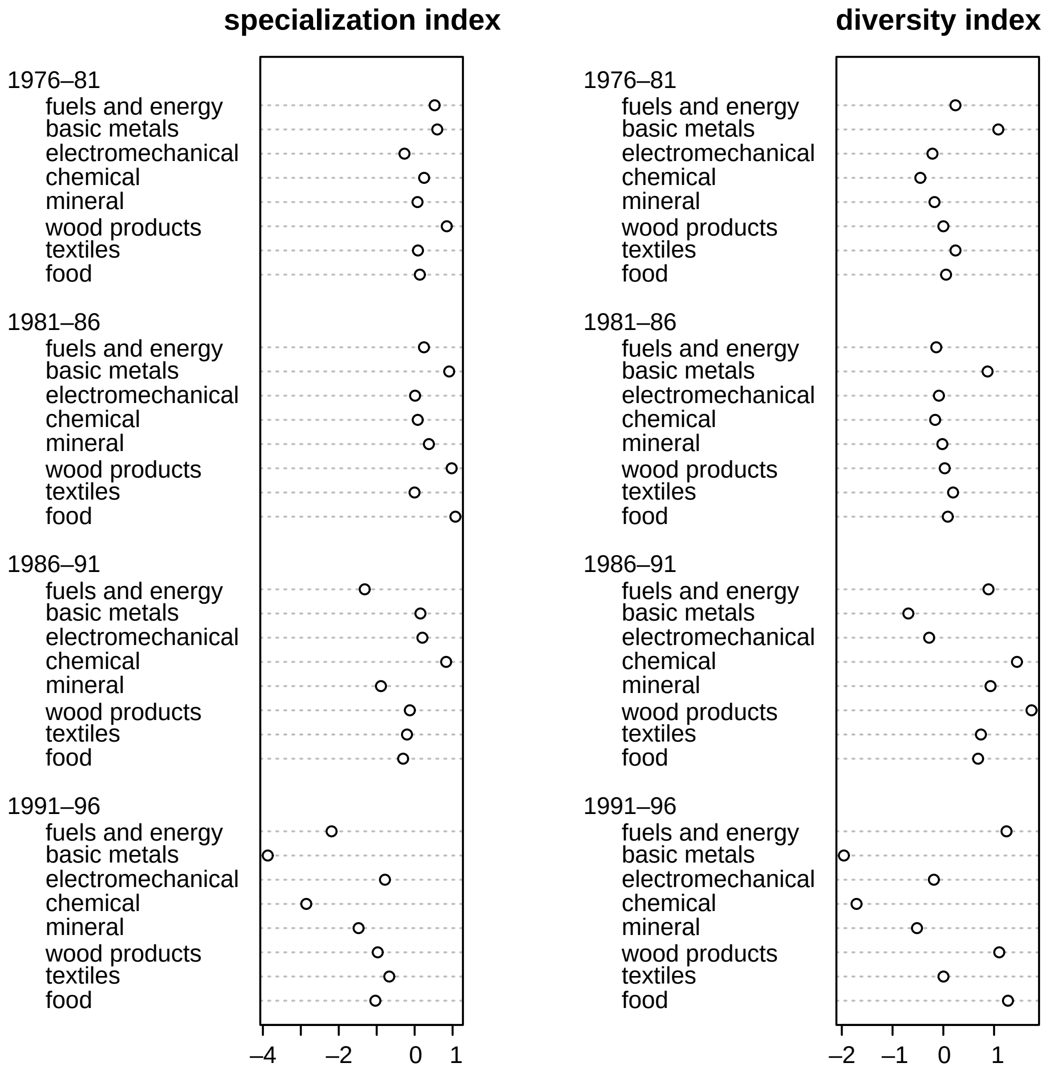

Figure 7: Dotplots of specialization and diversity coefficient estimates by sector, 1976–81 to 1991–96.

In order to explore this further, Poisson regressions were estimated for each sector seperately without the offset variable, but including the logarithm of base year employment among the expanatory variables (equation 19). Since the maximum number of observations was 49, and for several sectors with zero employment like basic metals, there were less than 20, the results are probably not as robust as those reported above. In addition, regional fixed effects could not be treated, and no weights were employed. Ignoring estimates of the coefficient on the logarithm of base year employment, which were clustered around unity, Figure 7 and Tables 10 and 11 show the estimation results obtained. Figure 7 summarises the values in the tables in two dotplots in order to see whether the periodization reached above also holds for this simple model. As can be seen, estimated values of the specialization index coefficient are well to the right of the plot in the first two periods, although there are detail differences beteen sectors. This pattern begins to break up in the third, 1986–91, period, with five sectors crossing zero. By the final period, all the eight sectors modelled have moved into negative territory, many quite deeply. The interpretation of this coefficient is that positive values associate specialization in the given sector with growth in employment in the sector, MAR externalities. Only the estimates of the specialization index coefficient for electromechanical products and textiles and clothing for 1981–86 are not significant, although significance levels do vary a little otherwise.

Table 10: Specialization coefficient estimates by sector, 1976–81 to 1991–96 (prob. values: *** $<$ 0.001, ** 0.001–0.01, * 0.01–0.05).

	1976-81		1981-86		1986-91		1991-96	
fuels and energy	0.527	***	0.245	***	-1.316	***	-2.189	***
basic metals	0.596	***	0.910	***	0.152	***	-3.871	***
electromechanical	-0.269	***	0.011		0.204	***	-0.783	***
chemical products	0.249	***	0.081	*	0.830	***	-2.856	***
mineral products	0.075	*	0.376	***	-0.888	***	-1.478	***
wood products	0.846	***	0.975	***	-0.127	**	-0.973	***
textiles & clothing	0.087	***	-0.003		-0.202	***	-0.669	***
food products	0.137	***	1.074	***	-0.304	***	-1.036	***

The second dotplot in Figure 7 provides analogous information about the estimates of the diversity index coefficient for these eight sectors and four periods. For the first two periods, most values are clustered around zero, with the exception of basic metals, which is positive. This sector crashes out in the two final periods, with strongly negative values. The cloud of values breaks up in 1986–91, with all the other sectors going positive, but to varying extents. In the final period, only three sectors stay positive, one is near zero, and the remainder scattered on the negative side. The sectors on the positive side are fuels and energy, which may be associated with the employment growth in energy supply in major urban areas noted above, wood products, and food products, with textiles and clothing now near zero. Apart from the estimate for the diversity index coefficient for textiles and clothing for 1991–96, and the estimates for wood products for 1976–81 and 1981–86, all others are significant.

Table 11: Diversity coefficient estimates by sector, 1976–81 to 1991–96 (prob. values: *** $<$ 0.001, ** 0.001–0.01, * 0.01–0.05).

	1976-81		1981-86		1986-91		1991-96	
fuels and energy	0.239	***	-0.139	***	0.890	***	1.245	***
basic metals	1.083	***	0.872	***	-0.689	***	-1.959	***
electromechanical	-0.214	***	-0.087	***	-0.279	***	-0.186	***
chemical products	-0.453	***	-0.161	***	1.451	***	-1.710	***
mineral products	-0.174	***	-0.019		0.930	***	-0.519	***
wood products	0.001		0.028		1.738	***	1.102	***
textiles & clothing	0.240	***	0.192	***	0.741	***	0.003	
food products	0.054	**	0.088	***	0.685	***	1.274	***

6 Conclusions

These conclusions are necessarily tentative, given the data used, the coarse sectoral and regional aggregation used, and finally the choice of the four five-year periods for examination. It is however unlikely that the turnaround detected both in three different measures of regional differential shift, in the significance of the factors in the estimated augmented models, and in the significant sign changes in dynamic externalities variables for eight sectors is due to chance, or to data imperfections. Indeed, it would be more than strange if no responses were observable in regional manufacturing employment associated with the onset and progress of transition to market relationships from central planning.

It may be concluded reasonably that transition is being led by key metropolitan areas and their neighbouring voivodeships. This is also among the arguments behind the present reorganization of Poland's regional administrative structure, with the ongoing introduction of 16 self-governing regions to replace the 49 voivodeships, which have not had autonomous local government functions, but have been part of central government. At the level of resolution used here, it is not possible to contribute to the discussion around this issue. Further analysis of regional change using data at the district (powiat) level now being introduced would be much more helpful in this respect, and should be undertaken in the future.

Analysis of dynamic externalities suggests firstly that US experience is relevant to the transition process, firstly because the chosen indices do account for much of the deviance of the response variables, and secondly because the change from pre-transition positive specialization index coefficients to negative, and to strongly positive diversity index coefficients can reasonably be associated with transition. This would indeed correspond with regional economies in which pre-existing specialization, operationalizing MAR externalities, ceases to secure the retention of existing industries, as Henderson et al. (1995) held that it should, all else being equal. In transition economies, it seems that the valuable store of "local knowledge" within own sector may lose in importance for bewildered managers and workers. This would also conform with increases in coefficient values on the diversity index, operationalizing Jacobs externalities; it may be that transition creates contexts of new firm formation and state firm restructuring in which almost all economic agents are obliged to behave as though they are in new industries, for which both Glaeser et al. (1992) and Henderson et al. (1995) expect Jacobs externalities to be more important. While a small worry is associated with significant dynamic externalities coefficients in periods under central planning, it may be noted that sectoral and regional "local knowledge" and knowledge spillovers also existed then, and may well be reflected in the specialization index, although they have not come about through profit maximizing mechanisms.

Finally, analysis indicates firmly that variants of shift-share analysis, using analysis of variance and Poisson regression, continue to have much to offer for the analysis and modelling of regional manufacturing employment change at aggregated levels in terms of regions and sectors. While they can naturally not tell us what individual firms are doing, they provide useful tools for analysing and presenting the contexts within which decisions are taken by the economic agents themselves.

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