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ANALYSIS OF EMPLOYMENT CHANGE IN THE MANUFACTURING SECTOR OF VOIVODESHIPS ECONOMIES. APPLICATION OF THE EXTENDED SHIFT-SHARE TECHNIQUE

Abstract: After 1999, when the new administrative division was introduced, a growing interest in developing and implementing new methods of regional analysis in Poland has been observed. The aim of the paper is to show the utility of extended shift-share technique in the Rigby-Anderson form to analyse regional economy performance. The example of Lower Silesia in the years 2005-2009 was analysed as a case.
Key words: Shift-share analysis, regional analysis, Poland.

Introduction

Since the new administrative units of Poland's territorial division (voivodeships, NUTS 2 units) were introduced in 1999, a new period in regional programming (in both theory and practice) in Poland started. To face up to the challenge of proper allocation of scarce resources, regional authorities need modern tools to evaluate regional economy performance and to project intervention. In the 2007-2013 financial perspective, the amount of funds allocated by regional governments has grown rapidly. To emphasise the significance of this fact, let us compare that Polish regions (voivodeships) will obtain on average about EUR 1 billion (2007-2013) from the European Regional Development Fund, while the yearly average budget of a voivodeship in 2008 was around PLN 800 million (Central Statistical Office (CSO), 2012).

The most advanced tools used for this purpose are multiequation econometric models (general equilibrium class) for voivodeship economies (originally designed to evaluate structural fund intervention), *i.e.*:

- the HERMIN Model, developed by the Wrocław Regional Development Agency (*Wrocławska Agencja Rozwoju Regionalnego – WARR*),
- the MaMoR2 Model, developed by the Gdańsk Institute for Market Economics (*Instytut Badań nad Gospodarką Rynkową*).

Besides the obvious strengths of such models, their weaknesses should also be mentioned. The shortcomings result from vast data requirements, and thus from difficulties to take the structure of the regional economy into account (for example, according to NACE classification into the "section" and "division" level). As noted by Czarnecki and Woźniak [2012], after examining the techniques of regional analysis used in preparing regional development strategies, further development of alternative or complimentary tools/techniques of regional analysis is needed.

The aim of the article is to show the usefulness of the extended shift-share technique in analysing regional economy performance. The authors referred to regional science literature and used official data provided by Central and Regional Statistical Offices to achieve the objective defined in this way. The structure of this article is as follows: the first part presents the method and data used, the second part discusses the results, and the conclusions are included in the last section.

1. Method and data

The shift-share technique, also called components of change analysis, is one of the most popular methods to describe reasons for change in economic growth (using *e.g.* the employment variable). It is also used in the analysis of business demographics [Fotopoulos 2007], regional inequality [Ezcurra *et al.* 2005] and international trade [Noponen *et al.* 1998]. Its originated in the 1940s when Professor H.J. Jones used the technique in the work of the Barlow Commission on the Distribution of the Industrial Population [Armstrong and Taylor 1978; cited in Ray 1990] and the economists from the U.S. Bureau of Labor and Statistics developed the concept of "location shift" used to measure the growth trends differences between the nation and the states [Creamer 1942, cited in: Selting, Loveridge 1992]. The standard (or, in the article, the classic or traditional) three component approach comes from Dunn [1960].

The shift-share model is usually a mathematical identity where the regional change in employment in given sector (*TG*) between two periods is decomposed into three components: the national share effect (*NS*), industry mix (*IM*, also called a structural, proportional or industrial effect) and the regional (also differential or competitive) effect (*RS*).

$$TG = NS + IM + RS \tag{1}$$

The national share effect reflects the employment change which would have occurred in a region if total base year employment in that region had grown at the same

rate as the total employment in the nation as a whole. This effect provides a useful comparison with the actual change in employment in the region.

$$NS = E_{ir}g_n \tag{2}$$

where:
i – sector,
r – region,
E – employment,
g – relative change in employment,
n – reference area.

The difference between actual employment growth in a region and that expected on the basis of the national share is called a total shift or a net shift (denoted *TS*). The total shift may be expressed as the sum of the industry mix and the regional effect. The industry mix effect shows the employment change expected from the national growth rate of that sector after taking the overall growth rate into account. It measures the portion of regional growth resulting from an abundance of either quickly or slowly growing sectors.

$$IM = E_{ir}(g_{in} - g_n) \tag{3}$$

The regional effect is a residual component calculated as the difference between the actual and expected change in employment (sum of NS and IM). A positive regional effect for a sector in given region may be interpreted as indicating a positive interaction between a sector and a region, although the source of such competitive advantage is not known.

$$RS = E_{ir}(g_{ir} - g_{in}) \tag{4}$$

The reason for such frequent application of the classic shift-share is that it is easy to use. This technique is neither mathematically complex nor data-intensive, which explains the widespread use of the method. Although the shift-share is generally accepted, the shortcomings of the method should be mentioned. There are four main areas of criticism of the traditional model [Selting, Loveridge 1992]:

- no theoretical base,
- disaggregation and the shift-share components,
- base or terminal year weight use,
- interdependence of industrial mix and the regional effect.

The criticism results in further development of the model proposed by Dunn. The main extensions of the classic model are made by (among others): Arcelus [1984]; Artidge, van Neuss [2012]; Barff, Knight [1988]; Esteban-Marquillas [1972]; Haynes, Dinc [1997]; Nazara, Hewings [2004]; Rigby, Anderson [1993]. Apart from the traditional model, probabilistic forms of shift-share (ANOVA-based and information-theoretic models) are developed [Knudsen 2000].

Despite its popularity and general acceptance in the world, the method is known but rarely used in Poland, in research [Batóg, Batóg 2007; Kudłacz 1998; Łaźniewska, Górecki 2008; Woźniak 2010a,b] and in practice [*Konkurencyjność...* 2011].

The method used in this article is a variation of the classic model with the extension made by Rigby and Anderson. The authors focused on the manufacturing sector (section C according to the Polish Classification of Activities 2007 – PKD-2007) in Dolnośląskie Voivodeship compared to Poland, divided into divisions (two-digit groups). PKD-2007 is fully methodologically and conceptually coherent and comparable with NACE Revision 2 as to the scope and the coding system (up to the fourth digit).

In further analysis, symbols used in equations 2-4 denote:

i – division,
r – region (voivodeship),
E – employment,
g – relative change in employment,
n – manufacturing sector in Poland.

Rigby and Anderson argued that the traditional shift-share model measures the combined effects of output growth and productivity change on employment. As they pointed out, a positive (negative) shift may result from above (below) average output growth, and below (above) average productivity gains. Unless these effects are isolated, regional performance cannot be evaluated unambiguously. They extended the standard shift-share method to separate the effects of changes in output and productivity on employment. Average labour productivity is described as follows[1]:

$$q_{ir} = \frac{Q_{ir}}{E_{ir}} \tag{5}$$

where:

q – labour productivity,
Q – output.

The absolute change in employment anticipated in industry i region r over a given time period, if productivity remains constant and output changes as observed (A_{ir}), is:

$$A_{ir} = \frac{Q_{ir_{(t+1)}} - Q_{ir_{(t)}}}{q_{ir_{(t)}}} \tag{6}$$

Equation 7 describes, in turn, the potential change in employment in industry i region r resulting from variations in productivity with output constant:

[1] As Haynes and Dinc [1997] pointed out, they ignore the other factors of production such as capital, technology, infrastructure or quality of material input. They develop a model regarding total factor productivity.

$$B_{ir} = \frac{Q_{ir_{(t+1)}}}{q_{ir_{(t+1)}}} - \frac{Q_{ir_{(t+1)}}}{q_{ir_{(t)}}} \tag{7}$$

Both A_{ir} i B_{ir} can be expressed in relative terms (in relation to E_{ir}), denoted a_{ir} and b_{ir}, respectively . Hence, g_{ir} is the sum of a_{ir} and b_{ir}. These effects may be defined at the level of the industry, the region or the nation, and the equations 2-4 may be rewritten:

$$NS = NS(a) + NS(b) = E_{ir}[(a_n) + (b_n)] \tag{8}$$

$$IM = IM(a) + IM(b) = E_{ir}[(a_{in} - a_n) + (b_{in} - b_n)] \tag{9}$$

$$RS = NS(a) + NS(b) = E_{ir}[(a_{ir} - a_{in}) + (b_{ir} - b_{in})] \tag{10}$$

Some further remarks about the data used are necessary. The period of investigation is between 2005 (the first year after EU accession) and 2009 (most recent data). Although the method is not data-intensive, the official data system (provided by Central Statistical Office) should be upgraded on the regional level. Employment was measured by the number of employees. Output is described by the sold production of

Table 1

List of divisions according to PKD 2007 used in the article

Division (According to PKD 2007)	No.	Article code
Manufacture of textiles	13	TEX
Manufacture of wearing apparel and furriery	14	WEA
Manufacture of wood and wood, straw and wicker products	16	WOD
Manufacture of pulp and paper	17	PAP
Publishing, printing and reproduction of recorded media	18	PRI
Manufacture of chemicals and chemical products	19	CHE
Manufacture of rubber and plastic products	20	RUB
Manufacture of other non-metallic mineral products	21	NMT
Manufacture of basic metals	22	MET
Manufacture of metal products	23	MTP
Manufacture of office machinery and computers	24	OFF
Manufacture of electrical machinery and apparatus n. e. c.	25	ELE
Manufacture of machinery and equipments n . e . c .	26	MAH
Manufacture of motor vehicles, trailers and semi-trailers	27	VEH
Manufacture of other transport equipment	28	TRA
Manufacture of furniture; manufacturing n . e . c .	29	FUR
Other divisions (e.g., manufacture of coke, refined petroleum products, manufacture of food products and beverages, Processing of leather and manufacture of leather products)		OTH

Source: Own elaboration.

industry in nominal values (GVA or GDP are not available). These data were deflated using national price indexes for divisions. Three official data sources of Central and Regional Statistical Offices were used:

- Local Data Bank (accessed between 1 and 31 July, CSO 2012);
- 16 voivodeship statistical industry yearbooks (for each voivodeship);
- Prices in the national economy in 2008 and 2007.

One of the main problems is a change in the Polish Classification of Activities (PKD). Data from 2004 are originally in the PKD-2004 version, which is slightly different than the PKD-2007. The list of divisions taken into account is listed in Table 1. The authors made their own recalculation to make data comparable. Therefore, one must be cautious when drawing conclusions from the analysis. Voivodeships are presented in an alphabetical order, two-letter codes are used in place of the full names of voivodeships.

2. Results

In the years under analysis, employment in the entire economy increased from 8.79 to 9.77 Mio., while in manufacturing dropped slightly (by 0.23%). Production in Poland (in terms of GVA) increased by 21.1%. and by 47.1% in manufacturing (23.7% taking into account sold production of industry only).

Table 2 shows the results for classic share and total shift components. As mentioned above, the slight decrease in employment in manufacturing resulted in a negative NS (manufacturing is considered the reference "area", not the entire economy). The total shift component varies (negative values, positive values) in individual divisions and voivodeships. Therefore, to understand the meaning of *TS*, Table 3 introduces the division into industry mix and the regional component.

The structural effect is the result of division performance compared with manufacturing performance at the national level. In eight divisions, there were better results than in the entire manufacturing section (the IM is positive). Employment in the best performing division in all voivodeships (*Manufacturing of motor vehicles, trailers and semi-trailers*) increased by 43%. On the other hand, in *Publishing, printing and reproduction of recorded media* employment decreased by 48% (the worst result).

The regional effect describes whether regional conditions favour or discourage growth in any given division. For example, there are positive incentives for Manufactur*ing* of textiles in 7 out of 16 voivodeships (positive RS) and negative conditions for development of this division in other regions (negative RS).

Although the traditional model yields a quite useful image of a region's economy, without consideration of the relationship between output and employment change, the technique may provide extremely misleading conclusions. Table 4 examines the example of Dolnośląskie Voivodeship (Lower Silesia).

Table 2

Standard Shift-share analysis. NS and TS components for voivodeships

	TEX	WEA	WOD	PAP	PRI	CHE	RUB	NMT	MET	MTP	OFF	ELE	MAH	VEH	TRA	FUR
	NS															
DL*	-32	-33	-18	-8	-12	-24	-28	-45	-20	-49	-24	-31	-64	-52	-10	-50
KP	-11	-29	-16	-17	-15	-23	-31	-16	-6	-55	-13	-14	-32	-5	-9	-34
LL	-4	-23	-18	-5	-6	-14	-9	-18	-2	-18	-6	-4	-35	:	:	-22
LB	-8	-12	-24	-6	-3	-6	-8	-13	-2	-26	-6	-16	-11	-5	-3	-28
LD	-75	-102	-18	-8	-15	-19	-29	-34	-5	-35	-17	-20	-36	-14	-5	-35
ML	-9	-29	-30	-6	-27	-25	-27	-26	-40	-56	-19	-24	-41	:	:	-29
MZ	-12	-42	-21	-23	-87	-64	-51	-32	-8	-70	-66	-23	-45	-22	-9	-37
OP	-4	-6	-8	-3	-3	-9	-6	-13	-5	-27	-3	-13	-19	-4	-4	-18
PD	-7	-7	-19	-1	-5	-2	-10	-7	0	-9	-3	-3	-15	0	-6	-15
PK	-8	-14	-29	-4	-6	-15	-36	-35	-11	-36	-4	-9	-38	-31	-22	-38
PM	-4	-20	-30	-9	-10	-12	-23	-15	-1	-48	-32	-13	-26	-9	-62	-37
SL	-27	-41	-25	-9	-20	-20	-56	-44	-71	-109	-28	-59	-120	:	:	-47
SW	-2	-18	-12	-3	-6	-2	-6	-32	-10	-29	-2	-4	-22	:	:	-5
WL	-25	-57	-50	-17	-30	-16	-47	-31	-15	-78	-18	-48	-59	-57	-18	-105
WM	-5	-17	-29	-3	-5	-1	-21	-11	-2	-20	-2	-11	-14	-2	-5	-51
ZP	-4	-14	-29	-6	-7	-12	-17	-9	-3	-29	-9	-10	-12	-4	-31	-21
	TS															
DL	-3,860	-4,959	-676	849	-1,983	1,637	5,110	-1,198	897	4,344	2,651	4,721	-8,203	100	-252	1,538
KP	-683	-2,508	170	3,377	-2,638	-153	1,565	-268	-912	1,262	461	-79	-4,237	884	-1,726	1,417
LL	-651	-2,409	111	122	-844	310	-26	96	142	1,362	-1,359	-389	-5,976	:	:	192
LB	6,023	8,520	8,374	5,618	4,764	5,551	16,143	8,328	3,368	20,499	-183	8,299	12,681	21,163	3,523	35,404
LD	-11,736	-3,490	-792	575	-1,967	385	4,598	408	-4	5,351	581	3,807	-5,583	65	-938	678
ML	-1,599	-1,798	-152	853	-4,739	-301	3,079	-264	-1,720	2,601	-2,996	-1,437	-4,709	:	:	2,118
MZ	-1,680	-829	-227	1,223	-16,053	1,667	1,918	2,730	460	1,153	-10,292	-2,864	-3,798	1,405	-1,071	3,741
OP	-364	-954	919	190	-308	-90	314	-102	527	-953	-931	-1,162	-1,927	3,940	-524	-316
PD	-1,981	2,227	-2,172	874	-454	-301	-858	7,887	3,378	10,438	-877	876	-1,217	4,524	-1,963	-3,231
PK	-1,800	-495	-1,087	41	-977	551	895	-2,082	281	1,481	1,553	1,094	-3,960	4,429	1,396	1,017
PM	-561	-2,575	-136	-2,232	-2,506	-3,652	-127	-885	9	-9,339	-10,744	-2,219	-4,700	-1,449	-20,350	5,289
SL	-3,681	-3,512	757	190	-3,494	1,287	3,984	1,697	2,428	7,198	-6,476	-3,712	-19,071	:	:	-1,386
SW	936	-4,133	1,636	-98	-886	-7	3,134	-8,573	-3,226	-6,446	-453	148	-3,602	:	:	3,696
WL	-7,446	-15,858	-6,537	-4,098	-8,871	-1,105	-10,500	-7,207	-4,714	-15,882	-4,239	-15,044	-17,759	-17,260	-3,354	-28,515
WM	-353	-400	1,327	2,181	114	2,675	1,050	2,687	-11	12,492	9,923	-1,854	2,520	2,648	7,652	-3,470
ZP	643	-1,723	-1,782	626	-2,089	-2,159	-2,241	2,000	-148	-1,531	95	-1,427	-889	8,159	-9,711	2,354

* DL – Dolnośląskie; KP – Kujawsko-pomorskie; LL – Lubelskie; LB – Lubuskie; LD – Łódzkie; MP – Małopolskie; MZ – Mazowieckie; OP – Opolskie; PK – Podkarpackie; PD – Podlaskie; PM – Pomorskie; SL – Śląskie; SW – Świętokrzyskie; WM – Warmińsko-Mazurskie; WP – Wielkopolskie; ZP – Zachodniopomorskie.

Table 3

Industry mix and regional component of total shift for voivodeships

	TEX	WEA	WOD	PAP	PRI	CHE	RUB	NMT	MET	MTP	OFF	ELE	MAH	VEH	TRA	FUR
	IM															
DL	-3,907	-2,481	-13	665	-2,052	724	1,969	620	75	2,378	-2,327	-1,154	-7,668	7,725	-1,235	1,808
KP	-1,392	-2,189	-12	1,352	-2,540	703	2,136	221	23	2,714	-1,261	-535	-3,877	696	-1,143	1,228
LL	-466	-1,722	-13	368	-1,017	439	604	241	8	871	-536	-152	-4,207	:	:	783
LB	-952	-881	-17	474	-534	180	579	185	9	1,281	-568	-589	-1,278	809	-391	1,008
LD	-9,159	-7,700	-13	635	-2,534	567	1,982	466	20	1,701	-1,649	-745	-4,249	2,044	-566	1,266
ML	-1,125	-2,173	-21	519	-4,461	774	1,843	364	152	2,761	-1,867	-903	-4,952	:	:	1,046
MZ	-1,456	-3,153	-15	1,851	-14,495	1,930	3,516	444	28	3,445	-6,447	-852	-5,318	3,244	-1,092	1,314
OP	-448	-473	-6	252	-528	283	397	180	19	1,312	-301	-474	-2,269	599	-432	637
PD	-863	-494	-13	108	-791	59	725	97	1	443	-296	-94	-1,833	52	-704	540
PK	-918	-1,050	-21	358	-1,020	462	2,479	479	40	1,774	-372	-323	-4,593	4,631	-2,676	1,354
PM	-530	-1,505	-21	768	-1,702	377	1,587	208	4	2,362	-3,103	-481	-3,107	1,271	-7,663	1,339
SL	-3,304	-3,068	-18	696	-3,378	609	3,895	601	266	5,353	-2,718	-2,206	-14,288	:	:	1,691
SW	-220	-1,383	-9	225	-1,025	52	442	447	36	1,424	-233	-166	-2,675	:	:	183
WL	-3,053	-4,283	-35	1,359	-4,915	483	3,261	430	57	3,832	-1,718	-1,785	-7,017	8,509	-2,217	3,747
WM	-552	-1,277	-21	212	-777	45	1,465	147	7	962	-186	-415	-1,647	301	-566	1,821
ZP	-451	-1,062	-21	448	-1,161	349	1,158	123	10	1,418	-912	-371	-1,450	587	-3,750	762

	RS															
DL	47	-2,478	-662	185	70	913	3,141	-1,818	822	1,965	4,978	5,875	-535	-7,625	983	-269
KP	709	-318	182	2,025	-97	-856	-571	-489	-935	-1,452	1,722	456	-359	188	-583	190
LL	-185	-687	123	-247	173	-129	-630	-146	134	491	-824	-237	-1,768	:	:	-591
LB	6,975	9,401	8,392	5,143	5,298	5,371	15,565	8,143	3,359	19,219	384	8,887	13,959	20,354	3,914	34,396
LD	-2,577	4,211	-779	-60	567	-183	2,616	-58	-23	3,650	2,230	4,552	-1,334	-1,979	-372	-588
ML	-474	375	-131	335	-279	-1,074	1,235	-628	-1,871	-159	-1,129	-534	243	:	:	1,072
MZ	-224	2,324	-212	-628	-1,558	-264	-1,598	2,286	431	-2,292	-3,845	-2,012	1,520	-1,840	21	2,427
OP	83	-481	924	-62	221	-373	-83	-282	508	-2,265	-629	-688	342	3,341	-93	-954
PD	-1,118	2,721	-2,159	767	337	-361	-1,583	7,790	3,378	9,995	-581	970	616	4,472	-1,260	-3,771
PK	-883	555	-1,066	-316	43	89	-1,584	-2,562	241	-293	1,925	1,417	633	-202	4,072	-337
PM	-30	-1,070	-115	-3,000	-804	-4,029	-1,714	-1,093	5	-11,701	-7,641	-1,738	-1,593	-2,720	-12,687	3,951
SL	-377	-444	775	-507	-115	678	89	1,096	2,161	1,846	-3,758	-1,506	-4,784	:	:	-3,077
SW	1,156	-2,749	1,645	-323	139	-59	2,693	-9,020	-3,262	-7,870	-219	314	-926	:	:	3,513
WL	-4,393	-11,575	-6,502	-5,457	-3,956	-1,588	-13,761	-7,637	-4,771	-19,714	-2,521	-13,260	-10,743	-25,769	-1,137	-32,262
WM	198	877	1,348	1,969	890	2,630	-415	2,539	-18	11,530	10,109	-1,439	4,167	2,347	8,218	-5,291
ZP	1,093	-661	-1,762	177	-928	-2,509	-3,399	1,877	-159	-2,949	1,007	-1,056	561	7,572	-5,962	1,592

Table 4

Modified version of shift-share for Dolnośląskie Voivodeship

	TS			IM	of which:		RS	of which:	
		TS(A)	TS(B)		IM(A)	IM(B)		RS(A)	RS(B)
TEX	-3,860	-4,719	859	-3,907	-1,603	-2,304	47	-3,116	3,163
WEA	-4,959	-5,750	791	-2,481	-4,703	2,222	-2,478	-1,047	-1,431
WOD	-676	-2,118	1,443	-13	-634	621	-662	-1,484	822
PAP	849	18	831	665	-295	960	185	313	-128
PRI	-1,983	-329	-1,654	-2,052	-195	-1,858	70	-134	204
CHE	1,637	-1,869	3,506	724	-540	1,264	913	-1,329	2,242
RUB	5,110	4,312	798	1,969	197	1,772	3,141	4,115	-973
NMT	-1,198	-2,770	1,572	620	704	-84	-1,818	-3,475	1,657
MET	897	-446	1,343	75	-2,476	2,551	822	2,030	-1,208
MTP	4,344	6,557	-2,213	2,378	1,858	520	1,965	4,699	-2,734
OFF	2,651	91,891	-89,240	-2,327	7,688	-10,015	4,978	84,204	-79,225
ELE	4,721	16,053	-11,332	-1,154	4,818	-5,972	5,875	11,236	-5,360
MAH	-8,203	15,159	-23,362	-7,668	2,384	-10,052	-535	12,775	-13,310
VEH	100	-3,130	3,230	7,725	678	7,047	-7,625	-3,808	-3,817
TRA	-252	1170	-1,422	-1,235	-188	-1,047	983	1,359	-376
FUR	1,538	-1,372	2,910	1,808	156	1,651	-269	-1,528	1,259
OTH	7,568	-8,513	16,081	4,111	-2,003	6,113	3,458	-6,510	9,967

The following conclusions might be drawn on the basis of the analysis. Seven out of the 17 analysed divisions of manufacturing in Dolnośląskie Voivodeship (*Manufacturing of textiles, Manufacturing of apparel, Manufacturing of products of wood, cork, straw and wicker, Printing and reproduction of recorded media, Manufacturing of other non-metallic mineral products, Manufacturing of machinery and equipment n.e.c., Manufacturing of other transport equipment*) had lower than expected employment growth (negative TS). In the case of some of the above mentioned industries (*Manufacturing of textiles, Manufacturing of apparel, Manufacturing of products of wood, cork, straw and wicker, Printing and reproduction of recorded media, Manufacturing of other non-metallic mineral products)* poor performance was due to both sluggish productivity growth and output growth. This allows concluding that the situation in these fields seems not optimistic due to a decline in output, being primarily a result of the economic crisis in the international environment entailing a significant decrease in global demand and affecting regional employment. However, poor performance of these industries (especially *Manufacturing of other non-metallic mineral products)* is more important for the long-run development in terms of the main driving force of cost-competitiveness, namely productivity. All those industries are traditional and relatively labour-intensive, which may be considered some kind of an explanation for their poor performance. These industries must compete head-to-

head with products manufactured in countries with relatively low labour costs. It implies the urgent need of their restructuring in order to allow them to exist in the region in the longer perspective. There are also industries such as: *Manufacturing of machinery and equipment n.e.c. and Manufacturing of other transport equipment* which are in fact below the national average in terms of employment growth. However, they are characterised at the same time by relatively strong productivity performance whose negative results for the labour market are not offset by output-induced employment gain. One may expect these industries to perform better in the long run, provided that the global economy recovers from the economic turmoil fully.

Ten divisions have higher than expected employment growth (*Manufacturing of paper and paper products; Manufacturing of chemicals and chemical products; Manufacturing of rubber and plastic products; Manufacturing of basic metals; Manufacturing of metal products; Manufacturing of computer, electronic and optical products; Manufacturing of electrical equipment; Manufacturing of motor vehicles, trailers and semi-trailers; Manufacturing of furniture and other manufacturing; Other manufacturing*). These are key divisions which contribute the most to the good performance of the region in terms of the labour market in manufacturing. *Manufacturing of electrical equipment, Manufacturing of computer electronic and optical products and Manufacturing of metal products* are not only vital contributors to regional employment performance, but they also have the strongest performance in terms of both productivity and output growth. It is, among others, due to relatively high investment appeal of the region in question, which resulted in numerous foreign direct investments associated with the production of household appliances (*e.g.* Whirpool, Fagor, Electrolux) and electronic devices (*e.g.* LG, Toshiba). Transnational companies have significantly contributed to stronger performance of those industries, more than their national counterparts, which is reflected by their higher productivity and stronger output growth in spite of global economic problems. It is also worth to emphasise the traditions and great academic potential of Lower Silesia in the field of computer science which play a significant role in the relatively good performance of *Manufacturing of computer, electronic and optical products*.

An interesting case to be mentioned is the *Manufacturing of motor vehicles, trailers and semi-trailers.* The industry has a strong position in the region of Lower Silesia, being one of the main driving forces of its economic development (with such automotive companies running their operations there as Volvo, Toyota, Volkswagen). However, the results of the analysis show a relatively poor performance of this industry in terms of both productivity and output growth, even though the automotive sector contributed to regional employment increases. This may imply decreasing sectoral competitiveness of this industry resulting from the dramatic decline in global demand and relatively high rigidity of employment in the automotive industry in Lower Silesia. In other words, it can be concluded that the industry was unable to rationalise its employment during the time of recession. Analysing the impact of proportional and differential shifts, it should

be concluded that the industry mix explains hardly any change in employment in Lower Silesia for manufacturing as a whole. The dominant role is played by other factors not associated with the structure of this sector (*e.g.* endogenous potentials of the region that allow some industries to perform better than in other regions).

Manufacturing of textiles, Manufacturing of paper and paper products, Printing and reproduction of recorded media, Manufacturing of machinery and equipment n.e.c. and Manufacturing of furniture and other manufacturing are the only divisions in the case of which the structural factor (proportional shift) is the main determinant of regional employment performance, which is in line with the relatively labour-intensive character of these divisions in general. Other industries are characterized by decisive role of other determinants (differential shift) – *e.g. Manufacturing of basic metals* or are determined by both proportional and differential shifts – *e.g. Manufacturing of chemicals and chemical products.* It confirms that Lower Silesia is a competitive region with adequate physical and human capital resources, skilled labour force, agglomeration forces, clusters and an increasing level of social capital. All of those factors, connected with the "differential shift" indicator, affect competitiveness of specific industries in a positive way. Good examples are *Manufacturing of computer, electronic and optical products and Manufacturing of electrical equipment* where the differential shift is affected by both strong productivity and output performance.

From the point of view of the sectoral analysis, it must be emphasised that there are several industries in Lower Silesia in the case of which productivity growth effects in terms of employment are largely determined by the performance of these industries nationally (*e.g. Manufacturing of basic metals or Manufacturing of rubber and plastic products* where the productivity component of proportional shift strongly affects total productivity performance*).* Productivity of more capital and knowledge-intensive industries (*e.g. Manufacturing of computer, electronic and optical products*) is more likely to be affected by other determinants strictly associated with the region of Lower Silesia.

Keeping in mind that the data used in our research are for the period 2005-2009, including the time of prosperity and economic recession in 2009, it is important to note that the results of the shift-share analysis should be interpreted in the way that would take business cycles into account. Therefore, when interpreting the results readers should remember that output effects might have been affected by the decline in global demand, being the result of economic crises, and the productivity effect could have been due to rationalisation rather than to innovation.

Conclusions

The results of the analysis prove that shift-share is a useful technique, which can be applied successfully in exploring regional economy performance in the case of Poland. However, it is worth to note that the method should be used carefully to avoid mis-

leading conclusions. First of all, shift-share is a descriptive technique, it cannot be used to prove the determinants of economic trends. The authors suggest the use of shift-share as a complimentary tool to evaluate regional performance. Furthermore, the technique should be used in extended versions (like the Rigby-Anderson model) rather than in the classic form. Last but not least, there is the problem of data availability. Although the method is not much data-intensive, there is a need to upgrade data accessibility on the regional level, especially in sections and divisions of PKD. That is a necessary condition for drawing meaningful conclusions on the basis of shift-share and using other extensions of this technique [*e.g.* Barff and Knight or ANOVA versions].

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