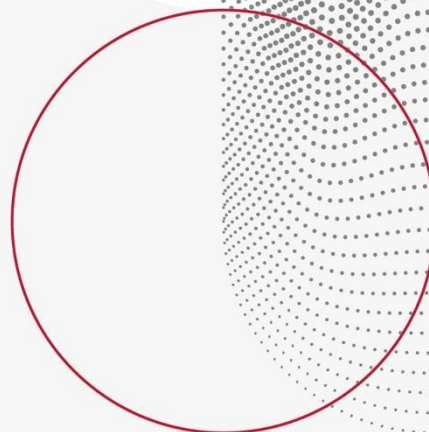


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# PROSPECTS OF GREEN GROWTH IN COAL-DEPENDENT REGIONS OF POLAND

## Macroeconomic Analysis of Śląskie Voivodeship and Konin Subregion

Jakub Sawulski  
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Jakub Sawulski<sup>1</sup>

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### Abstract

The purpose of this report is to identify potential engines of economic growth in two regions of Poland: Śląskie Voivodeship and Konin Subregion. Currently, the economy in both regions is largely dependent on coal mining. A likely drop in demand for coal due to the adoption of ambitious climate policies and crowding-out by low-cost Renewable Energy Sources constitutes a significant challenge for the two regions. In this report we explore which sectors could drive the growth of the economy in the future. We also analyse the composition of the labour force with respect to its age, education and gender in each sector of the economy in the two regions. This allows us to identify sectors which could offer jobs that are appropriate for workers leaving the mining sector.

Keywords: green growth; regional development; coal phase-out; macroeconomic analysis

JEL: O21, O41, Q52

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# 1. Introduction

In the near future the Polish energy system will likely undergo a radical transformation involving a phase-down of coal and a diversification of energy sources. The transformation will be induced by an objective to reduce CO<sub>2</sub> emissions as well as a rapid fall in costs of new technologies, including offshore wind and solar PV.

The transformation will involve a large investment effort, however, the costs are not going to significantly affect the growth rate of the economy, according to recent macroeconomic studies (see Kiuila (2017) for an overview). For instance, the study by Witajewski-Baltvilks et al. (2018) indicates that a reduction of CO<sub>2</sub> from power sector by 60% will involve a slowdown of the average annual GDP growth rate from 3% to 2.98%.

Nevertheless, the phase-down of coal may have significant economic and social consequences for the local economy of the regions that are highly dependent on the production and consumption of that fuel. A structural change in production implies losses of jobs in the mining sector. If these workers remain unemployed in the long-run or if they leave the labour force, the GDP of those regions will significantly drop. The negative shock will then spill-over to other sectors of the region. For instance, lower spending may depress demand in retail and construction.

In order to mitigate the risk of declining GDP, coal-dependent regions need to develop a coherent plan of economic transformation. The preparation of the plan involves (i) investigating the size, age, education and gender composition of the labour force in the mining sector and (ii) exploring which sectors could accommodate workers leaving the mining sector.

Understanding the size and composition of the labour force is essential for determining the nature of the structural change. For instance, if a large fraction of workers is expected to retire soon, the transition could be smooth if we ensure that no new workers enter the industry. However, if lay-offs are necessary, we need to assess how easy it is for these workers to transition to others sectors.

Understanding employment prospects of workers leaving the mining sector requires an analysis which sectors have the best growth potential as well as identifying sectors which require the profile of workers that is similar to the profile of workers redundant in the mining sector. For instance, if financial services require workers with tertiary education, the chances of successful switch of workers from the mining sector to financial services are low.

This report provides a preliminary analysis, using regional data, which explores the potential engines of economic growth in coal-dependent regions, the composition of the labour force in the mining sector and the potential of other sectors to accommodate laid-off workers, should the demand for coal drop rapidly. To address these goals we analyse key data describing:

- the size and growth of sectors in regional economy
- the relative productivity and investment in sectors
- the composition of the labour force in the mining sector and other sectors.

We focus on two coal-dependent regions in Poland: the Konin Subregion and Śląskie Voivodeship. The Konin Subregion hosts two lignite mines that are crucial for the Polish energy system. The Śląskie Voivodeship region

hosts almost all hard-coal mines in Poland. In the report we compare the situation in the two regions pointing at similarities and differences for the potential transformation of their economy.

Limitations of data imply a trade-off between the sectoral and geographical dimension of the analysis. Some data sources provide detailed information on disaggregated sectors, however, only at the voivodeship level (NUTS2 level). Other sources provide information on aggregated sectors at the level of subregions (NUTS3). In order to give a picture that is as complete as possible, we use both sources.

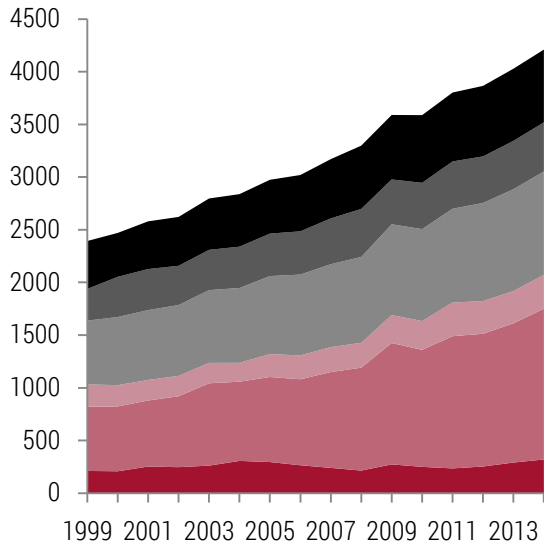
## 2. Sectoral growth decomposition

### 2.1. Konin Subregion

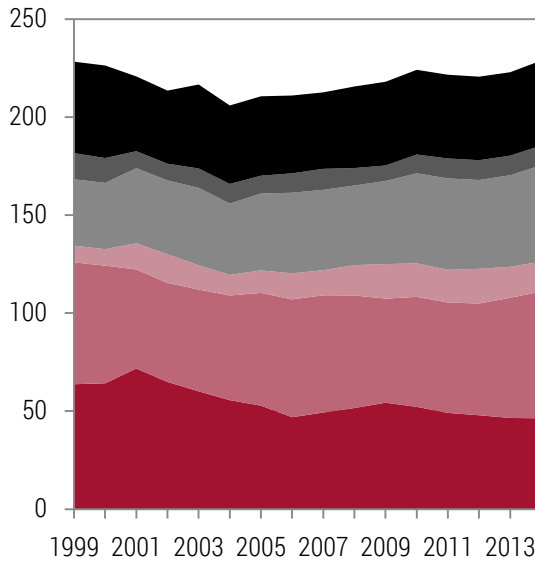
#### 2.1.1. Past growth

All sectors experienced a significant growth of value added between 1990 and 2014 in the Konin Subregion, yet their growth rates differed substantially between sectors (see Figure 1). The Industry sector was the fastest growing sector in the Konin Subregion in the beginning of 21st century. While, between 1999 and 2014, on average, industry grew at the annual rate of 5.9%, the growth of all remaining sectors was close to 3%.

**Figure 1. Sectoral decomposition of Gross Value Added in Konin Subregion 1999-2014 (unit: €2005m)**



**Figure 2. Employment by sector in Konin Subregion 1999-2014 (unit: thousands of people)**



■ NMServ    ■ FBS    ■ WRTAFIC    ■ Construction    ■ Industry    ■ Agriculture

*Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ - Non-market services.*

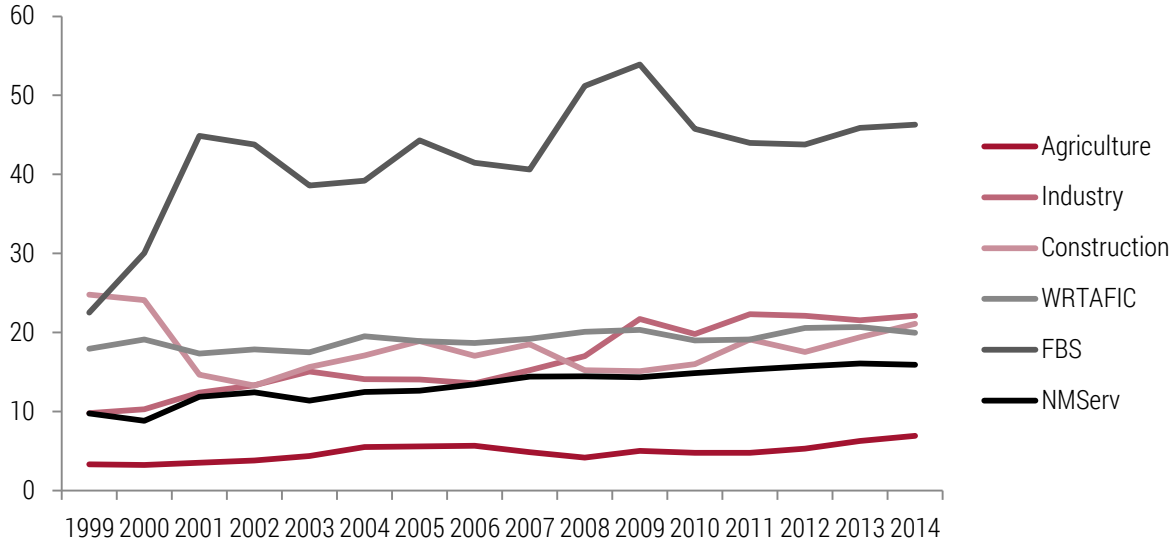
*Source: Own elaboration based on European Regional Database, Cambridge Econometrics (2016).*

The fast growth of industry translated into a growing share of this sector in the total economy (see Figure 1). In 1999 industry and the WRTAFIC sector (non-financial market services<sup>3</sup>) constituted around a quarter of total value added. The third most important sector (with a 19% share) was non-market services. In 2014 the share of industry in total GDP increased to 34%. The share of all other sectors has decreased, however the ranking remained approximately the same as before.

Interestingly, the growing role of industry did not coincide with growing employment. The share of workers in industry almost did not change (27% in 1999 and 28% 2014). Meanwhile, the share of workers in the WRTAFIC sector grew from 15% in 1999 to 21% in 2014. The share of workers in the construction sector almost doubled (from 4% in 1999 to 7% 2014).

One could observe a clear convergence of productivity between the key sectors of the economy (see Figure 3). In 1999 output per worker in construction and WRTAFIC sectors was almost twice the output per worker in industry and non-market services. By 2014 these differences were significantly reduced. Only the productivity in non-market services remained slightly below the productivity of other main sectors.

**Figure 3. Productivity (output per worker) by sector in Konin Subregion, 1999-2014 (unit: thousand PLN)**



Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ – Non-market services.

Source: Own elaboration based on European Regional Database, Cambridge Econometrics (2016).

The sector with the highest productivity in the Konin region is financial services. The output per worker in this sector is at least two times larger than the output per worker in other sectors. The smallest productivity was reported in the agriculture sector. One could also notice stability of the ranking of sectors' productivity since 2008. The only exception is the construction sector which experienced a relatively fast productivity increase and overtook WRTAFIC sector in 2014.

<sup>3</sup> Specifically, this sector includes wholesale, retail, transport, accommodation and food services, information and communication.

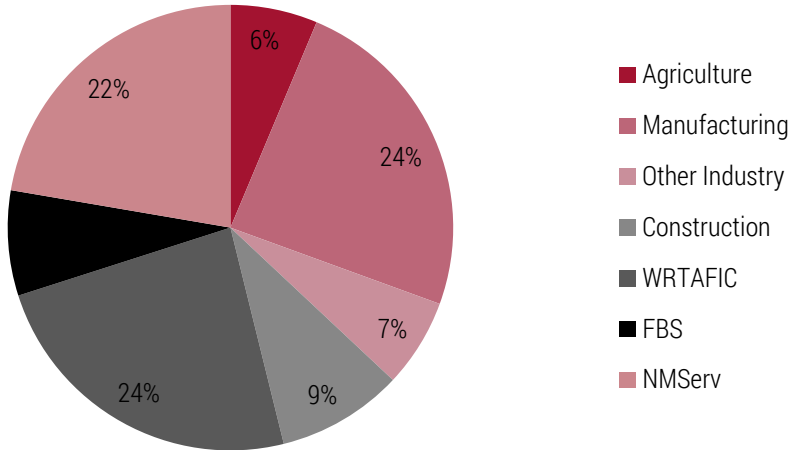
One could conclude that the recent history of growth in Konin Subregion is the story of modernization of industry and building its productivity to catch-up with the productivity of other sectors. Today industry is a key sector of the economy, both, in terms of value added and employment. WRTAFIC sector is slightly less important. The role of financial services, construction, non-market services and agriculture remain limited.

**2.1.2. Sectoral composition in 2015**

The Regional Accounting database by the Statistics Office of Poland (2017c) provides information on the structure of GDP in 2015. Importantly, the dataset allows distinguishing between manufacturing and the remaining industry sector, which includes among others mining.

The data shows that manufacturing is one of the three key sectors of the regional economy. The other two are WRTAFIC and non-market services. The remaining sectors constitute between 6 and 9 percent of the economy.

**Figure 4. Gross Domestic Product by sector in Konin Subregion, 2015**



*Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ – Non-market services.*

*Source: Own elaboration based on Statistics of Poland (2017c).*

**2.2. Śląskie Voivodeship**

Figures 5 and 6 suggest that the growth in Śląskie Voivodeship could be divided into two distinct phases. Until the turn of centuries all sectors of the economy experienced a rather sluggish growth. After that point, the economy significantly accelerated. The acceleration was driven primarily by the growth of industry (resulting from the growth of productivity of that sector). However, the growth was evident also in financial services and the WRTAFIC sector.

As in the Konin Subregion, industry clearly dominated the economy in the 21<sup>st</sup> century. The share of value added of the sector grew from 31% in 2000 to 38% in 2014. Meanwhile, the share of the second most important sector, the WRTAFIC sector declined from 30% in 2000 to 26% in 2014. The other important sectors in the region, i.e. nonmarket services and financial services maintained their share in the total economy at the level of approximately 14%.



Figure 5. Sectoral decomposition of Gross Value Added in Śląskie Voivodeship 1999-2014 (€2005m)

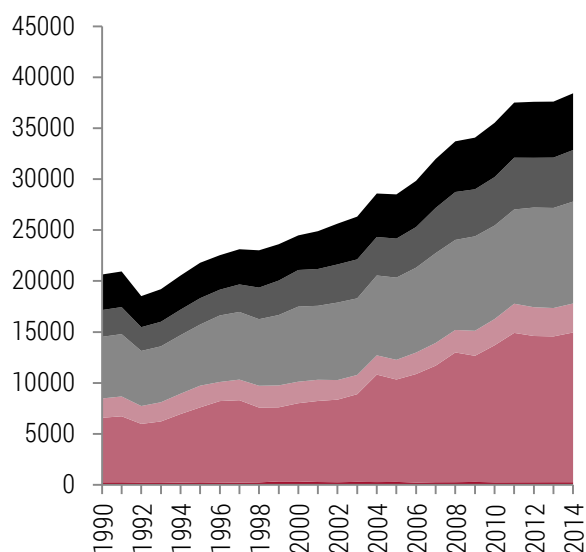
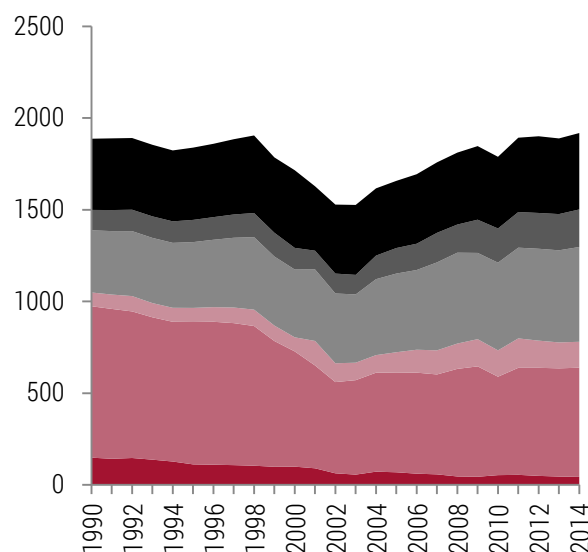


Figure 6. Employment by sector in Śląskie Voivodeship 1999-2014 (thousands of people)

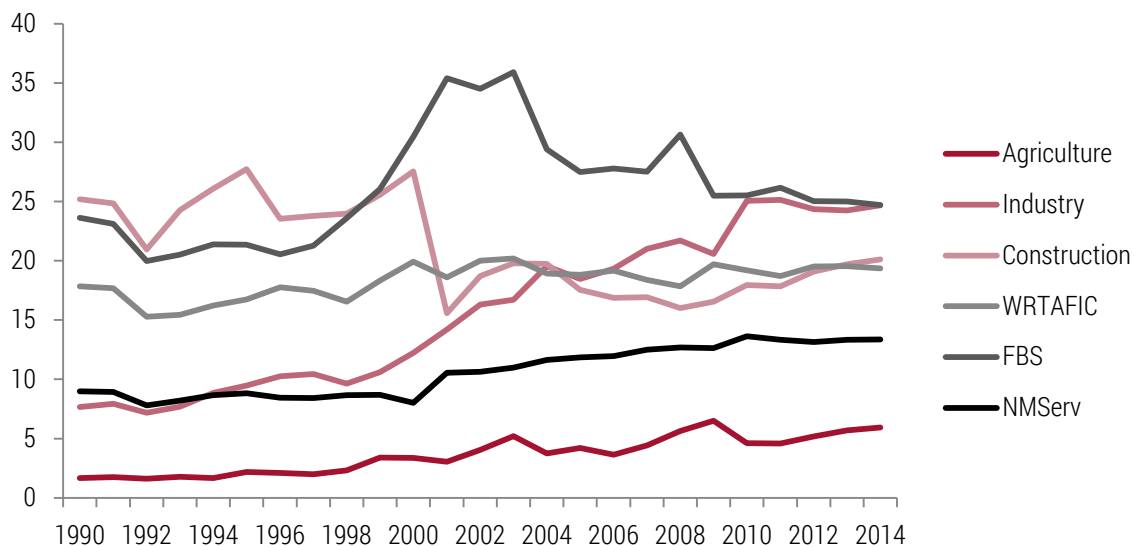


■ NMServ   ■ FBS   ■ WRTAFIC   ■ Construction   ■ Industry   ■ Agriculture

Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ - Non-market services.

Source: Own elaboration based on European Regional Database, Cambridge Econometrics (2016).

Figure 7. Productivity by sector in Śląskie Voivodeship, 1990-2014. (unit: thousand PLN)



Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ - Non-market services.

Source: Own elaboration based on European Regional Database, Cambridge Econometrics (2016)

The two phases in the development of the region are also evident in Figure 6, which shows the labour force by sector. Until 2000, the number of workers fell significantly. The decline was particularly sharp in the industry: the number of workers in this sector decreased by 40%. This could be explained by the massive number of miners leaving the labour force at that time. After 2000, the number of workers returned to the level from the beginning of the 90s.

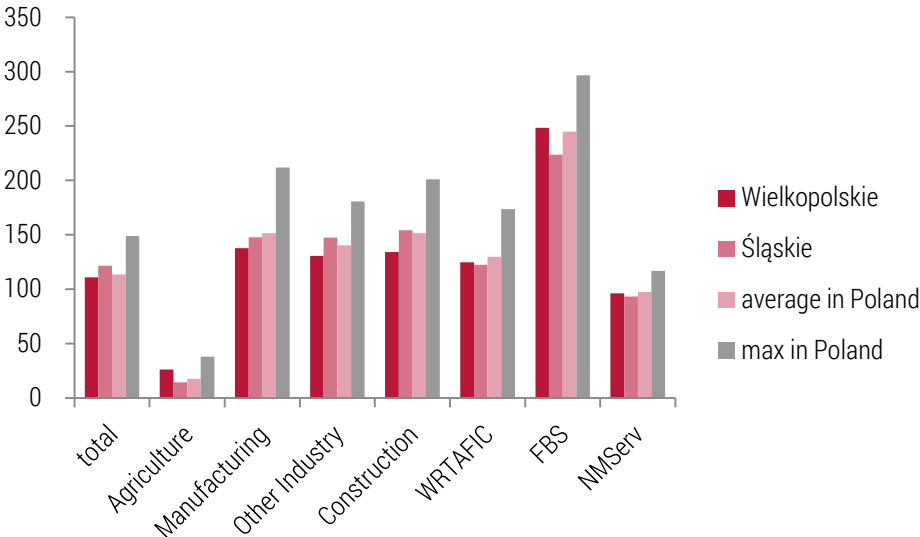
The success of industry sector in the region is also evident from the dynamics of productivity. In early 1990s industry had lower productivity than any other sector, except agriculture. In 2014 the productivity in industry reached the level of productivity in the financial services sector ( see Figure 7).

### 3. Growth engines

There are three potential sources of future growth of sectors. The first source is modernization, i.e. the possibility to adopt the most productive methods of production available today and catching-up with technological leaders. The second channel is progress at the technological frontier. This source depends on the prospects of development of techniques and technologies which are not available today. The third source is investment and accumulation of capital in a given sector.

Figure 8 indicates that Wielkopolskie and Śląskie Voivodship have a large potential for modernization of their largest sector, i.e. manufacturing. In both regions, the productivity in the sector is below its average level in Poland and it is distant from the leader in Poland, Mazowieckie Voivodship. Wielkopolskie Voivodship has also room for improvement in construction sector, which has significantly lower productivity than the average in Poland.

**Figure 8. Output per worker by sector in Wielkopolskie Voivodship, Śląskie Voivodship, on average and maximum across Voivodship in Poland, 2015 (in thousand PLN per year)**



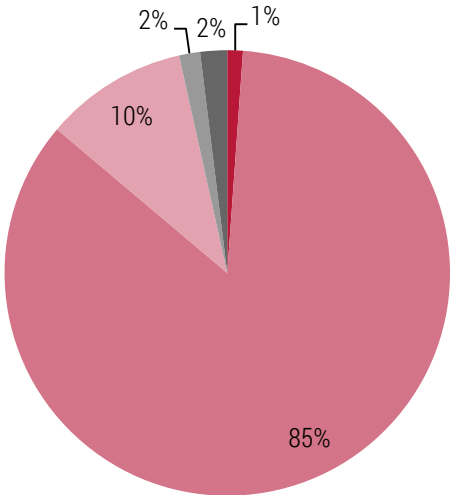
*Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ – Non-market services.*

*Source: Own elaboration based on Statistics of Poland (2017b)*

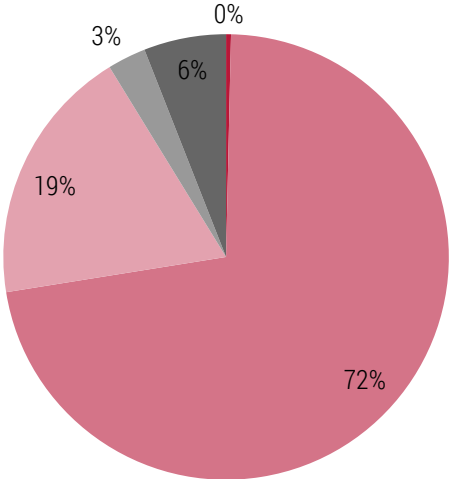
Regarding the progress at the technological frontier, recent trends in robotization may give an additional impulse for the growth of productivity in manufacturing. Nevertheless, the adoption of these techniques in Poland is likely to be delayed. The reason is that production methods involving industrial robots are capital-intensive and labour-saving. Since the cost of labour relative to the costs of capital is low in Poland, adoption of these techniques is not rational in the nearest future from the economic point of view.

An analysis of investment data indicates that productivity in industry could increase in coming years. The data from Local Data Bank (BDL, Statistics of Poland 2018) suggests that in the years 2012-2016 the share of investment in industry constituted 85% of total private investment in the region (Figure 9). The share of investment in the WRTAFIC sector was at the level of 10%. Investment in other sectors was negligible.

**Figure 9. Sectoral shares in total investment in Konin Subregion**



**Figure 10. Sectoral shares in total investment in Śląskie Voivodeship**



■ Agriculture ■ Industry and Construction ■ WRTAFIC ■ FBS ■ NMServ

*Notes: WRTAFIC - Wholesale, retail, transport, accommodation & food services, information and communication; FBS - Financial & business services; NMServ – Non-market services.*

*Source: Own elaboration based on BDL.*

In Śląskie Voivodeship investment is slightly more diversified, although the bulk of its share is still consumed by industry and construction (72%, see figure 10). The investment in WRTAFIC services sector accounts for 19% of total investment. Thus, the growth in these two sectors is likely to be fuelled by capital accumulation in the nearest future. Non-market services sector is responsible for 6% of investment.

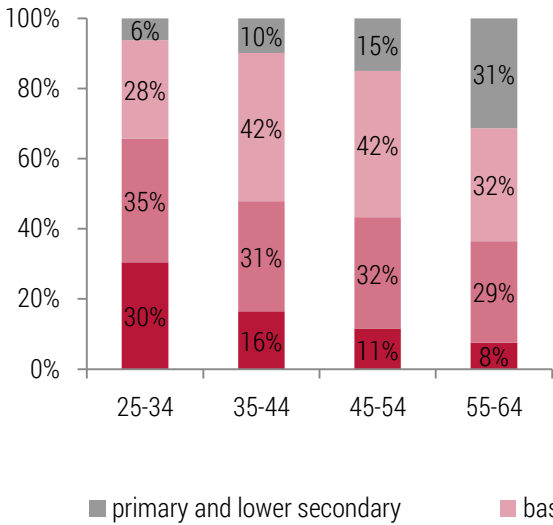
## 4. The flow of labour

### 4.1. Cross-generational differences in educational attainments

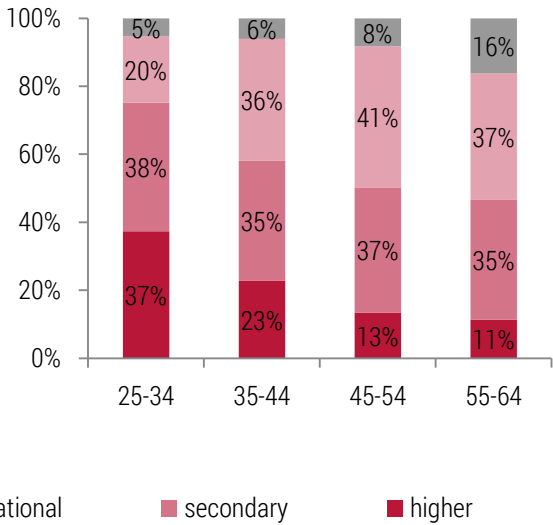
After the fall of communism Poland experienced an educational boom. This was reflected in a significant growth in the number of people receiving college degrees. The net enrolment rate for people aged 19–24 increased from 10% in early 90s to about 40% in the second decade of the 21<sup>st</sup> century (Statistics Poland 2017a). A consequence of the trend is a clear pattern in the composition of the labour force in Poland – the younger a cohort, the better educated it is.

This is also the case in Konin Subregion and Śląskie Voivodeship (Figures 11 and 12). In the Konin Subregion almost one-third of the population in the age of 25–34 has a university degree, while among people nearing retirement age the share is about 10%. Almost two-thirds of people aged 55–64 and more than half of people aged 45–54 have attained only primary, lower secondary or basic vocational educational level. On average, the population in the Śląskie Voivodeship seems to be slightly better educated than in the Konin Subregion, but the cross-generational differences are still significant. 37% of people aged 25–34 have reached a university degree, in comparison to 11% in the 55–64 age cohort. About half of people aged 45 to 64 have educational attainment lower than secondary.

**Figure 11. Population by level of educational attainment in Konin Subregion**



**Figure 12. Population by level of educational attainment in Śląskie Voivodeship**



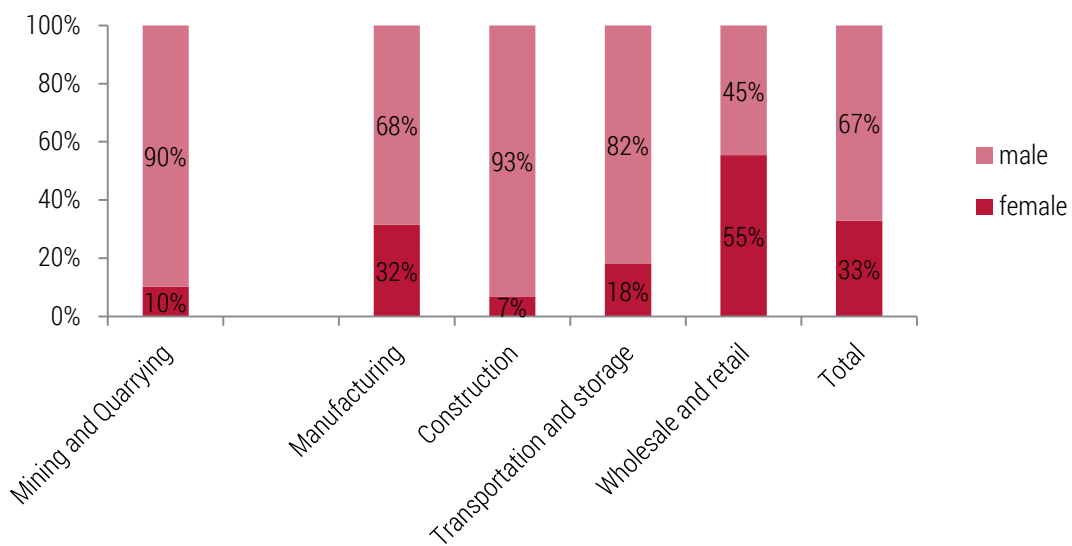
Source: own elaboration based on the results of 2011 National Census of Population and Housing (available at BDL).

The cross-generational differences in educational attainment may have an important impact on mitigation of the effects of transition in coal-dependent regions. As the mining sector is typically perceived as popular for less-qualified workers, its contraction would not be as harmful for better-educated younger generations. However, a significant part of labour force entrants – 34% of people aged 25–34 in Konin Subregion and 25% in Śląskie Voivodeship – have attained only the primary, lower secondary or basic vocational educational level.

## 4.2. Employment structure in the mining sector in Wielkopolskie Voivodeship

The Labour Force Survey allows analysing the data on employment structure only at the voivodeship level. Fortunately, the Konin Subregion is the only coal basin in the Wielkopolskie Voivodeship. Therefore, it is safe to assume that employment in the mining and quarrying sector in Wielkopolskie Voivodeship almost fully reflects employment in the Konin Subregion. We present data on the employment structure in mining and quarrying sector in comparison to total employment in Wielkopolskie Voivodeship, as well as in comparison to employment in selected sectors in Wielkopolskie Voivodeship. We have selected these sectors, which are the most similar in terms of gender, age and educational attainment composition to mining and quarrying sector, and at the same time represent a significant part of the labour force in the region.

**Figure 13. Employment structure by gender in selected sectors of the economy in Wielkopolskie Voivodeship**



Source: own elaboration based on Labour Force Survey data pooled for 2013-2017.

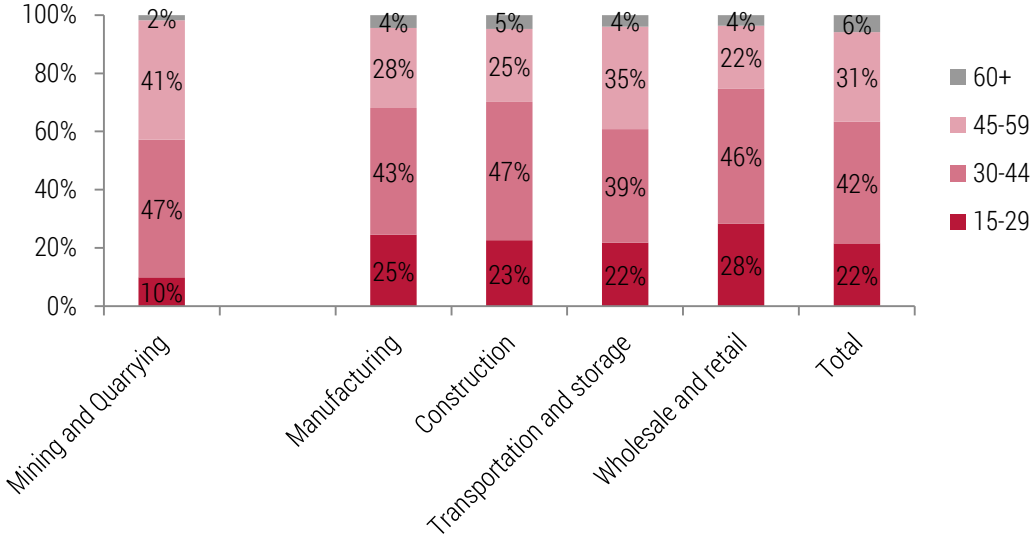
The number of workers employed in mining and quarrying in Wielkopolskie Voivodeship amounts to 7.3 thousand people, which is about 15 times less than in Śląskie Voivodeship. However, when we refer this number to the total employment only in the Konin Subregion, which amounts to 183 thousand people, workers in mining and quarrying constitute about 4% of employment in that Subregion, similarly to the Silesian Voivodeship (Statistics Poland 2018).

The composition of workers within the sectors is estimated using the Labour for Survey pooled for the years 2013-2017. Total number of observations for Wielkopolskie Voivodeship is 43 thousand. The number of observations that were used to construct the estimates of the labour force composition in the mining sector in Wielkopolskie voivodship is 234.

The employment structure by age in the mining sector is dominated by male workers and older age cohorts. In years 2013-2017 90% of employees in mining and quarrying sector in Wielkopolskie Voivodeship were males and 41% of workers was in the age cohort 45–59, while the share of young workers was of minor importance – amounted to only 10% (Figures 13 and 14). The median age of workers in the sector is 45 years (Statistics Poland 2016). That is significantly different than in the whole Wielkopolskie Voivodeship, where the age cohort 45–59

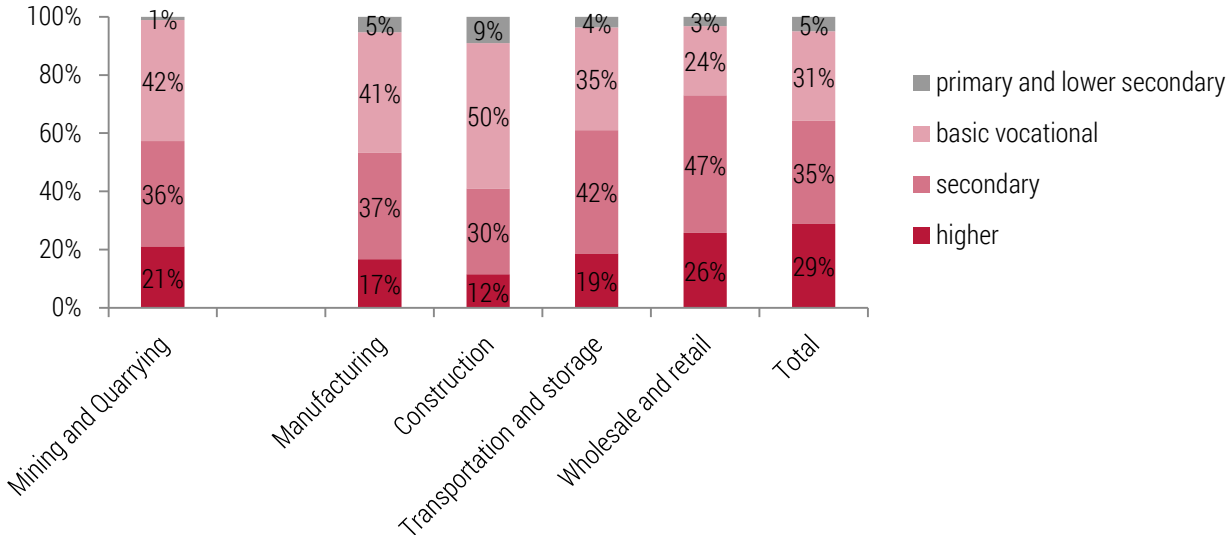
covers 31% of employment and young workers are responsible for about 22% (see Figure 14). The employment structure by educational attainment also delivers some interesting observations. About one third of employees in mining and quarrying have a secondary educational attainment, and 21% employees have a university degree (Figure 15). This composition is similar to the composition in the sector of transportation and storage, manufacturing and wholesale and retail.

**Figure 14. Employment structure by age in selected sectors of economy in Wielkopolskie Voivodeship**



Source: own elaboration based on Labour Force Survey data pooled for 2013-2017.

**Figure 15. Employment structure by level of educational attainment in selected sectors of economy in Wielkopolskie Voivodeship**



Source: own elaboration based on Labour Force Survey data.

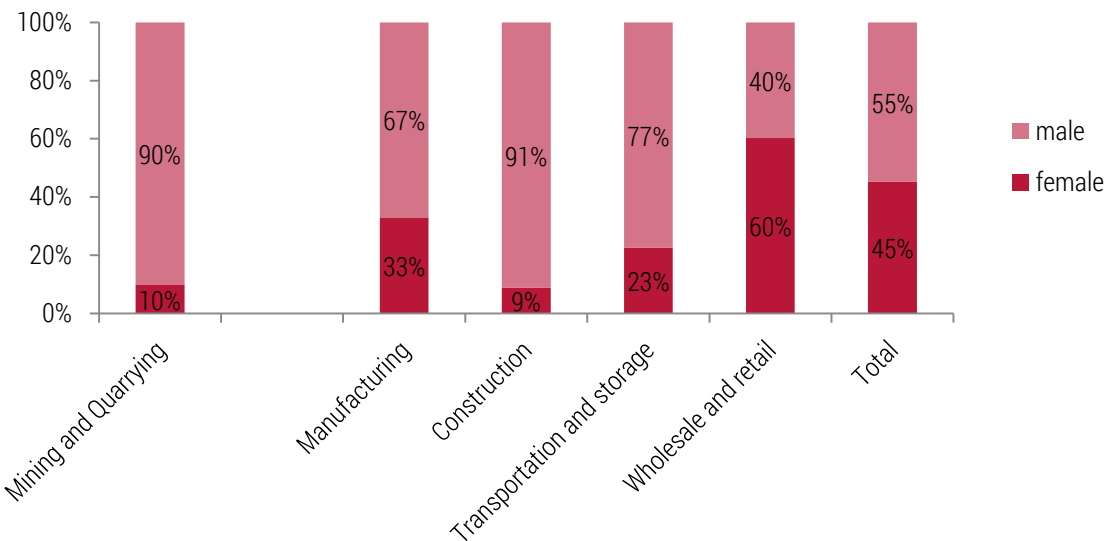
The characteristics of employment structure in mining and quarrying in Wielkopolskie Voivodeship suggests that the decarbonisation process in that region may be challenging if the pace of decarbonization is fast. The main challenge in Konin Subregion is the age composition of workforce in the sector. The high share of older workers has at least three implications. First, the ability to change qualifications in this age cohort may be lower than in

other groups. Secondly, it is hard to find any other sector relevant for males in that age. Even the construction, transportation and storage, and manufacturing sectors have, in general, a younger structure of the workforce. Finally, the public regulations giving special privileges to people in the pre-retirement age may discourage employers from hiring workers in older age cohorts. On the other hand, there are also two possible chances related to employment structure. First, the age structure suggests that the movement of labour force may not be from the mining sector to employment in other sector, but from the mining sector to retirement. That will naturally decrease the number of people employed in mining and quarrying in the nearest future. Secondly, the current workforce in mining and quarrying sector seems to be quite well educated (relative to the education of workers in manufacturing), which should help in their transition to other sectors.

**4.3. Employment structure in the mining and quarrying sector in Śląskie Voivodeship**

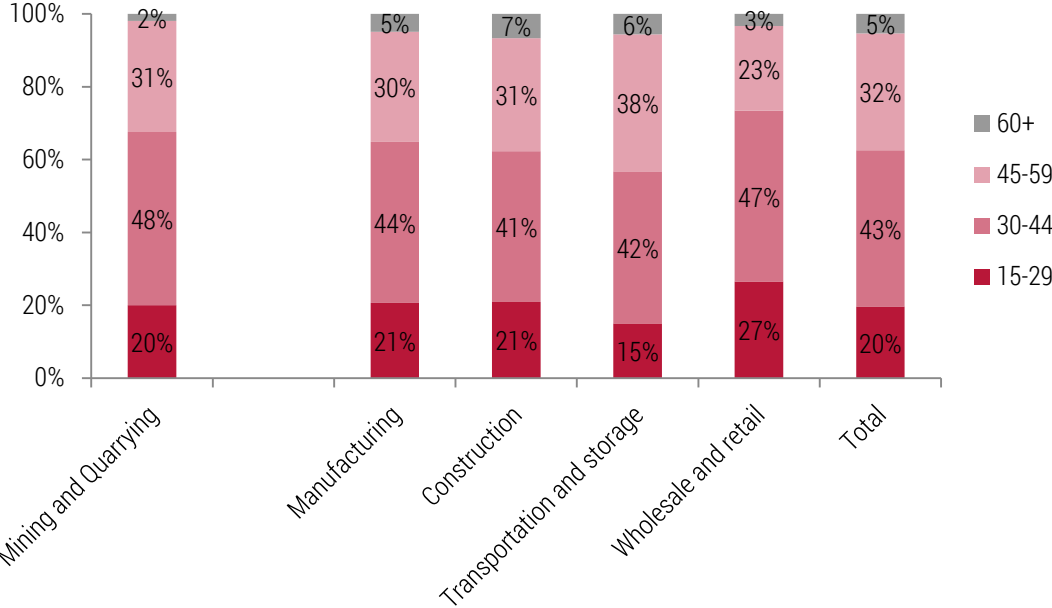
Śląskie Voivodeship is the most coal-dependent region in Poland. The mining and quarrying sector covers 117 thousands employees. It is 6% of the total employment in this Voivodeship (data for year 2017). Employment in mining and quarrying in Śląskie Voivodeship has its specific characteristics. Firstly, the sector is dominated by male workers. In 2017 90% of employees in the sector were male (Figure 16). Secondly, there is an overrepresentation of middle aged people in the employment structure in mining and quarrying in comparison to other sectors. Around half of workers in mining and quarrying are aged 30–44, while in the total employment in Śląskie Voivodeship the share of this age cohort is 43% (Figure 17). Thirdly, people working in the mining and quarrying sector in Śląskie Voivodeship are generally less qualified than people working in other sectors. On the one hand around 40% of employees in mining and quarrying have attained only primary, lower secondary or basic vocational level of education. The same share in total employment in this region is 28%. On the other hand only 16% of people working in mining and quarrying have a university degree, while in total employment the share is almost two times higher – it equals 33% (Figure 18).

**Figure 16. Employment structure by gender in selected sectors of economy in Śląskie Voivodeship**



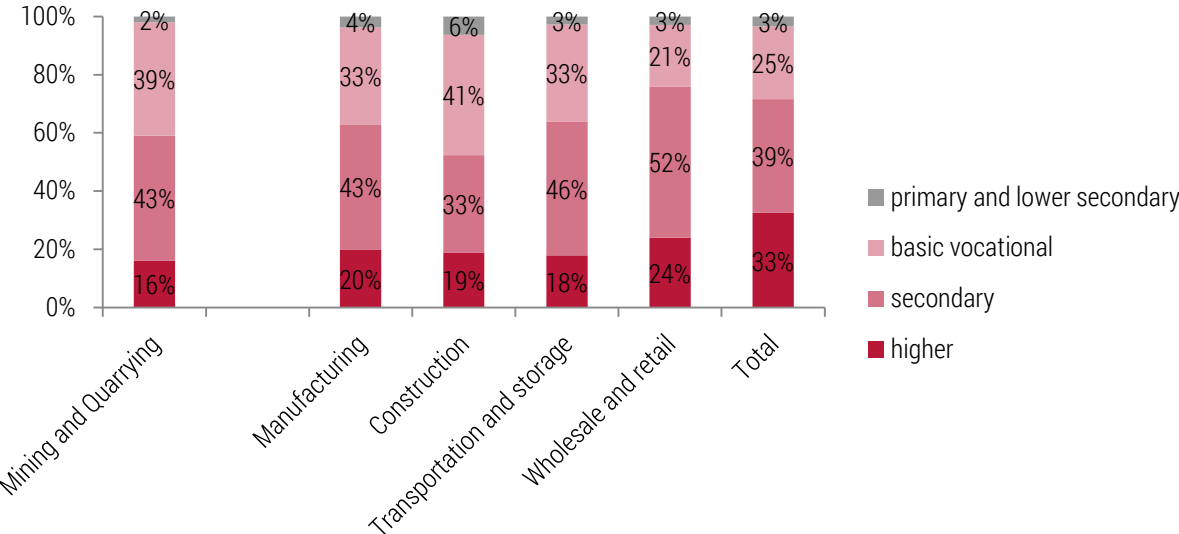
Source: own elaboration based on Labour Force Survey data.

Figure 17. Employment structure by age in selected sectors of economy in Śląskie Voivodeship



Source: own elaboration based on Labour Force Survey data.

Figure 18. Employment structure by educational attainment in selected sectors of economy in Śląskie Voivodeship



Source: own elaboration based on Labour Force Survey data.

The decarbonisation process of the Polish economy should take into account the specific characteristics of the labour force employed in the mining and quarrying sector in Śląskie Voivodeship. Special attention should be paid to low-qualified, middle aged male workers. Also young workers, who account for 20% of employment in mining and quarrying in this region (about 20 thousand people), require appropriate policy, as in the face of decreasing importance of the sector in the economy, the chance of long-term stay in their current specialization is low. Policymakers should identify potential sectors, which may absorb this specific labour force. The most similar



sector in terms of employment structure (age, gender and educational attainment) in Śląskie Voivodeship is the construction sector. It is almost equally male-dominated, has a similar age structure of workers and rarely employs people with a university degree. Two other sectors with potentially high opportunities for employment of people being laid-off from the mining and quarrying are transportation and storage as well as manufacturing. These sectors are more gender-balanced, but the age structure of workers is similar, and the educational attainments are even better matched with mining and quarrying sector than construction sector.

## 5. Discussion and conclusions

The 21st century growth in Konin Subregion and Śląskie Voivodeship region was driven by an increase in productivity in industry. However, in the last 5 years of the analysis this growth seems to decelerate. In the same period, the average productivity in industry in Poland continued fast growth. In 2014 the productivity in industry in Konin Subregion was below the average productivity of this sector in Poland. In Śląskie Voivodeship the productivity was close to the average. Similarly, the 2015 data on productivity in manufacturing by voivodeships indicates that Wielkopolskie Voivodeship reports lower productivity in the sector than the average productivity of the sector in Poland. Śląskie Voivodeship is close to the average. The source of the relatively poor performance of the industry in the two regions, particularly in Wielkopolskie Voivodeship, requires further investigation.

The most productive sector in both regions is financial services, followed by industry, construction, retail, non-market services and agriculture. While the ranking of sectors in the two regions is similar, the distances between the productivity levels across sectors are different. In Konin the productivity in industry, construction and retail is very similar. Thus the shifts of labour between these three sectors will have little effect on the GDP of the regions. In Śląskie Voivodeship, the productivity in industry is much higher than in construction or basic market services. This implies that shifts of labour towards industry can increase the GDP of the region.

The majority of workers in the mining sector in Wielkopolskie Voivodeship is above 45 years old. This has two implications. First, if the transition is very rapid, big part of the workers who are laid-off will have difficulties to change qualifications and find employment in other sectors. Second, if the transition is gradual, the number of necessary lay-offs will be small, since most of the workers will retire in the nearest future. However this optimistic scenario assumes that the sector will no longer hire labour market entrants.

In Śląskie Voivodeship the labour force in the mining sector is younger than in Wielkopolskie Voivodeship, however it has a smaller share of young workers (below 30) than other sectors in Śląskie Voivodeship. A large share of workers in the sector are middle age. The simulations in the report by Witajewski-Baltvilks et al. (2018) indicate that those workers will retire by the time the demand for hard coal dries out.

The education of workers in the mining sector in both regions is similar to the education of those in manufacturing and transportation. This implies that these two sectors could potentially accommodate those workers who are laid off. Another potential destination for laid-off workers is the construction sector, however, in Wielkopolskie Voivodeship, a large share of mining workers might be overqualified for jobs in construction.

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