Description of scientific achievements

Robert Pater, PhD

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1. Information on education and employment

Education

- January 2011: obtaining the PhD degree in economics, **Warsaw School of Economics** *Collegium of Economic Analysis*. PhD thesis: *Business cycles in the Polish labour market and their disturbance*s, supervisor: prof. SGH Maria Drozdowicz-Bieć, PhD
- 2002-2004: Master's studies, **Rzeszów University of Technology** *Faculty of Marketing and Management*, Master's degree
- 2002-2004: Master's studies, **University of Information Technology and Management in Rzeszów** *Faculty of Economics*, Master's degree
- 1999-2002: Bachelor studies, **University of Information Technology and Management in Rzeszów** *Faculty of Economics*, Bachelor's degree

Employment

- 2018 – now: Educational Research Institute, Expert
- 2016 – now: University of Information Technology and Management in Rzeszów, Head of the Department of Economics
- 2013-2016: University of Information Technology and Management based in Rzeszów, Head of the Department of Macroeconomics
- 2011-2013: University of Information Technology and Management based in Rzeszów, Assistant Professor
- 2004-2011: University of Information Technology and Management based in Rzeszów, Research Assistant

A brief description of the course of education and career

In the beginning of master's studies, I started working at the Institute of Economics (IG) at the University of Information Technology and Management (UITM) as a research assistant. I conducted research on the business cycle using the economic tendency survey method, called: *Barometer of Economic Sentiments in the Podkarpackie Region*. I also participated in other studies conducted by the Institute. My interests were connected to the use of quantitative methods in economics, in particular applied econometrics and the time series analysis. My interests in the application of quantitative methods for solving economic problems were supplemented with studies at the Rzeszów University of Technology, where I wrote my master's thesis on the forecasting of production sold using time series models (Rzeszów University of Technology). My second master's thesis concerned the competitiveness of nations (UITM).

After my master's studies, I continued working in the Institute of Economics as a research assistant. I continued to study the business cycles. I still conducted the economic tendency survey for Podkarpackie Region, later extended to the area of three Eastern Poland regions: Podkarpackie, Lubelskie and Podlaskie. Shortly after graduation, I started working with Prof. Maria Drozdowicz-Bieć from the Collegium of Economic Analysis at the Warsaw School of Economics (KAE SGH). The first research grant I participated in was a grant received from the Scientific Research Committee named: *Forecasting GDP, inflation and the unemployment rate for the Polish economy with a system of leading indices* (KBN Grant No. 1 H02B 017 27), under the supervision of Prof. Drozdowicz-Bieć. I was responsible for the analysis of the *Labour Market Leading Index* (WRP).

I attended scientific seminars of the Research Institute of Economic Development at SGH. I regularly presented articles at conferences of business cycles researchers in Poland and around the world organized by CIRET (*Center for International Research on Economic Tendency Surveys*), which my university was a member of. I also attended labour market seminars organized by the Chair of Macroeconomics and International Trade Theory at the University of Warsaw, supervised by Prof. Urszula Sztandar-Sztanderska and Prof. Mieczysław Socha, as well as scientific seminars of econometric modeling "Senamek", supervised by prof. Marek Gruszczyński and Prof. Aleksander Welfe. My teaching activity was mainly connected to recitation classes on: international economic relations (undergraduate course) and international economic relations (graduate course), and later on microeconomics and macroeconomics (undergraduate course) and macroeconomics (graduate course).

In October 2004, together with Prof. Drozdowicz-Bieć we started cooperation with Polish newspaper "Gazeta Wyborcza", which since then has provided us with a weekly number of job offers published in the newspaper. The index based on the collected data was called the *Job Offers Barometer* (BOP). Having historical data since 1999, we have continuously analysed developments in the number of vacancies shown by the Barometer. The index was accepted by the group of business cycle scientists. It showed the desired leading properties of a labour market business cycle indicator. It was a valuable supplementary data to the only vacancy measure in Poland during this time – job offers from public employment offices. A quarterly representative survey started to be conducted by the Central Statistical Office only in 2005.

Before I defended my PhD dissertation, in IG I took part in three research grants related to the labour market: *Monitoring of surplus and deficit occupations in the Podkarpackie Region*, *Monitoring of the labour market and education market in the Podkarpackie Region*, and *System of unemployment prevention in poorly urbanized areas*. I carried out analyses of the impact of the economic situation on the labour market and forecasts of labour demand. I also participated in the studies of the Bureau for Investment and Economic Cycles (BIEC) as a contractor of the *Labour Market Leading Index* (WRP). Based on the analyses, I proposed reconstruction of the WRP, which was accepted, and to this day the index has been calculated with this method. I prepared scientific articles and monthly press releases on WRP and BOP. Since then, I have been analysing the vacancy market every month. In 2007, the uncertainty related to the financial crisis caused Gazeta Wyborcza to withhold statistical data about job offers and we finished cooperation. At the same time, the development of the online job vacancy market has changed the sources of data about job offers towards the Internet. I also took over the supervision over the BOP research. I started to collect data from two websites: gazetapraca.pl and pracuj.pl.

Before I defended my PhD dissertation, I have participated also in several external labour market research, ordered by: Regional Public Employment Office in Opole, Regional Public Employment Office in Poznań, Ministry of Regional Development and Industrial Development Agency. I consider the most important of them to be: the evaluation study of the impact of the shipbuilding industry restructuring on the local labour markets in the Pomorskie and Zachodniopomorskie Regions. With the use of a logit model, I modelled the impact of active labour market policies that were used to activate former shipyard workers on the probability of finding a job by them.

In January 2011, I defended my PhD dissertation at KAE SGH under the supervision of Prof. Drozdowicz-Bieć. I stayed at UITM as an assistant professor. I continued my scientific interest in the business cycles effects on the labour market. I started research on the heterogeneity of the business cycles and changes in the structure of the economy over the business cycle. I supervised the project financed from the statutory funds of the Faculty of Economics at UITM entitled: *Business cycles in the European Union and in other regions of the world, their dynamics and influence on the structure of economies.*

Soon I changed the department from IG to the Department of Macroeconomics, which was more related to scientific work, a feature that suited my interests. In 2013, I became the Head of Deaprtment of Macroeconomics. I continued to cooperate with BIEC and I also became an expert at the Ifo Institute in Munich in the field of quarterly assessments of the economic situation in Poland, which I remain to this day. I stopped being involved in the WRP analysis, focusing on the vacancy market research with the *Job Offers Barometer* (BOP). In 2012, I started to collect not only the numbers of job offers, but whole job offers texts with all its content from the Internet. I supervised the research in 2012-2015 by financing it from statutory funds. I initiated and implemented a system of automatic collection of this data with a special webscraping algorithm. It allowed me to supplement my analyses with structural issues, including demand for skills.

A practical effect of my research on the quantity and content of job offers were monthly reports published in the main Polish media and my cooperation in 2011 with the *Polish Market* magazine. In the latter I was (the main) co-author of the monthly report on the condition and prospects of the Polish economy – *Economic Monitor*, addressed mainly to foreign investors. I also cooperated with *Forbes* magazine and *Rzeczpospolita* newspaper.

In the centre of my interests was the demand for labour and the vacancy market. I participated in two studies, funded from the statutory funds of KAE SGH on the demand for labour: *The market of vacancies in the light of changes in the economic situation that started in 2007* (2014) and *Jobs Calculator for Poland: a simple tool to simulate the situation on the labour market* (2017). However, at the same time I was involved in other research. First, I participated as the main researcher in the research: *Conditions of the efficiency of the public sector* (2009-2014) and *Monitoring and evaluation of the Regional Innovation Strategy of the Podkarpackie Region for 2005-2013* (2009-2014). Then, I supervised the research on innovativeness at the regional level (2013-2014) and development of Eastern Poland (2016-2017). I also participated in research directed to estimation of the intangible capital in Poland as a member of the research team. In the beginning, the research were supervised by Prof. Jan Winiecki, later I took over supervision over this project (2015). This study was unique. It resulted in the first report estimating the impact of the intangible capital on the economic growth in Poland.

In 2016, the Department of Microeconomics and the Department of Macroeconomics at UITM were merged into the Department of Economics, which I became the head of. My teaching activity was related to conducting recitation classes and lectures in: macroeconomics (undergraduate and graduate courses), econometrics (undergraduate and graduate courses), and later, on the fundamentals of macroeconomics (undergraduate course in English). Immediately after the defence of my PhD dissertation, I started conducting diploma seminars (undergraduate and graduate).

The next stage of my research interests focused on the labour market, and in particular on the issue of labour demand, was the labour market matching and mismatch. In 2015, I participated in a grant entitled: *Data spatial aggregation in labour market matching*, headed by dr. Ewa Gałecka-Burdziak, financed from international sources and carried out at the Collegium of Economic Analysis at the Warsaw School of Economics. As part of this project, I dealt with, among others: modelling inefficiencies in the matching process, temporal and spatial aggregation, selected aspects of spatial dependencies and recommendations for economic policy.

In 2017, I received a research grant from the "Dialog" program of the Ministry of Science and Higher Education in Poland, entitled: Horizontal educational mismatch: a new method of measurement with application to Poland. To investigate the educational mismatch at a detailed level (e.g. skills mismatch), I proposed using, among others, data on labour demand from online job offers. In my research, I tried to enrich the estimate of vacancies for measuring the representativeness of data from online job offers and for measuring the demand for specific skills and competences.

In 2017-2019, I was also one of the main researchers in the next project coordinated by dr. Ewa Gałecka-Burdziak on the cyclicality of labour force participation rate (added and discouraged worker effects), financed from the funds of the National Science Centre in Poland.

The results of my research on the demand for skills and educational mismatches met with interest from the Educational Research Institute (IBE) in Warsaw. In 2018 I was offered a permanent cooperation with IBE and the use of my research results to shape educational policy in Poland. During the implementation of my project and work at IBE, the results of my research have found practical applications in: estimating the demand for skills and competences (Diagnosis of OECD Skills Strategy for Poland, 2018) and evaluating the demand for occupations and qualifications of vocational education (Integrated Qualification Strategy for Poland, 2019).

2. Synthetic description of scientific interests and research work carried out before and after obtaining the doctoral degree

Period 2004-2010 (before obtaining the doctoral degree)

Before obtaining a PhD degree, I was interested in research on economic changes, mainly in the short-run, i.e. over the business cycle. I published the first scientific article on the basis of my master's thesis.

Pater R. (2005). Prognozowanie produkcji sprzedanej wyrobów gumowych i z tworzyw sztucznych [Forecasting production sold of rubber and plastic products]. Wiadomości Statystyczne 12, pp. 28-41.

I started to specialize in research on the impact of economic fluctuations on the labour market, with particular emphasis on research methods and business cycle analysis. I used these methods in research grants related to the labour market. The demand for such analysis was high due to high unemployment rate in Poland in those years. I published mainly in the following journals: Prace i Materiały IRG-SGH, Barometr Regionalny and e-Finanse. I also have two articles in the journal Acta Universitatis Lodziensis Folia Oeconomica. Out of my published articles, as the most important I consider the ones related to the business cycles in the labour market. Following is a list of them.

Pater R. (2010). Dynamiczne zależności na polskim rynku pracy w metodologii SVECM [Dynamic relations in the Polish labour market using the SVECM methodology]. Barometr Regionalny 19(1), s. 11-26.

Drozdowicz-Bieć M., Pater R., Wargacki M. (2008). Using Survey Data for Labor Market Leading Index. Prace i Materiały Instytutu Rozwoju Gospodarczego SGH 79, s. 118-149.

Pater R., Wargacki M. (2008). Specyfika cyklicznych wahań rynku pracy województwa podkarpackiego na podstawie badań koniunktury [The specificity of cyclical fluctuations in the labour market of the Podkarpackie Region on the basis of business climate survey results]. Prace i Materiały Instytutu Rozwoju Gospodarczego SGH 80, s. 299-325.

Pater R. (2008). Cykle wzrostowe a dynamika cykli koniunkturalnych [Growth cycles and the dynamics of the business cycles]. Barometr Regionalny 14(4), s. 63-79.

Drozdowicz-Bieć M., Pater R., Wargacki M. (2007). Konstrukcja wskaźników wyprzedzających dla regionalnych rynków pracy [Construction of leading indicators for regional labor markets]. Barometr Regionalny 7(1), s. 33-44.

Drozdowicz-Bieć M., Pater R., Wargacki M. (2007). Identyfikacja zmian na rynku pracy za pomocą Barometru Ofert Pracy [Identification of changes in the labor market using the Job Offers Barometer]. Barometr Regionalny 7(1), s. 13-21.

Period 2011-2019 (after obtaining the doctoral degree)

In the first years after obtaining the doctoral degree, business cycles remained in the centre of my interests. In my research, I always tried to use econometric modelling, business cycle analysis tools and decomposition of analysed relation into the short run and long run. I started research on the heterogeneity of the business cycle and made efforts to assess the interrelation of economic fluctuations and the structure of the economy. The result of the research was the publication of two articles of my own authorship. The first one concerned the division of the business cycle periodicity interval (2-10 years) into two sub-periods [item 4.8] (see Table 2 and description in Section 4). In the second one, I considered the effects of aggregate and sector-specific shocks on the business cycle and the structure of the economy [item 2.7] (see Table 1 and description in section 3).

Another topic of my research was the functioning and productivity of the public sector. In this research, we tried to estimate the optimal size of the public sector. My contribution was to propose an method of estimating the sector's optimum size in terms of employment. The result of the study were three scientific articles [items 2.1, 2.8 and 4.11]. In [item 2.1], we finally managed to find the

optimal size of the public sector, and to show that in terms of employment in 2014 public sector in Poland was too large. We verified this hypothesis referring to the (modified) Armey curve.

Till the end of 2014, I was involved in monitoring and evaluation of the Regional Innovation Strategy for the Podkarpackie Region. The study consisted of a qualitative part, own quantitative research and analyses of data from official statistics. Within the research we wrote a number of reports **[items 8.5-8.16]**. We have included recommendations regarding economic policy at the NUTS-2 regional level to support regional innovativeness. My contribution in the study included planning the research process and conducting official statistics analyses, co-authorship of the research questionnaire for quantitative and qualitative research, and co-execution of these analyses. The research was continued within the statutory funds of UITM entitled: *The impact of investments in innovations on the competitiveness of enterprises in the SME sector in the Podkarpackie Region.* I supervised this project in 2013-2014. The results of both projects were publications **[item 1.5]** and **[items 4.10, 5.1 and 6.1]**.

During the previous phase of research on *Job Offers Barometer*, I focused on the forecasting role of vacancies as an unmet labour demand measure **[items 2.6 and 2.9]**. This ended my analyses on the forecasting properties of vacancies in the business cycle. Since 2012, when I took over the management of the research, I began to work intensively on the inclusion of many Internet portals for research and analysis of the vacancy data structure. In October 2012, we created an IT tool directed to collect full job offers from 31 nationwide Internet portals. As a result, we have estimated the size of the online job market in Poland, understood as the number of unique vacancies posted online. We examined the structure of job offers by their category, required field of study and skills. This stage of the research ended with the end of 2015, when the market of online job offers developed and changed so much that many of the portals we examined ceased to exist, and the others significantly changed their structure. Modest statutory funds were not enough to improve the algorithm that collected data. This stage of the research ended with the publication **[item 2.4]**. The vacancy market was my main research interest, not only from the point of view of Poland and online job offers. For several years, I have been studying changes occurring in the vacancy market in the short, medium and long run. The result of this work was the publication of my sole authorship **[item 1.4]**.

In the meantime, taking into account global trends to shift from a measure of economic development based on GDP per capita to development indexes such as the *Human Development Index* or *Better Life Index*, I have been working on an indicator of economic development at the NUTS-2 regional level. My hypothesis was that to properly balance the development measure, we need to combine development measures based on indicators of quality of life and productivity. Development cannot exist without productivity improvement, and productivity cannot be a measure of development without inclusion the quality of life measures. I prepared such a measure for the project entitled: *Evaluation of the effectiveness of the European Union structural funds as an instrument of social and economic cohesion policy and improvement of living conditions* (project supervisor: dr. Jan Misiąg). Next, I supervised a small study entitled: *Acceleration of the development of Eastern Poland. Recommendations based on the experience of selected regions.* These research resulted in publications **[items 4.4 and 8.3]**.

Together with dr. Ewa Gałecka-Burdziak, we prepared a report and then an article within the KAE SGH statutory research (no. KAE/S/26/14) supervised by dr. Michał Gradzewicz about changes observed in the vacancy market during the 2007-2009 recession and immediately afterwards [items 2.6 and 8.4].

In 2015, I was involved in the project entitled: *Structural transformations in the development of countries*. Within the research we estimated the intangible capital in Poland. My contribution in the research was primarily the supervision of its second part, focused on analysing the impact of intangible capital on the economic growth in Poland. We managed to estimate the level of this capital in Poland and its share in the economic growth. In the capital estimation itself, I mainly dealt with its component related to the estimates of human capital and economic competencies. The result were two publications [items 2.3 and 2.5].

In 2015, I was involved in a project financed from foreign funds, entitled: *Data spatial aggregation in labour market matching*, as one of the main researchers. I had the opportunity to analyse the matching process between participants of the labour market on a regional and local level. My particular contribution is mainly the study of the efficiency of the matching process at various levels of temporal and spatial aggregation, and the formulation of conclusions for economic policy. Two publications base on this research [items 1.2 and 1.3].

Until now, the effects of the business cycle on the labour market is one of my research interests. The result of these interests was the co-authorship of an article on the cyclical nature of labour participation [item 3.1]. We continued this research with dr. Ewa Gałecka-Burdziak (project leader) during 2017-2019, in the project entitled: *The cyclicality of the labour force participation. The added/discouraged worker effect*. I was one of the main researchers. Thanks to this project, I have established cooperation with Prof. Emilio Congregado and Prof. Antonio Golpe from the University of Huelva (Spain).

During 2017-2018 I also participated in the research on the Jobs Calculator for Poland, financed from statutory funds of KAE SGH (KAE/S17/25/17). I co-created the Jobs Calculator application, which is a tool used for creating simple simulations on the labour market. It is aimed at determining the number of jobs necessary to create and fill to lower the unemployment rate to a certain value. The research ended with a publication [item 2.2].

My greatest research achievement so far was a research entitled: Horizontal educational mismatch: a new method of measurement with application to Poland. In mid-2017, I received funding for this research from the Ministry of Science and Higher Education ("Dialog" program). The study ends with the end of May 2019. The result of the study are two scientific publications, already published during project lifetime [items 1.1 and 4.1], an article popularizing science [item 9.1], a series of educational policy consultations, and presentations at international scientific conferences. This study is Poland's largest research on the demand for qualifications and skills carried out with the online job offers data. We have managed to investigate the coverage and representativeness of online job offers, propose various improvements in relation to existing approaches to Internet data research, skills demand and skills mismatches. The results of the research were immediately applied in shaping the education policy of Poland in the *Diagnosis of the OECD Skills Strategy for Poland* [item 8.2] and in the project entitled: *Supporting the implementation of the Integrated Qualifications System at the level of central administration and institutions that give qualifications and ensure the quality of*

awarding qualifications **[item 8.1]**. In both cases, the ordering institution was the Ministry of National Education, and the executing institution was the Educational Research Institute. These surveys have filled the gap in research on the labour demand at a detailed level, especially in terms of demand for skills. As a result of the project, I established international cooperation with Prof. Carlos Usabiaga Ibáñez from Universidad Pablo de Olavide in Seville and Prof. Fernando Núñez Hernández from the University of Seville, popularizing the methodology used in the project internationally.

3. **Scientific achievements submitted for evaluation (resulting from Article 16. Section 2 of the Act of March 14, 2003 on academic degrees and academic title and on degrees and title in the field of art (Journal of Laws No. 65, item 595, as amended).**

Achievement submitted for evaluation

Table 1 shows a summary of the main publications achievements, that I present for the assessment. The list consists of a series of scientific publications entitled **"Labour demand: measurement including human capital, dynamics in the short, medium and long run, as well as the problems of matching with the labour supply"**. The series consists of 14 scientific articles, including 5 published in journals from the Journal Citation Reports (JCR) list and 9 articles published in journals from the B list of the Ministry of Science and Higher Education (MNiSW) in Poland. Ten of these publications were written in English, four of them were written in Polish.

Table 1 List of publications making up the cycle entitled Labour demand: measurement including human capital, dynamics in the short, medium and long run, as well as the problems of matching with the labour supply

No.	Publication	My contribution	Impact factor according to the Web of Science (in the year of publication)	MNiSW points
1.	**SCIENTIFIC ARTICLES PUBLISHED IN JOURNALS FROM THE JCR LIST (the A list)**			
1.1	Pater R., Szkoła J., Kozak M. (2019). A method for measuring detailed demand for workers' competences. Economics: The Open-Access, Open-Assessment E-Journal 13(2019-27), pp. 1-29; DOI: http://dx.doi.org/10.5018/economics-ejournal. ja. 2019-27.	65%	0.545	20
1.2	Antczak E., Gałecka-Burdziak E., Pater R. (2019). What affects efficiency in labour market matching at different territorial aggregation levels in Poland? Bulletin of Economic Research 71(2), pp. 160-179; DOI: 10.1111/boer.12171.	33%	0.264	15
1.3	Antczak E., Gałecka-Burdziak E., Pater R. (2018). Unemployment and vacancy flows in spatial labour market matching at the regional level. The case of a transition country. Journal of Applied Economics 21(1), pp. 25-43; DOI: 10.1080/15140326.2018. 1526874.	33%	0.375	20

1.4	Pater R. (2017a), Is there a Beveridge curve in the short and the long-run, Journal of Applied Economics 20(2), pp. 283-303, DOI: https://doi.org /10.1016/S1514-0326(17)30013-2.	100%	0.375	20
1.5	Pater R., Lewandowska A. (2015). Human Capital and Innovativeness of the European Union Regions. Innovation: The European Journal of Social Science Research 28(1), pp. 31-51, DOI: 10.1080/13511610.2014.962487.	50%	0.346	15
2.	**SCIENTIFIC ARTICLES PUBLISHED IN OTHER JOURNALS (the B list)**			
2.1	Pater R., Cywiński Ł. (2019). Optimal size of the public sector in Poland in terms of employment. Ekonomista 2, pp. 194-206.	50%	-	14
2.2	Bieć M., Gałecka-Burdziak E., Pater R. (2018). Kalkulator pracy: użyteczne narzędzie do modelowania zależności na rynku pracy [Jobs calculator for Poland: a useful tool for modelling the labour market]. Wiadomości Statystyczne 7, pp. 14-24.	33%	-	12
2.3	Pater R., Cywiński Ł., Harasym R., Tarchalski K. (2018). Intangible capital and the economic growth in Poland. Bank i Kredyt 49(2), pp. 1-16.	25%	-	14
2.4	Pater R. (2017b). Internetowe oferty pracy jako źródło informacji o zapotrzebowaniu na kompetencje [Internet job offers as a source of information about the demand for competences]. Polityka Społeczna 516(3), pp. 32-39.	100%	-	12
2.5	Cywiński Ł., Harasym R., Pater R., Tarchalski K. (2016). Intangible capital, level of economic development, and middle income trap. Studia Ekonomiczne 90(3), pp. 439-461.	25%	-	13
2.6	Gałecka-Burdziak E., Pater R. (2015). Ile jest wolnych miejsc pracy w Polsce? [How many vacancies are there in Poland?]. Gospodarka Narodowa 5, pp. 171-186.	50%	-	14
2.7	Pater R. (2015). The UK business cycle and the structure of the economy. Prace i Materiały Instytutu Rozwoju Gospodarczego SGH 97, pp. 67-93.	100%	-	8
2.8	Pater R., Skica T. (2014). The productivity of public and private sector in Poland. Business and Economic Horizons 10(2), pp. 120-137.	50%	-	8
2.9	Pater R. (2011). Wskaźniki wyprzedzające dla rynku pracy [Leading indices for the labour market]. Prace i Materiały Instytutu Rozwoju Gospodarczego SGH 87, pp. 117-141.	100%	-	9

The publications listed in Table 1 show different aspects of labour demand. In each of these aspects I proposed new solutions, enriching the current state of knowledge about labour demand:

A. **Measurement with particular emphasis on the demand for human capital.**
   Problems of measuring unmet demand (vacancies): while the measurement of the realized demand (employment) does not raise serious doubts, vacancies are considered one of the most difficult macroeconomic aggregates to measure.
   Measurement of demand for human capital: detailed measurement of the demand for competences and qualifications, which extends the current approach focusing on larger aggregates — occupations or subjectively and broadly defined skills, as well as the measurement of intangible aspects of labour input.
B. **Changes in the long, medium, and short-run, as well as in the structure of labour demand.**
   Short and medium run: research on the use vacancies to forecast cyclical changes in the labour market; behaviour of vacancies in the business cycle and in the medium-term cycles; analysis of cyclical properties of various measures of vacancies and labour demand.
   Long run: analysing the behaviour of vacancies in the long run, while the literature focuses on the behaviour of unemployment in the long run.
   Structural changes: the study of structural changes in the demand for labour, and the role of labour input in economic growth.
C. **Problems with labour demand and labour supply matching.**
   The matching process: the mechanism of matching between labour demand and labour supply at various levels of temporal and spatial aggregation, as well as the impact of economic policy applied from different territorial levels on the efficiency of labour market matching.
   Measurement of labour market mismatch: measurement of spatial and educational mismatch.

The importance of topics and the current state of knowledge

A. On measuring labour demand, including human capital

Labour demand consists of a realized demand and unrealized or unmet demand. The former is measured by employment, and the latter by vacancies.

Vacancies play an role in the labour market.

i. They illustrate a part of the labour demand that is not producing, yet. It is worth supplementing the estimates of the labour demand for vacancies, which, however, are not as clearly quantifiable as employment.
ii. They play a forecasting role in relation to employment. Being still unrealized demand, they show with lead in which direction the inflow of employees can change and, as a result, they can serve as a measures for forecasting changes in employment.
iii. They show the scale of difficulty in hiring employees. The length of the vacancy and the chance of its turning into employment indicates the scale of structural mismatch and frictions in the labour market. This mismatch and frictions may result from demand or supply factors.

While measurement of employment is not problematic, with exclusion of unregistered employment, the measurement of vacancies is not easy. The first problem is defining the vacancy. If production capacity is below full, it does not mean that there is a vacancy, as a company may intentionally not

want to create a job (e.g. because of ongoing business cycle contraction) or plan to create it without employing a new employee. Central Statistical Office (GUS) in a representative study entitled The demand for work specified the concept of a "vacancy" (Zgierska 2018). It means a workplace that was newly created (as a result of organizational changes in the company, changes or extension of its business profile and all jobs in newly created businesses) or was created as a result of the movement of employees. There are three conditions necessary to meet the definition of a vacancy: (i) the workplace was not occupied on the reporting day, (ii) the employer was actively looking for an employee; and (iii) the employer declared that they would hire an employee if a person with appropriate qualifications/competences had applied. The second problem in the study of vacancies is the detail or representativeness of the research. The survey of the demand for the work is conducted with sectional breakdown of the Polish Classification of Activities (PKD) and large professional groups of the Classification of Occupations and Specialties (KZiS). Registered data provide information on the number of job offers addressed to public employment offices. Employers should submit vacancies to employment offices[1], but a small percentage of companies use this method of recruiting employees[2]. Employment services often receive offers of job in the public sector and less paid jobs. These offers are also biased by regulations that affect the incentives of submitting a job offer in the office, for example job offers of internships reimbursed by the state. Online job offers can supplement sample surveys to provide more detailed data on labour demand. On their basis, one can get, among others, information about the demand for: occupations, qualifications, and skills/competences. Evaluation of the properties of various measures of vacancies in terms of market coverage, changes in time and structure requires analysis.

While job offers are an imperfect measure of vacancies, they contain a valid information about this portion of labour demand (Abraham 1987). Nowadays, there is a growing literature on the use of online job offers (see, e.g., Kuhn and Skuterud (2004), Kuhn and Mansour (2011), Hershbein and Kahn (2018) and citations therein), and the online job market has been rapidly developing for more than a decade. Also official statistics is looking for ways to incorporate online data. Thus, looking at online job offers provides us with interesting research possibilities. The question is whether internet job offers can be considered to represent the whole vacancy market. In the second decade of the 21st century, most job offers are published online. As in most European countries, internet penetration in Poland is high: in 2015, 92.7% of companies and 75.8% of households in Poland had internet access (Central Statistical Office 2016). Thus, we can assume that internet job offers are viewed by most job seekers. Pavlicek and Kristoufek (2015) show that job seekers in Poland use the internet extensively to search for jobs, and that the online activity levels of job seekers are related to movements in the unemployment rate. Internet data are relatively easy and cheap to collect continuously. However, the literature in this area is still infant.

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[1] Article 36. point 5a of the Act of 20 April 2004 on the promotion of employment and labour market institutions (Journal of Laws of 1 May 2004) and Article 36. point 5a of the Act of 14 March 2014 amending the Act on the promotion of employment and labour market institutions and some other acts (Journal of Laws of 12 May 2014).

[2] One in eight job offers goes to public employment offices. 70% of enterprises do not submit vacancies to public employment offices (Tyrowicz 2014). The scale of underestimation of the number of job offers, based on the registered data may show a positive difference between the outflow from unemployment to employment and the number of available job offers.

There is an increasing need for analysing the demand for skills, or more generally – human capital, in the labour market. Human capital is „the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (OECD 2001, p. 18). Chevalier (2011) shows that the difference in average earnings between graduates of different fields of study is smaller than the range of earnings of graduates in the same field of study. Hershbein and Kahn (2018) argue that by looking directly at the skill requirements in job offers, rather than relying on assumptions about the skills associated with a particular occupation, it is possible to document the evolution in skill requirements for this occupation over time. Even though looking at occupational and educational composition of jobs it is possible, to some extent, to evaluate the demand for job-related skills, it is impossible to infer about the demand for transversal skills. This means that the broadly defined qualifications are not sufficient to determine the labour demand for work and the conclusions for educational policy. A more detailed view is needed, from the perspective of individual skills/competences[3].

Workers' skills have been measured from a macroeconomic perspective in a number of studies (McGowan and Andrews 2015). These studies provide measures of the supply of competences in the labour market. The detailed demand for competences by employers have so far been measured from a microeconomic perspective (for example, Winterton et al. 2006). Meanwhile, there is a lack of research from a macroeconomic perspective.

Another problem is the long-run labour demand and the role of the labour input factor in economic growth. In this context, the aggregate production function is estimated. Typical estimates of production elasticity with respect to labour oscillate around 0.66. Gradzewicz and Kolasa report for Poland output elasticity with respect to labour for 0.57 while Epstein and Macchiarelli (2010) show 0.49. A question arises: what structural factors on the labour demand side could maximize the GDP per capita? The labour factor can also be analysed with greater accuracy, e.g. by ownership sector. An appropriate ratio of public to private sector according to employment could contribute to maximizing economic growth. It is also extremely important to estimate the influence of human capital, which, due to its intangible nature, is difficult to measure.

One of the measures that take into account human capital is intangible capital. As defined by authors of the most often used methodology, called Corrado-Hulten-Sichel – CHS (Corrado et al., 2005, 2006) "intangible investment is expenditures of businesses that are intended to boost output in the future but that are not traditional, tangible, physical capital". Intangible capital consists of: computerized information, innovative property, and economic competencies. The major share within the sub-category of economic competencies of the firm is held by: firm specific human capital and organizational structure. The former covers various forms of training, while the latter presents involvement of an important share of managerial/marketing personnel in absorbing, adapting, and upgrading the technological change. So far, the estimates of this capital for Poland were fragmentary and no analysis of its impact on the economic growth was made.

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[3] In the economic literature, "skills" are understood in a broad sense, as: knowledge, skills in the strict sense and attitudes, which means treating "skill" as a synonym of "competence". However, skills are measured differently. Due to the lack of data, simplifications in their measurement are often used, e.g. job-related competences measured with data on occupations.

B. On the dynamics of labour demand in different time horizons

Search and matching models have been widely used to describe labour market stocks and flows (Pissarides 2000). A downward-sloped and convex to the origin Beveridge curve (BC) is one of the key elements of the model. The Beveridge curve is a graphical representation of the matching process that describes the relation between the vacancy rate (VR) and the unemployment rate (UR) in equilibrium. It indicates interchangeability between vacancies and unemployment that generally occurs over the business cycle. However, empirical Beveridge curves for most countries proved to be very irregular, frequently changing position and slope. The positive correlation occurring in certain periods between vacancies and unemployment is not precisely recognized. Another question is what the Beveridge curve looks like in the long-run. In theory, aggregate productivity shock have opposite effects on vacancies and unemployment, thus producing a downward-sloped BC. Fujita (2011) finds that demand shocks and technology shocks have opposite effects on vacancies and unemployment. After the above shocks, the job creation condition, represented by the vacancy–unemployment ratio, needs to adjust very fast to provide a stable BC locus. Various labour market rigidities can lengthen this adjustment, thus providing observed cyclical shifts of the curve, not explained by the productivity shock itself. As a result, vacancies and unemployment often trace counter-clockwise 'loops' around the Beveridge curve. Farther and prolonged 'loops' occur after more severe recessions (Pissarides 2006). The positive co-movement between vacancies and unemployment may result from changes in the job destruction rate (probability of job loss). Elsby et al. (2015) state that assuming 'reasonable' parametrization of the model, vacancies and unemployment can co-move positively in the steady-state after this shock. Shocks to matching efficiency, most often occurring over longer periods, results from various heterogeneities in jobs and workers, e.g., educational, spatial, in qualifications. Thus, the BC shifts outwards, making vacancies and unemployment move in the same direction. Although many analyses of the BC curve shifts can be found in literature, there are relatively few generalizations for the theory of economics.

Fujita (2011) uses a sign restriction approach to identify a demand shock as the one inducing opposite-signed movements in unemployment and vacancies. He does not characterize the effect of a shock inducing shifts in the Beveridge curve. Blanchard and Diamond (1989) do recover a shock inducing short-run positive co-movement of unemployment and vacancies, but they do not incorporate information from the long-run response. King (2011) undertakes the task to confirm the existence of a long-run relation between vacancies and unemployment. He finds a positive relation between low-frequency (trend) components of both time series using data for the U.S. economy. He does not explain what permanent shocks drive processes behind the co-movements between the trends of vacancies and unemployment. Daly et al. (2011) present a Beveridge curve composed on the basis of long-run components of vacancies and unemployment, and the relation they recognize is positive. However, these analyses did not explain what shocks contributed to the negative correlation between UR and VR, and what shocks resulted in the positive correlation between them.

Another research issue is the leading properties of various data on future labour demand. Forecasting changes in the labour market is an important problem of economic policy. However, it is difficult. Particularly difficult, but potentially useful, is forecasting the turning points of labour market situation indicators: employment or unemployment rate. The classical approach to employment forecasting is related to the estimation of the labour demand function, most often as a function of product and wages (Hamermesh 1993). Various empirical specifications of the labour

demand function are provided by Florczak (2003), as well as Welfe and Welfe (2004). Leading indicators dedicated to the labour market are not a popular, although leading indicators constructed for general economic activity are quite popular. One of the reasons for the low interest in them is the fact that the labour market volatility is low. Indicators, such as unemployment or employment rates, are relatively smooth and are not subject to many unpredictable short-term fluctuations. This is why short-term forecasts are relatively easy to obtain on the basis of linear autoregressive models or labour demand function. The problem arises when determining their business cycle turning points. Then, leading indicators are especially useful. It is necessary to analyse variables that might show the future labour demand and their forecasting properties.

There have been numerous analyses of business cycles but the question remains open as to the effects they have on the structure of an economy. Individual sectors of the economy are characterized by different cyclicality. So, what is the impact of aggregate shocks on the employment structure? What effect do sectoral shocks have on the business cycle? We know that the majority of business sectors are synchronized by gross value added and employment over the business cycle, but their productivity exhibits weak correlation. This phenomenon is called a co-movement puzzle (Veldkamp and Wolfers 2007). The importance of sector-specific shocks is underlined by Stockman (1988) and Durlauf (1989). Engle and Issler (1995) show that sectoral cycles in the US economy are almost identical in timing and seem to share a common component. However, business cycles generating transitory shocks are the most important for manufacturing and trade. Caporale (1997) studies UK sectoral shocks, and finds limited evidence for an impact of asymmetric shocks, although sufficient evidence is found for the impact of aggregate shocks on the sectors of the economy. Hughes (1997) shows various industries exhibit different behaviour in the business cycle. Studies for Korea confirm the general findings for other countries that manufacturing is leading in the business cycle, especially in heavy and chemical industries (Yang & Kim 2005). Skrzypczyńska (2012) points that the patterns of the sectoral cycles in Poland differ from each other. Eickmeier (2007) indicates sectoral transitions between cyclical fluctuations across countries, with the examples of the USA and Germany. Liu and Spector (2005) argue that non-production employment changes lag over the business cycle, and its amplitude is smaller than in the case of production workers. Finally, Jaimovich and Siu (2012) indicate the direct impact of business cycle phases, i.e. recession and jobless recoveries, on the structure of the labour market, i.e. job polarization. This is a visible example for the importance of the relationship between the business cycle and the structure of an economy. Burren and Neusser (2013) conclude that approximately 30% of the decline in US GDP volatility observed over the period 1949-2005 was due to the shift of production to services. This indicates a relation between business cycle properties and long-run sectoral shifts. It may therefore seem that much has been said about the cyclicality of sectors of an economy. It is however not clear how the business cycle affects its structure.

Another problem is the structural change taking place in the long-run. From this point of view, the optimal relation of economic sectors to maximize the GDP per capita can be analysed. In Poland, an economy after the transformation process, it might be especially interesting to analyse the optimal employment share in the public sector.

C. On the matching process between the labour demand and labour supply

Theories explaining the coexistence of unemployment and vacancies belong to the group of search and matching theories. One of the two main reasons behind the natural unemployment, apart from frictions, is the structural mismatch between participants of the labour market – job seekers and employers posting vacancies. Mismatch in the labour market result from differences in the structure of labour demand and labour supply. As a result, even effective search will not result in filling the vacant workplace, due to lack of agreement between job seekers and employers. The reasons for this mismatch are changes in: technology (Bruno and Sachs 1985), institutions (Blanchard and Wolfers 2000), demography (Abraham and Shimer 2001) and education (Phelps and Zoega 2000).

The search and matching process that occurs between employers posting vacancies and job seekers is illustrated with the Beveridge curve (UV curve), described in the previous section. To quantify the relation that the curve represents graphically, the (augmented) matching function is most commonly used. In Poland, it was the subject of relatively many studies. The efficiency of the matching process for Poland was examined by: Lehmann (1995), Góra et al. (1996), Kwiatkowski and Tokarski (1997), Kaczorowski and Tokarski (1997), Stasiak and Tokarski (1998), Rogut and Tokarski (2000), Kucharski and Tokarski (2003), and Gałecka (2007) for the country and regions, Tyrowicz (2011), Jeruzalski and Tyrowicz (2013) for poviats (see detailed review in Gałecka 2008). The literature on the determinants of matching process efficiency points many important factors, e.g. the impact of: economic development, population density, business cycle, duration of unemployment, active labour market policies, demographic characteristics, occupational, regional and sectoral specificity. The problems of spatial and temporal aggregation in the matching process and spatial dependencies are not fully recognized.

Labour market matching in Poland differs between regions, and between rural and urban areas. Matching vacancies and the unemployed individuals is less efficient in eastern regions and rural areas than in western regions and cities. Differences within regions are also substantial, with certain NUTS-4 units being more efficient than others. Moreover, factors that determine differences between broadly defined regions, for example NUTS-1, may not explain why local territorial units, for instance NUTS-4, localized possibly within one larger region, differ. The literature on the matching process efficiency indicates many findings, e.g. the influence of: economic development, population density, the business cycle, unemployment duration, demographic characteristics, occupation as well as regional and sectoral specificity. Areas that have not been sufficiently explored are: spatial dependencies and the matching at different aggregation levels.

Spatial disparities in unemployment figures across regions are persistent in many economies (e.g., Bradley and Taylor 1997; Arntz and Wilke 2009; Clark and Mass 2015). This pattern seems to contradict the theoretical implications of migration behaviour, but is more in line with observed patterns of mobility mismatch. Commuting behaviour (interregional spatial mobility) seems to provide an intermediate solution, especially if developed regions with low unemployment rates are located next to regions with high unemployment rates (Kosfeld 2007; Clemente, Larramona, and Olmos 2016; Rijnks, Koster, and McCann 2016). Commuting is less costly than moving and increases labour force mobility, and thus enhances the job creation process from a spatial perspective. But to what extent does commuting help reduce the disparities between local labour markets if the workers in these markets are not mobile enough to migrate has not been analysed in Poland.

A different approach to evaluate efficiency of the search and matching process in the labour market is based on calculation of mismatch indices. They assess the degree of heterogeneity in supply and demand side of the market (Schioppa 1991). These indices are based on measures of similarity of structures. In the mismatch research, factor analysis and cluster analysis are applied. Boudarbat and Chernoff (2012) have observed that educational characteristics play a bigger role in the labour market than the demographic and socioeconomic characteristics. Their examination is therefore particularly important.

Below is a brief outline of my achievements in the areas mentioned above.

A. Measurement of labour demand, with particular emphasis on human capital

Unmet demand (vacancies)

Although the Internet can be a source of statistical data on job vacancies, the literature lacks methods of this measurement – collecting, processing and analysing online job offers in appropriate breakdowns. I filled this gap in my own research, as presented in articles **[items 1.1, 2.4 and 2.6]**. These studies are the largest in Poland and have been carried out for the longest time, successively since 2004.

The article **[item 1.1]** contains a summary of the procedure for obtaining online job offers from the research I have been conducting so far. We described the procedure for collecting and analysing online job offers. To do this, we analysed web portals with job offers, we selected those that contain different types of job offers (nationwide, local, for the higher-educated or the lower-educated). We have prepared a tool for continuous collection of entire job offers. Our contribution is in this case a more accurate selection of web portals than was done in previous studies. Internet job offers form a certain fraction of the market. The ones we collect are characterized by a different regional and occupational distribution than the ones from a representative survey. However, an important advantage of our method is the knowledge of these distributions (also described in the paper **[item 2.6]**). This creates the possibility of selecting subsample for dedicated research, introducing weights under- and overrepresented sections or taking these differences into account in data modelling. The advantage of online job offers research is the possibility of a more detailed analysis of their structure than in the case of alternative research.

Representative research on vacancies does not provide full information about the structure of them. The purpose of the article **[item 2.4]** was to present additional information on vacancies that can provide online job offers. These are primarily data on the structure of vacancies in various sections, and in particular, according to qualifications and competences, providing information on the demand for human capital. The article was the first attempt to analyse the collected online job offers in terms of competences, which is rare at the macroeconomic scope, both in Polish and international literature. In the second part of the article, I pointed to the legitimacy of using Internet research on job offers in shaping education policy and trainings of the unemployed. I demonstrated the usefulness of this research as an instrument supporting active labour market policy in the light of the Act of 20 April 2004 on employment promotion and labour market institutions, and the Act of 14 March 2014 amending the Act on employment promotion and labour market institutions and some other laws. This usefulness is mainly due to the possibility of obtaining constant and detailed structural information about the labour demand, for example about the demand for skills and

competences. In this approach, the collected data may contribute in particular to: easier profiling of the unemployed due to their competences and facilitating the task of the client's adviser, which until now is to a small extent carried out by labour offices, due to the lack of detailed data on labour demand. It can also be a tool for planning labour market policy. Functioning and coordination of public employment services and educational institutions can be improved, to better adjust educational programs to the needs of the labour market. This method can also support the functioning of: consulting agencies, career counselling agencies, Labour Market Councils and other institutions.

How can we continuously measure demand for individual competences? In the article **[item 1.1]** we proposed a method for addressing this question that is based on collecting and analysing internet job offers. We show the usefulness of the proposed method for analysing the labour market in the context of measuring the detailed structure of vacancies by their transversal competences. Deming (2017), for example, finds evidence of growing demand for social skills. But which social skills are most likely to be required? Careful studies of the labour market are needed to answer this question. In this paper, we investigate this issue by disaggregating general competences into individual competences, and analysing the changing importance of these competences within groups of skills. We analyse the demand for disaggregated skills, not only occupations or fields of education, as it was done so far. Up to now, detailed requirements in job offers have only been studied at the occupational or geographical level (Şahin et al. 2014); at the company level (Modestino et al. 2016); or by job title (Marinescu and Wolthoff 2016). We seek to fill the gap in the existing literature by focusing on individual transversal competences. In this article, we proposed a method for conducting a continuous and efficient analysis of demand for transversal competences. While there is a large body of research on educational and occupational requirements, research on requirements for transversal competences has been scarce. This is partly because there is a lack of methodological research that would enable scholars to conduct such analyses. Thus, previous studies on this topic either investigated the demand for skills from an aggregate perspective or analysed measures of job-related skills. While most studies aggregate skills in groups, use available proxies for them, the authors analyse the demand by employers for individual competences. Such an analysis better reflects reality because companies usually require job candidates to have particular competences, rather than generally defined groups of skills. However, no method exists to analyse on a large scale which competences are required by employers. At a detailed level, there are hundreds of competences; thus, this demand cannot be measured in a sample survey. The authors propose a method for conducting a continuous and efficient analysis of the demand for competences of prospective employees. The method involves collecting internet job offers and analysing them with data mining and text analysis tools. This method can be used continuously. Various institutions can analyse and publish up-to-date information on the current demand for competences, as well as on trends in this demand. These studies have found empirical application in the Diagnosis of the OECD Skills Strategy for Poland and the diagnosis of the demand for vocational education.

We also contribute by using official classifications. Previous approach used did not use a official classifications framework. For example, Deming and Kahn (2018) categorise keywords representing skills found in internet job offers. As one of the first in the world, we used the European Commission ESCO classification of transversal competences to perform our analysis. This achievement is particularly important given the lack of uniformity of Internet data. Our next contribution to the literature is that we lemmatise words and their synonyms in our dictionaries (which we use to search

job offers), which makes it possible to recognize, on average 93% of occupations in job offers, while Cedefop, in the study of job offers, in countries with similar vocabulary to Polish (e.g. Czech Republic) recognizes 20-30% of occupations in the job offers.

In the empirical part of the article [item 1.1] we described transversal competences most often sought by Polish employers. In the case of more general conclusions as to the transversal competences changes, we found evidence of upskilling during economic contractions and of downskilling after such downturns. These observations suggest that the number of competences companies require of job candidates is counter–cyclical. Such counter-cyclicality may lead to increases in levels of labour market mismatch during economic contractions, which may in turn help explain jobless recoveries (Jaimovich and Siu 2012). The article also contains a number of detailed conclusions for Poland's education policy.

Realised demand (employment)

In the article [item 2.5] we examined the intangible capital in Polish companies, containing an important component – human capital and organizational structure (economic competencies). In the research team I was especially involved in estimation of these types of intangible capital. Intangible capital is an important source of economic growth. Firms that are in the centre of innovative growth increase their economic competencies. Therefore, this type of capital can be a valid source of economic growth in the European economies, while traditional growth factors will provide low growth. The authors found that most of the eastern European countries share common features in the intangible investment structure, which differentiates them from highly developed countries. Tangible to intangible capital ratio is considerably larger in the eastern European economies. These differences between Eastern and Western Europe are roughly proportional to the differences in GDP per capita. It is connected to the fact that eastern European economies mostly import technology, while relying on traditional growth factors. During digital revolution countries undergo significant structural changes. The authors found that this may be connected to the structure of intangible capital they acquire. In highly developed economies proportions between two largest basic categories of intangibles – innovative property and economic competencies of firms are approximately equal. In the middle-developed ones the share of economic competencies in intangibles was markedly higher until late 2000s, and then it rapidly decreased to lower levels. In highly developed economies firm-specific human capital and organizational structure accompany the introduction of new technologies, while in the middle-developed one the latter are often purchased from outside.

In the work [item 2.3] we examined the impact of intangible capital in Polish enterprises on economic growth. We supply previous studies with the analysis of changes in real intangible capital formation and the effects of accumulated intangible capital on GDP. Since most of the intangible capital components have not been accounted for in the national accounts, human capital being one of them, we suggest possible improvements in economic growth measurement. We show that intangible capital had a significant impact on economic growth in Poland during 1995–2013, accounting for at least one third of the economic growth. Intangible capital grew faster than GDP and its meaning for economic growth gradually increased during the analysed period. It accounted for 3.1% of GDP in 1995, and for 5.5% in 2015. 'economic competencies' were the most prominent

component of intangible capital, accounting for 54% of its whole value. In economic competencies growth was visible especially in 1995–2001 and 2004–2008.

B. Changes in labour demand in the long-, medium- and short run, as well as in its structure

Unmet demand (vacancies)

An understudied phenomenon in the literature is the changes in the number of vacancies in the long run and the positive correlation between vacancies and unemployment occurring in certain periods. I have analysed these issues in the article **[item 1.4]**. I conducted the analysis using the Beveridge curve for the US economy. Search and matching theory indicates that certain shocks may affect unemployment and vacancies in the same way. I trace the effects of both types of shocks affecting the vacancy rate and the unemployment rate using U.S. data. I impose common factor restrictions in an unobserved component model and sign restrictions in a vector autoregressive model. I derive negatively and positively-correlated components of vacancies and unemployment with historical variance decomposition and make a counterfactual analysis.

The empirical analysis showed that the vacancy rate (VR) and the unemployment rate (VR) have two components. The first one is the effect of an aggregate labour demand shock. It has transitory adverse effects on vacancies and unemployment. It results in a traditional negatively-sloped Beveridge curve. This shock also causes some long-lasting effects, that is, Beveridge curve 'looping' as a result of labour market adjustments. Opposite movements in VR and VR occur over the business cycles and medium-term cycles. More time-consuming adjustments occur in the medium-term cycles. The second shock, derived as a disturbance to UR, causes permanent one-directional changes in the unemployment rate and the vacancy rate. It explains shifts of the negatively-sloped Beveridge curve, especially in the long run. These shifts create a positively-sloped path. During 1955Q1-2016Q1 this curve was steep, showing more adjustments in VR than UR. On the basis of these shocks I computed the 'natural' rate of vacancies. In this sense, the 'natural' level means the one that does not cause interchangeability between UR and VR. My models showed that the negatively-sloped BC is not only a result of 'pure' business cycle fluctuations, but also longer adjustments. A positively-sloped path is the result of long-run changes, but also of some post-recessionary adjustments.

Leading indicators dedicated to the labour market are not a popular method of forecasting changes occurring in it. I analysed it in the article **[item 2.9]**, in which I made the classification of labour market variables in terms of leads and lags. This approach refers to one of the most difficult issues in forecasting – forecasting business cycles turning points. In my article, I reviewed existing leading indices for the labour market. Their components are mainly based on leading information on labour demand. I selected and analysed the leading properties of available variables for the Polish economy. In the analysis I took into account both classical cycles and growth cycles (cycles of levels and deviations), extracted by means of selected linear filters. In the article, I showed the importance of leading information on labour demand in the form of job offers, unemployment flows (mainly flow from unemployment to employment), data on expected demand for labour from surveys, and indicators of the general business climate. The research found empirical application in the *Labour Market Leading Index* published by the Bureau of Investment and Economic Cycles on a monthly basis to this day.

Continuing work on forecasting labour demand, in the next article **[item 2.6]** we analysed the available vacancy measures in Poland. We have made a comparative analysis of the following measures: vacancies from a representative Demand for labour survey, job offers from public employment offices, and job offers from the Internet using my own research. We analysed the cyclical properties of these measures in the context of the recession of 2007-2009 and the period after the recession, as well as their long-run changes. We found that the cycles of all analysed vacancy measures slightly led the cycles of employment and unemployment. The share of the cyclical component in the volatility of vacancies was higher than in the case of unemployment, employment and GDP, which means their high pro-cyclicality. We assessed job offers from public employment offices and the Internet as measures of vacancies, and showed the market fraction covered by these measures. Data from the Internet turned out to be particularly interesting. The offers collected on the basis of my own research covered a large part of the market. They were received on a regular basis – much earlier than those provided by the official statistics and were not as susceptible as the offers from public employment offices to changes of a legislative nature.

We have extended the analysis of the size and changes in vacancies and their consequences for the economy in the Jobs Calculator for Poland, a tool described in the article **[item 2.2]**. The tool calculates the number of jobs, required to change the unemployment rate to a given value. The innovation introduced in the algorithm is taking into account the impact of seasonal, cyclical and long-run changes, which was my proposition and my contribution in the research group. The confrontation of real data about the current number of newly created jobs with data resulting from simulations allows the user to assess how far the economy is from the assumed goal (unemployment rate), and whether it can be achieved in the near future. The Jobs Calculator for Poland can be used to assess the reality of policy actions aimed at reducing unemployment. Such an analysis is supplementary to other methods forecasting the labour demand.

Realised demand (employment)

In the article **[item 2.7]** I examined the mutual dependence of the business cycles and employment structure, i.e. the effects of aggregate shocks on the employment structure, and the effects of idiosyncratic sectoral shocks on the economic activity. I used NACE classification and conducted the analysis based on (relatively long) time series for the British economy. The innovation of the article is the analysis of the interrelation of the business cycle and the structure of the economy. The analysis presents empirical examples supporting the theories of the heterogeneity of the business cycle and the relationship between economic fluctuations and structural changes. It was found that the business cycle both influences and is influenced by the structure of the economy. The impact of fluctuations on employment shares were generally lagged but more persistent than that on gross value added. A rise in the employment shares of public services and industry negatively affects the business cycle, while the employment shares of construction and market services affect it positively. Recognition of employment flows between sectors can contribute to the knowledge on the short-run job-to-job transitions, which influences labour market stickiness. This may direct labour market policy, e.g. unemployment support and demand for training in different business cycle phases.

In the articles **[items 2.1 and 2.8]** we are looking for the optimal relation between ownership sectors in terms of labour input, for maximizing GDP per capita. Such measurement of a public and private sectors size is uncommon in the literature, wherein we observe mostly the expenditure approach. Its

advantage over the typical approach, based on the government expenditure is that it is based on the accumulated labour input in the economy, and not only on the cash flow in a given year. The conclusion of the first article is that the ratio of employment in the private to public sector is positively correlated with economic growth and development, as measured by GDP and GDP per capita. Estimation with use of both GLS as IV estimators gave similar results, so it is tempting to say that the increase of this ratio in terms of employment results in higher economic growth and development. Our analysis showed that the productivity of the two sectors is different. The private sector has a higher productivity of labour in comparison to the public sector. In the second paper we conducted a more accurate analysis. We used an approach based on the Armey curve, modified for the needs of our analysis. We showed that in the case of Poland employment in the public sector optimally should be around 21% for the whole economy and 24% without agricultural sector. The results show that regarding labour input, the optimal size of the public sector should be one percentage point lower than the actual public sector size observed in Poland in 2014.

C. (Mis)match between labour demand and labour supply

Measuring the matching process

My proposal of an approach to the analysis of labour market matching was presented in [item 1.4], described in the previous section – B. Thanks to this approach, I examined the Beveridge curve slope in the business cycle and in the medium-term cycle for the US economy, as well as adjustment costs occurring after recessions and job destruction, and the path of the BC curve over decades, caused by changing matching efficiency. My definition of shocks also allowed me to indicate to what extent the persistence of unemployment and vacancies results from the labour demand – its dynamic transformations (e.g. arising from changing technologies), and to what extent it results from the maladjustments in labour supply (e.g. due to lack of adjustments in education to the needs of enterprises).

In the first analysis for Poland with the augmented matching function [item 1.3] we analysed to what extent agents in regional labour markets, unemployed workers, and vacancies affect the job matching process in adjacent regions. We contributed to the literature by examining spatial interdependencies in the regional job matching process using three matching frameworks: random, stock-flow, and job-queuing. We found spatial interactions in all of the labour market matching frameworks. Workers commute to surrounding local markets, but many of these flows take place across a single administrative border. We find that vacancies in contiguous local labour markets exert positive externalities on focal markets, and increase the matching rate there. However, we also find that unemployed individuals generate negative externalities, as most workers who seek work and cause congestion in adjacent areas are newly unemployed, whereas individuals from the unemployment stock are less likely to engage in a matching process in adjacent areas. These findings confirm our assumption that workers compete for scarce job opportunities in focal and adjacent areas. The results of the stock-flow model indicate that the unemployment stock affects matching more than the unemployment inflow, but that the vacancy inflow affects matching more than the vacancy stock. Based on these findings, we argue that policy actions should be aimed at exploiting spatial interdependencies to improve labour market matching at the regional level.

In the second analysis of the matching process in Poland [item 1.2] we analysed the matching efficiency at different spatial and temporal levels. We examine the impact of a wide range of

possible determinants of this efficiency. The territorial disaggregation shows how the efficiency of matching differs across territorial units, and what the determinants of this (in)efficiency in the labour market matching are at particular territorial aggregation levels. Such a comparison has not been done before, but should be relevant when we account for the fact that institutional policy-makers at different aggregation levels are in charge of different policy measures. We found that different factors affect the efficiency of matching at different levels of territorial aggregation. These determinants are: economic growth and the pace of new companies' creation (NUTS-1), vocational schools and technical university graduates (NUTS-2), migrations and ALMP (NUTS-3 and NUTS-4). Since these findings suggest that different measures of economic policy should be applied to improve the efficiency of the labour market matching at certain levels of territorial aggregation and in different time horizons. Our results can be used to design tailor-made policy instruments at different aggregation levels to improve the functioning of the labour market. We also found that the efficiency was higher with an annual analysis than with a monthly one. Search is more efficient when labour market participants have time to match, as the search process is time-consuming, and the mean job search duration in Poland is around 10-12 months (LFS data). A year-long search produces more jobs than a month-long search. From a monthly perspective search frictions had larger meaning, while from an annual perspective the mismatch affected the efficiency of matching more.

Measuring the labour market mismatch

In the second part of the article **[item 2.6]**, thanks to the data from online job offers from my own research, we calculated the mismatch indices discussed in the article of Schioppa (1991). We analysed the mismatch across NUTS-2 regions, fields of education, and their groups, according to the ISCED-F 2013 classification. We demonstrated a high supply surplus over labour demand for students and graduates of the humanities, arts and education. In turn, the best prospects of finding a job had graduates of natural sciences and engineering. We also showed an increase in the structural mismatch, both in spatial terms and over education fields in the period 2012-2014. Moreover, the mismatch in the number of graduates of higher education and job offers across education fields was higher than the mismatch between the unemployed and job offers in the regional breakdown. The comparison of the number of students and graduates in 2013 showed that labour market adjustments only occurred in some fields of study, mostly in science and engineering.

The analyses described above show the importance of human capital for economic growth, but also the fact that (i) the need for human capital may not match with its supply **[item 2.6]**, and (ii) human capital may not create innovation **[item 2.5]**. In the article **[item 1.5]** we examined the links between the demand for human capital provided by enterprises, its supply and measures of innovation at the level of the NUTS-2 regions of the European Union. We have classified these regions in terms of their characteristics, measured from these three perspectives. In the research team, I proposed and applied research methods (factor analysis and cluster analysis). The first identified group of regions were the ones with low demand and supply of human capital and innovation (Southern Europe). The next group were regions with high potential of human capital supply, but low demand for it and innovation (Eastern Europe with Poland, with the exception of large centres – state capitals). Another group of regions was characterized by high demand for human capital, but its low supply (Northern Europe). Among the regions of Eastern Europe, including Poland, country capitals were outlying. Their characteristics differed from the rest of the country by a significant demand for human capital. The last group, including the regions of Central Europe, was characterized by high

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values of all three factors. The identification of mismatch in the analysed fields has made it possible to better understand the slower pace of convergence of certain regions in relation to others.

Summary of the obtained results, their contribution to the development of science and practical application.

Thanks to the published articles, I contributed to an increase in economic knowledge in three areas:

A. **Measurement of labour demand with special emphasis on human capital.**
   Using the Internet as a source of data on vacancies; presenting the procedure for analysing job offers from the Internet as measures of vacancies.
   Analysis of the demand for skills and competences at a detailed level; application of official classifications in the analysis of Internet job offers, which is difficult because data from the Internet are presented in various forms. Obtaining a high degree of recognition of the occupations, qualifications and competences in online job offers, thanks to the lemmatization of dictionaries.
   Estimation of the role of the economic competencies in enterprises (component of the intangible capital), including measures of human capital and organizational structure; and proposing of the inclusion of these estimates in national accounts (currently they are not included in the official statistics).

B. **Changes in labour demand in the long, medium, and short run as well as in its structure.**
   Selection of indicators and research on leading information about labour demand; comparison of available vacancy measures; application of results in empirical forecasting of unemployment.
   Investigating the relation between vacancies and unemployment in the business cycle and in medium-term cycles (with the Beveridge curve). Examining the behaviour of vacancies in the long run; examining the effects of shocks that cause a positive correlation between vacancies and unemployment – the shifts in the traditional Beveridge curve; this shift is caused by: adjustment costs occurring after periods of job destruction and changes in the matching efficiency observed over decades.
   Analysing the impact of aggregate shocks on the employment structure and sectoral shocks on the business cycle; from the point of view of long-run structural changes, verification of the hypothesis about the optimum share of ownership sectors in terms of employment and finding an optimal, that is maximizing the GDP per capita, relation between public and private sector in terms of employment; this approach, based on the analysis of the labour input, is innovative in literature based mainly on the public sector expenditures.

C. **Problems of matching between labour demand and labour supply.**
   Research on the process of matching at various levels of temporal and spatial aggregation, positively verifying the hypothesis about different properties of this process and different determinants of its efficiency at different temporal and spatial levels; exploring the mechanism of spatial matching in Poland, which has so far been done to a small extent.
   Assessment of qualifications mismatch in Poland; research on mismatch between the supply of human capital, demand for it and innovation at the regional level.

4. Other publications achievements

In addition to the publications presented for evaluation as the main scientific achievement, I published a number of other scientific articles and reports during my post-doctoral work. Their summary is presented in Table 2.

Table 2 List of publications outside of the main scientific achievement

No.	Publication	My contribution	Impact factor according to the Web of Science (in the year of publication)	MNiSW points
3.	**SCIENTIFIC ARTICLES PUBLISHED IN JOURNALS FROM THE JCR LIST (the A list)**			
3.1	Gałecka-Burdziak E., Pater R. (2016). Discouraged or Added Worker Effect? Which one Prevails in the Polish Labour Market? Acta Oeconomica 66(2), pp. 491-507; DOI: 10.1556/032.2016.66.3.6.	50%	0.402	15
4.	**SCIENTIFIC ARTICLES PUBLISHED IN OTHER JOURNALS (the B list)**			
4.1	Pater R. (2019). Zapotrzebowanie na umiejętności na rynku pracy i w przestrzeni życia społecznego w Polsce [Demand for skills in the labour market and in society in Poland]. Edukacja 1 (accepted for publication, in print).	100%	-	12
4.2	Cwynar A., Cwynar W., Pater R., Filipek K. (2019). Social media as information source in finance: Evidence from the community of financial market professionals in Poland. The International Journal of Digital Accounting Research 19, pp. 29-58.	25%	-	- Indexed in Scopus
4.3	Cywiński Ł., Lewandowska A., Pater R. (2019). Determinants of business innovation in the Regional Innovation System context. Policy implications for a less developed region. Studia Regionalne i Lokalne 1(75), pp. 5-27; DOI: 10.7366/1509499517501.	33%	-	14
4.4	Harasym R., Pater R., Skica T. (2018). Konkurencyjność i rozwój Polski Wschodniej [Competitiveness and development of the Eastern Poland]. Samorząd Terytorialny 5, pp. 64-75.	33%	-	11
4.5	Cwynar A., Cwynar W., Pater R., Kaźmierkiewicz P. (2017). Information Needs of Financial Market Professionals in Big Data and Social Media Era. The Empirical Evidence from Poland. e-Finanse 13(4), pp. 1-13; DOI: https://doi.org/10.1515/fiqf-2016-0031.	25%	-	14

4.6	Cwynar A., Cwynar W., Pater R. (2017). Can Social Media Content Increase Financial Market Returns? A Survey Results from Poland. Organizacija 50(2), pp. 97-111; DOI: 10.1515/orga-2017-0007.	33%	-	10
4.7	Pater R., Skica T., Harasym R. (2015). Index of regional economic development. Studia Regionalne i Lokalne 1 (59), pp. 54-86.	33%	-	14
4.8	Pater R. (2014). Are there two types of business cycles? A note on crisis detection. e-Finanse 10(3), pp. 1-28; DOI: 10.14636/1734-039X_10_3 _004.	100%	-	9
4.9	Pater R., Cywiński Ł. (2013). Mechanizm formowania cen benzyny i oleju napędowego w Polsce [The mechanism of price formation for gasoline and diesel oil in Poland]. Rynek Energii 109(6), pp. 19-26.	50%	-	8
4.10	Pater R., Lewandowska A. (2012). Innovativeness of Podkarpackie District on the background of European Union. Nierówności społeczne a wzrost gospodarczy 28, pp. 299-306.	50%	-	7
4.11	Pater R., Skica T. (2011). Skutki kryzysu gospodarczego lat 2007-2009 dla sfery realnej polskiej gospodarki na tle UE [The effects of the 2007-2009 economic crisis on the real economy in Poland on the background of the EU]. Barometr Regionalny 23(1), pp. 29-43.	50%	-	6
5.	REVIEWED BOOKS			
5.1	Pater R., Lewandowska A., Stopa M., Woźniak L., Chrzanowski M. (2015). Po co nam innowacyjność? [Why do we need innovation?]. Rzeszów: Wydawnictwo Politechniki Rzeszowskiej.	20%	-	20
6.	CHAPTERS IN REVIEWED BOOKS			
6.1	Lewandowska A., Pater R. (2011). Innowacyjność województwa podkarpackiego na tle kraju [Innovativeness of the Podkarpackie Regions on the background of the country]. In: Gospodarka regionalna Polski wobec globalnego kryzysu gospodarczego. Z. Strzelecki (ed.), Warszawa: Wydawnictwo SGH, pp. 571-589.	50%	-	3
7.	WORKING PAPERS			
7.1	Pater R., Szkoła J., Kozak M. (2018). A method for measuring detailed demand for workers' competences. Economics Discussion Papers No 2018-83, Kiel Institute for the World Economy; http://www.economics-ejournal.org/economics/discussionpapers/2018-83.	33%	-	-

7.2	Antczak E., Gałecka-Burdziak E., Pater R. (2016a). Spatial labour market matching. CERGE-EI WP 578; https://www.cerge-ei.cz/pdf/wp/Wp578.pdf; WP KAE 2016_009; http://kolegia.sgh.waw.pl/pl/KAE/Documents/WorkingPapersKAE/WPKAE_2016_009.pdf.	33%	-	-
7.3	Antczak E., Gałecka-Burdziak E., Pater R. (2016b). Efficiency in spatially disaggregated labour market matching. CERGE-EI WP 575; https://www.cerge-ei.cz/pdf/wp/Wp575.pdf; WP KAE 2016_010; http://kolegia.sgh.waw.pl/pl/KAE/Documents/WorkingPapersKAE/WPKAE_2016_010.pdf.	33%	-	-
7.4	Pater R., Winiecki J., Tarchalski K., Cywiński Ł., Harasym R. (2016). Intangible capital, level of economic development, and "middle income trap": with special regard for post-communist transition leaders. WSIiZ Working Paper No. 17; http://workingpapers.wsiz.pl/pliki/working-papers/IC_JWiniecki_et%20al.pdf	20%	-	-
8.	**REPORTS**			
8.1	Pater R. (2019). Badanie rynku wakatów [Research on the vacancy market]. In: Diagnoza zapotrzebowania na pracowników w zawodach szkolnictwa branżowego. P. Mikiewicz (red.), Warszawa: Instytut Badań Edukacyjnych.	100%	-	-
8.2	Pater R. (2018). Diagnoza zapotrzebowania na umiejętności na rynku pracy i w przestrzeni życia społecznego, na podstawie istniejących badań i materiałów [Diagnosis of the demand for skills in the labour market and in society, based on existing research and materials]. Warszawa: Instytut Badań Edukacyjnych.	100%	-	-
8.3	Pater R. (red.). Harasym R., Skica T. (2016). Polska Wschodnia. Konkurencyjność i rozwój. [The Eastern Poland. Competitiveness and development]. Report from the research financed from statutory funds of the Faculty of Economics at UITM. Research supervisor: dr R. Pater; DOI: 10.13140/RG.2.2.12251.36646.	33%	-	-
8.4	Gałecka-Burdziak E., Pater R. (2015). Rynek wolnych miejsc pracy w świetle zmian sytuacji gospodarczej zapoczątkowanej w 2007 roku [Job vacancy market in the light of changes in the economic situation that started in 2007]. Report from the research financed from statutory funds of the KAE SGH no. KAE/S/26/14. Research supervisor: dr M. Gradzewicz.	50%	-	-

8.5	Pater R., Lewandowska A., Stopa M., Janiec M. (2015). Diagnoza innowacyjności woj. podkarpackiego na tle regionów Polski i Unii Europejskiej. Raport 2014 [Diagnosis of innovativeness of the Podkarpackie Region on the background of other regions of Poland and the European Union. Report 2014]. Rzeszów: WSIiZ.	25%		-	-
8.6	Pater R., Lewandowska A., Stopa M., Janiec M. (2014). Diagnoza innowacyjności woj. podkarpackiego na tle regionów Polski i Unii Europejskiej. Raport 2013 [Diagnosis of innovativeness of the Podkarpackie Region on the background of other regions of Poland and the European Union. Report 2013]. WSIiZ, Rzeszów.	25%		-	-
8.7	Pater R., Lewandowska A., Inglot-Brzęk E., Baran L., Janiec M., Przywara B., Rodzinka J., Stopa M. (2013). Ewaluacja klastrów i inicjatyw klastrowych w województwie podkarpackim [Evaluation of clusters and cluster initiatives in the Podkarpackie Region]. Rzeszów: WSIiZ.	12.5%		-	-
8.8	Pater R., Lewandowska A., Stopa M., Janiec M. (2013). Diagnoza innowacyjności wśród przedsiębiorstw, uczelni, B+R, instytucji otoczenia biznesu i JST. Raport 2013 [Diagnosis of innovation among enterprises, universities, R&D entities, business environment institutions and local government units. Report 2013]. Rzeszów: WSIiZ.	25%		-	-
8.9	Pater R., Lewandowska A., Stopa M., Janiec M. (2013). Raport z badań jakościowych IDI dotyczących diagnozy innowacyjności w grupie przedsiębiorstw „Liderów innowacji" [Report from IDI qualitative research on the diagnosis of innovation in the group of enterprises called "Innovation leaders"]. Rzeszów: WSIiZ.	25%		-	-
8.10	Pater R., Lewandowska A., Stopa M., Janiec M. (2013). Diagnoza innowacyjności woj. podkarpackiego na tle regionów Polski i Unii Europejskiej. Raport 2012 [Diagnosis of innovativeness of the Podkarpackie Region on the background of other regions of Poland and the European Union. Report 2012]. Rzeszów: WSIiZ.	25%		-	-

8.11	Pater R., Lewandowska A., Stopa M., Janiec M. (2012). Diagnoza innowacyjności wśród przedsiębiorstw, uczelni, B+R, instytucji otoczenia biznesu i JST. Raport 2012 [Diagnosis of innovation among enterprises, universities, R&D entities, business environment institutions and local government units. Report 2012]. Rzeszów: WSIiZ.	25%		-	-
8.12	Pater R., Lewandowska A., Stopa M., Janiec M. (2012). Raport z badań jakościowych IDI dotyczących diagnozy innowacyjności w grupie przedsiębiorstw „Liderów innowacji" [Report from IDI qualitative research on the diagnosis of innovation in the group of enterprises called "Innovation leaders"]. Rzeszów: WSIiZ.	25%		-	-
8.13	Pater R., Lewandowska A., Stopa M., Janiec M. (2012). Diagnoza innowacyjności woj. podkarpackiego na tle regionów Polski i Unii Europejskiej. Raport 2011 [Diagnosis of innovativeness of the Podkarpackie Region on the background of other regions of Poland and the European Union. Report 2011]. Rzeszów: WSIiZ.	25%		-	-
8.14	Pater R., Lewandowska A., Stopa M., Janiec M. (2011). Diagnoza innowacyjności wśród przedsiębiorstw, uczelni, B+R, instytucji otoczenia biznesu i JST. Raport 2011 [Diagnosis of innovation among enterprises, universities, R&D entities, business environment institutions and local government units. Report 2011]. Rzeszów: WSIiZ.	25%		-	-
8.15	Pater R., Lewandowska A., Stopa M., Janiec M. (2011). Raport z badań jakościowych IDI dotyczących diagnozy innowacyjności w grupie przedsiębiorstw „Liderów innowacji" [Report from IDI qualitative research on the diagnosis of innovation in the group of enterprises called "Innovation leaders"]. Rzeszów: WSIiZ.	25%		-	-
8.16	Lewandowska A., Pater R. (2011). Raport z badań dotyczących diagnozy innowacyjności na podstawie danych statystycznych GUS, Eurostat, Urzędu Patentowego [Report on the diagnosis of innovation based on statistical data from the Central Statistical Office, Eurostat, and Patent Office]. Rzeszów: WSIiZ.	50%		-	-

8.17	Pater R. (2011). Prognozy rozwoju sytuacji na rynku pracy w najbliższych latach [Forecasts of the development of the labour market situation in the coming years]. In: Rynek pracy w Polsce i innych krajach Unii Europejskiej. Wydanie X poszerzone i uaktualnione. T. Pomianek (red.), Rzeszów: WSIiZ., pp. 107-119.	100%		-	-
9.	**ARTICLES POPULARIZING SCIENCE**				
9.1	Pater R. (2018). Competences matter in the labour market. Mentor Kariery Jesień 2018, s. 28-29..	100%		-	-

In the article **[item 3.1]** we used the business cycle analysis methods to analyse the impact of the business cycle on the labour force participation rate. We examined cyclical properties of the labour force participation rates and discouraged worker rates of the working age males and females using a range of methods, including spectral analysis, unobserved component model, and time-varying parameter model. We analysed discouraged/added worker effects in the Polish labour market in time span 1994-2013 by looking at the cyclical properties of the labour force participation rates and discouraged worker rates of the working age males and females. They find that in the business cycle frequencies the added worker effect prevails over the discouraged worker effect for both sexes. During the downturns people enter the labour market, but leave it during the lower unemployment. The added worker effect is significant and varies over time. It is considerably stronger in recessions – people in working age enter the labour market, than in the economic expansions, when workers leave the labour force. We found that in the business cycle frequencies the added worker effect prevailed over the discouraged worker effect for both sexes. The added worker effect was significant and varied over time. It was considerably stronger in recessions – people in working age entered the labour market, than in the economic expansions, when workers left the labour force. In low business cycle frequencies discouraged worker effect prevailed. The latter case was rare, but it proved heterogeneity of labour force behaviour over the business cycle.

In the article **[item 4.1]** I compared the measures of skills that can be used to measure demand for labour. I presented existing research on skills demand in Poland and showed their implications for economic policy. I pointed the classifications of skills and competences that can be particularly well suited to the measurement of demand. Based on a review of terminology and typology of skills and competences, I formulated general conclusions for their analysis from an aggregate point of view: (i) isolating skills from competences and their separate research is less effective than understanding skills in a broad sense, i.e. as competences and analysing transversal and job-related skills; (ii) the set of transversal skills is relatively closed and constant over time, while the set of job-related skills is much broader and should evolve with technological progress, the emergence and disappearance of occupations; (iii) the most comprehensive and detailed classification of skills, including transversal and job-related skills, is provided by the ESCO classification of the European Commission.

In the articles **[items 4.2, 4.5 and 4.6]** we studied the role of other big data from the Internet in financial management. We performed our research on the basis of assessments of the usefulness of various data from the Internet made by 400 financial managers in Poland. My contribution was the modelling and description of results. We found that decision-makers representing these institutions

seldom use social media for job-related purposes. However, the professionals from institutions that manage more diversified asset portfolios and hold the most risky assets in the portfolios, are more likely to use social media for information purposes. We also found that the value of assets does not affect the use of social media for information purposes among financial market professionals in Poland. This implies that representatives of certain types of financial institutions are more inclined to use social media for professional purposes. Our study offers an insight into the variables that best explain the decision to monitor social media content by financial market professionals. Thus, it can provide a basis of recommendations aiming to enhance the market for business information. We also showed that although the information needs of financial market professionals are met to a large degree, still some potential for improvement remains in this regard. We found also that respondent-specific traits are insignificant in explaining the degree of satisfaction with data & information that is used by financial market professionals. Out of firm-specific characteristics, the value of assets under the institution's management turned out to be the key factor explaining the distribution of responses concerning the satisfaction. Finally, we found that majority of surveyed finance professionals believed that social media content could be useful in pursuing additional financial market returns. Interestingly, more experienced financial market professionals, especially analysts, were more inclined to neglect the potential of social media content in that respect.

The purpose of the article **[item 4.3]** was the identification of the determinants of enterprise innovation in the context of the Regional Innovation System for the Podkarpackie Region in the period 2011-2014. I dealt with modelling, analysis of results and formulation of recommendations and conclusions for economic policy. We analysed factors that determine regional innovation in a less developed region, taking the Podkarpackie region in Poland as our empirical counterpart. Our study examined how the EU economic policy instruments influence the innovation of enterprises, within the context of the Regional Innovation System. The paper provided insights on a rather a successful story from Poland. We posited that enterprises use only specific public policy instruments and that companies' demand for innovation-supporting instruments changes, reacting to the business cycle phase and to financial incentives. We have found that enterprises benefited from only a few out of the many instruments proposed by the Regional Innovation System. These instruments included especially – the tailor-made consulting and financial help from local, public and specialized organizations. The more general the instrument, the less attention enterprises paid to it. Thus, we recommended reduction of the budget for general Regional Innovation System activity, while directing the hereby saved funds to specialized more pin-pointed consultations. We have shown that innovativeness and short-run growth are closely and positively correlated. The effects of the Regional Innovation System also changed over time. This means that in the case of poorly developed regions, a diffusion of knowledge has to be carefully monitored to obtain expected results. In the beginning period, companies need consultations, as they do not have practical knowledge on how to create innovations. In the following years, lack of an R&D department is not a problem as it can be substituted by cooperation. The companies' needs should be diagnosed, because they change dynamically according to the business cycle phase and the inflow of funds.

In the article **[item 4.7]** we proposed an indicator of regional development at the NUTS-2 level, which combined labour productivity features and, at the same time, be a measure of qualitative changes such as human capital or social capital. This measure is comprised of the following aspects: technology, infrastructure, human capital and social capital and defined by an array of indicators. Such a measure has significant advantages over most commonly used indicator of GDP per capita.

The statistical data based on which it is built are freely available and with a much shorter time lag than GDP at the regional level. This indicator makes it possible to depict economic factors behind long-run economic growth as well as include less measurable factors such as social change, environmental degradation, etc. On the one hand, the proposed indicator comprises of the symptoms of the quality of life, and on the other hand, it includes factors which are essential for long-run economic growth and productivity. The authors show usefulness of such an indicator for policy formulation, which is rarely pointed in case of other indexes and especially important at a time when long-run economic growth, and also development, in high-developed countries is endangered. The authors also discuss some general aspects in constructing indexes of economic development for regions, e.g., often omitted problem of inclusion of cyclical indicators in the indexes of development. Empirical analysis of the proposed indicator is made for the NTS-2 regions of Poland for the years 2009-2011.

Eastern regions of Poland are traditionally perceived as less developed than the rest of the country. That is why the Eastern Poland is covered by a separate strategy for socio-economic development up to 2020, and an operational program for 2014-2020. In the article [item 4.4] and the report [item 8.3] we have applied previously proposed in [item 4.7] index, to assess the development of the Eastern Poland. We analysed its condition, components and changes that took place during 2000-2014. We focused on the convergence of this region in relation to the average for Poland. The main conclusions from the research are: high heterogeneity of the Eastern Poland, low relative level of competitiveness and development, and progressive divergence of the economic situation in relation to the rest of the country. This macroregion was especially weak in terms of human capital, and especially good in terms of social capital.

Business cycles are very irregular fluctuations in economic activity. In article [item 4.8] I tried to find whether there are some properties of business cycles that can make them look more regular. I analysed the business cycle dynamics, especially employing and adjusting to contemporary business cycle analysis the theories of growth cycles and classical cycles. I analysed the non-homogeneity of business cycles in theory and practice with use of ad hoc filtering, spectral analysis and unobserved components models. Several macroeconomic indicators for 32 economies were analysed to draw additional characteristics of contemporary business cycles. I suggest that fluctuations in economic activity lasting 8-19 quarters should be called 'growth cycles' and the ones lasting 20-40 quarters — 'classical cycles'. The value added of this article is considering the two different type of cycles in the light of the same methods of extraction, while so far, they were thought of as the ones that can be analysed with use of different methods of extraction. Another innovation is comparison of cyclicality of different macroeconomic indicators from the point of view of the two types of cycles, while so far, they were analysed in the light of one business cycle. In the article I showed that dividing business cycles into such defined classical cycles and growth cycles enables to understand the differences between the cyclicality of various macroeconomic aggregates and countries. It also enables to distinguish between smaller downturns and severe recessions.

Oil prices are one of the most important factors determining the state of the global economy. Their short-run fluctuations may be the main factors causing economic crises, as well as significantly hampering the recovery from the crisis caused by other factors. The purpose of the article [item 4.9] was to analyse the macroeconomic mechanism of crude oil price formation in the world, as well as wholesale and retail prices of gasoline and diesel oil in Poland. Fuel price formation was broken

down into the influence of long-run factors, as well as short-run fluctuations. The results showed that long-run changes in the wholesale prices of diesel oil to a slightly greater extent than gasoline prices depend on prices on the world market, but the prices of gasoline slightly more affected by the zloty exchange rate and prices of industrial production in Poland. In the short run gasoline prices were more susceptible to shocks in the global economy, and the policy of determining diesel oil prices was more stable over the considered period. The error correction mechanism worked more strongly in the case of gasoline, both wholesale and retail prices, which means that gasoline prices are returning faster to the long-run path than the prices of diesel oil. Also, diesel oil retail prices in the long run were slightly more determined by wholesale prices than gasoline prices. The opposite situation occurred in the short run. In both cases, changes in excise tax and fuel surcharge had a significant impact on fuel prices, especially in the long-run.

In publications **[items 4.10 and 8.5-8.16]** we examined the innovativeness of the Podkarpackie Region and its changes on the background of Poland and other regions of the European Union. My contribution concerned not only the analysis, description and formulation of conclusions for economic policy, but also the collection, selection and processing of statistical data. We received a picture of the level and changes in the innovativeness of the Podkarpackie Region in 2010-2014 according to official statistics. We have studied innovation from the point of view of its causes, such as education. Next, we examined the innovative activity of the enterprise sector – expenditures, patent applications and cooperation in the field of innovation. The third part of each analysis concerned the results of innovative activity – its financial and material effects in the form of new technologies and products.

Research conducted on the basis of existing statistical data was supplemented every year by own research, performed using the CATI method (computer-assisted telephone interview) **[items 8.8, 8.11, 8.14]** and IDI (in-depth interview) **[items 8.9, 8.12, 8.15]**. The former were performed with a random-quota sample of Podkarpackie enterprises and a targeted sample of other entities (local government units, incubators of innovation, etc.). The latter – qualitative, were made on the basis of interviews with "innovation leaders" – enterprises that were awarded by independent entities for innovative activities. My contribution to the CATI research concerned participation in the development of a research tool and on the analysis of results. In the case of qualitative research, I analysed their results.

In the publication from 2011 **[item 6.1]** we presented a comprehensive, qualitative and quantitative picture of the innovativeness of the Podkarpackie Region. Research conducted in 2011-2015 was summarized with a monograph **[item 5.1]**. My special contribution to the monograph concerned the implementation of the chapter "innovation in the theory of macroeconomics" and participation in the empirical part.

Summarizing research on innovation in the Podkarpackie Region, in 2011-2015 the region has increased its innovativeness, through the openness to innovative enterprises and low labour costswhat prompted innovative enterprises to invest in the region. Increasing investments in innovations by external companies went hand in hand with poor assessments of a region in terms of innovation driving forces. It was expressed above all in insufficient labour resources with education adequate to meet the needs of innovative enterprises. The relatively favourable was, however, the structure of students and the increase in expenditures on research and development in the higher

education sector. In terms of relative innovative activity, the region was at the forefront of the country. This was due to the growing expenditures on research and development and a high percentage of innovative enterprises. This percentage was especially high in industry. The successive improvement in the innovation of service enterprises was also an optimistic factor, although their outlays were still not high. In terms of the results of innovative activities, the voivodship was located in the middle of the Polish regions.

Publication [item 8.7] is a summary of the most dubious initiative related to the Regional Innovation Strategy – a cluster policy. The idea of the policy was to support the emergence of clusters, understood as a spatially concentrated group of enterprises and institutions linked with each other in order to strengthen their competitive advantage. However, the funds for the creation of clusters proved to be used extremely inefficiently, causing a rapid breakdown of links between companies shortly after financing ended. The report confirmed this hypothesis.

In the publication [item 4.11] we examined the effects of the economic crisis of 2007-2009 on the real economy in Poland in comparison to the changes that the EU economy was subject to. The analysis included selected indicators illustrating changes in the market of goods and services and the labour market – GDP with its main components, labour force participation, employment and unemployment. My contribution was an analysis from the point of view of business cycles and long-run changes. The analysis were aimed at distinguishing the cyclical and structural effects of the crisis, including the potential production and natural unemployment, as well as changes in the structure of GDP and labour market. I used ad hoc filters – Christiano-Fitzgerald filter and Hodrick-Prescott filter. This allowed us to analyse the temporary and permanent effects of the crisis. These effects were compared to those of the Polish economy in the period of the previous downturn in 2000-2001, as well as to the situation of other EU countries during 2007-2009. The main conclusion from the analyses is that the echoes of the crisis in 2011 would have a significant impact on the economic situation in Poland. This is the result of delayed changes in consumption and investments and the situation on the labour market. Poland undoubtedly was much better against the EU in terms of the impact of the crisis on long-run growth. The European Union, according to the analyses carried out, reached the level of zero economic growth in the long run, and the increase of its pace may not have happened quickly.

All my Working Papers [item 7.1-7.4] were later published as scientific articles (and described in section 3). Similarly, the report [item 8.4]. Report [item 8.17] was the last in a series of studies prepared to use in practice by students and other interested persons. It contained information on new trends observed in the labour market. It was intended to provide information that could influence sensible educational decisions. In conclusion, each study in which I participated ended with a peer-reviewed scientific publication.

5. Summary of publication achievements

My publications after the defence of my doctoral dissertation includes:

a) 26 published articles (including 20 articles in co-authorship, 6 articles in journals on JCR list, 18 articles in English),
b) 1 peer-reviewed monograph (in co-authorship),
c) 1 chapter in a peer-reviewed book,
d) 4 Working Papers,
e) 24 research reports (7 of which were mentioned in section: Expert activity and activity popularizing science),
f) 1 article popularizing science,
g) 9 expert opinions prepared for public units.

The parametric evaluation of all my scientific achievements after obtaining the doctoral degree is as follows (as at April 23, 2019):

a) Hirsch index according to the Web of Science (without self-citations): 2
   H-index according to Google Scholar (without self-citations): 4
b) number of citations according to the Web of Science (without self-citations): 7
   number of citations according to Google Scholar (without self-citations): 63
c) total impact factor for publications (by release year): 2.307
d) total number of MNiSW points for publications (without correction for co-authorship): 337
e) total number of papers presented at conferences: 13, including in English: 9, including at foreign conferences: 4.

6. Other scientific achievements

Participation in scientific projects (number)

International projects (1)

Title: Data spatial aggregation in labour market matching
Head: dr Ewa Gałecka-Burdziak
Function: main researcher
Co-financing institution: CERGE-IE GLOBAL DEVELOPMENT NETWORK
Starting date: January 2015
Ending date: December 2015
My contribution: modelling and analysis of the matching function for Poland at various levels of temporal and spatial aggregation, using models for panel data and stochastic frontier models; analysis of spatial dependencies.

National projects (14)

Supervision (5)

Title: Horizontal educational mismatch: a new method of measurement with application to Poland
Financing institution: Ministry of Science and Higher Education (DIALOG 0127/2016)
Starting date: June 28, 2017
Ending date: May 27, 2019
My contribution: Development of the method; its application; analysis of results and recommendations for economic and educational policy in the field of: labour demand, skills demand,

educational mismatch, skills mismatch at a detailed level; taking into account competences/skills, qualifications and occupations, according to ESCO, ISCED-F 2013 and ISCO. Application of the method to shape Poland's educational policy. Establishment of international cooperation with with Prof. Carlos Usabiaga Ibáñez from Universidad Pablo de Olavide in Seville and Prof. Fernando Núñez Hernández from the University of Seville.

Title: Acceleration of the development of Eastern Poland. Recommendations based on the experience of selected regions
Financing institution: statutory research of the Faculty of Economics at the University of Information Technology and Management in Rzeszów
Starting date: January 1, 2016
Ending date: December 31, 2017
My contribution: diagnosis of areas of competitiveness and economic development in five NUTS-2 regions, covered by the Program for the Development of the Eastern Poland. Indication of elements of economic policy, the introduction of which will contribute to reducing the development gap between Eastern Poland and other regions of the country.

Title: Investigating the impact of investments in innovation on the competitiveness of enterprises in the SME sector in the Podkarpackie Region
Financing institution: statutory research of the Faculty of Economics at the University of Information Technology and Management in Rzeszów
Starting date: January 2013
Ending date: December 2014
My contribution: determining the effective allocation of funds for investments in innovations in the SME sector in the Podkarpackie Region.

Title: Business cycles in the European Union and in other regions of the world, their dynamics and impact on the structure of economies
Financing institution: statutory research of the Faculty of Economics at the University of Information Technology and Management in Rzeszów
Starting date: September 2012
Ending date: December 2014
My contribution: increasing knowledge about business cycles, identifying new methods of analysing them, improving the possibilities of forecasting business cycles, in particular forecasting their turning points.

Title: Job Offers Barometer – research on labour demand
Head: dr Robert Pater (from February 2012), prof. Maria Drozdowicz-Bieć (from October 2004 do January 2012)
Financing institution: statutory research of the Faculty of Economics at the University of Information Technology and Management in Rzeszów (from October 2004 to November 2009 – Agora SA)
Starting date: October 2004
Ending date: continues
My contribution: analysis of newspapers and online job offers in Poland and its regions; publications media, scientific publications and the use of research in projects related to the labour market.

<u>Participation (9)</u>

Title: Supporting the second stage of implementation of the Integrated Qualifications System at the level of central administration and institutions that give qualifications and ensure the quality of awarding qualifications
Head: dr hab. Piotr Mikiewicz
Financing institution: European Fund: Knowledge Education Development
Starting date: July 1, 2018
Ending date: December 31, 2020
My contribution: Diagnosis of the demand for vocational occupations.

Title: Integrated Skills Strategy
Head: dr hab. Piotr Mikiewicz
Financing institution: Ministry of National Education
Starting date: 2017
Ending date: continues
My contribution: Diagnosis of the demand for skills in the labour market and in the society.

Title: The cyclicality of the labour force participation. The added/discouraged worker effect analysis
Head: dr Ewa Gałecka-Burdziak
Financing institution: Narodowe Centrum Nauki (UMO-2016/21/D/HS4/02808)
Starting date: February 22, 2017
Ending date: May 21, 2019
My contribution: Analysis of the cyclicality of labour supply, taking into account the effects of an added/discouraged workers. Development of a method for separate analysis of the effects at the aggregate level, non-linear modelling and analysis of the effects. Establishment of international cooperation with with Prof. Emilio Congregado and Prof. Antonio Golpe from the University of Huelva (Spain).

Title: Jobs Calculator for Poland: a simple tool for simulating the labour market situation
Head: dr Ewa Gałecka-Burdziak
Financing institution: statutory research of KAE SGH (KAE/S17/25/17)
Starting date: 2017
Ending date: 2018
My contribution: modification of the algorithm to take into account seasonal, cyclical and long-run changes; description of the methodology, empirical application of the algorithm, creation of scenarios for the development of the Polish labour market.

Title: The job vacancy market in the light of changes in the economic situation that started in 2007
Head: dr Michał Gradzewicz
Financing institution: statutory research of KAE SGH (KAE/S/26/14)
Starting date: 2014
Ending date: 2015
My contribution: analysis of different measures of vacancies according their business cycle and long-run properties; analysis of spatial and qualification mismatch during the crisis and the first post-crisis phase in Poland.

Title: Structural transformations in the development process
Head: prof. Jan Winiecki
Financing institution: statutory research of the Faculty of Economics at the University of Information Technology and Management in Rzeszów
Starting date: January 2014
Ending date: December 2015

My contribution: estimates and analysis of the intangible capital in Poland and selected countries, as well as its impact on economic growth.

Title: Assessment of the effectiveness of the use of financial aid from the European Union as an instrument of social and economic cohesion policy and improvement of living conditions
Head: dr Jan Misiąg
Financing institution: National Science Centre
Starting date: 2011
Ending date: 2013
My contribution: creating an economic development index for NUTS-2 regions, aimed at assessing the development of these regions with a different measure than GDP per capita.

Title: Monitoring and evaluation of the Regional Innovation Strategy of the Podkarpackie Region for the years 2005-2013
Head: dr. Anna Lewandowska
Financing institution: Marshal's Office of the Podkarpackie Region
Starting date: November 2009
Ending date: December 2014
My contribution: An evaluation study. Creating methodology and applying it to empirically monitor and evaluate of Regional Innovation Strategy: analysis of statistical data, data from CATI surveys and IDI surveys.

Title: Conditions for the efficiency of the public sector
Head: dr Tomasz Skica
Financing institution: University of Information Technology and Management in Rzeszów
Starting date: January 2009
Ending date: December 2014
My contribution: estimation of the optimal ratio of ownership sectors in terms of employment and fixed assets. Recommendations for implementing measures to improve the public sector efficiency in Poland, by making changes in its structure and organization.

Awards, scholarships and researcher visits

Type: visiting researcher
Date: May 2018
Place: Universidad Pablo de Olavide
Objective: Scientific consultation and cooperation in the project "Horizontal educational mismatch: a new method of measurement with application to Poland".

Type: short internship
Date: October 2017
Place: Universidad de Huelva
Objective: Scientific consultation and cooperation in the project "The cyclicality of the labour force participation. The added/discouraged worker effect analysis ".

Type: training
Date: July 2014
Place: Universitat Pompeu Fabra
Objective: Labour Market Summer School: Labour Marker Outcomes (lecturer: Prof. Robert Shimer), Econometrics Summer School: Bayesian Methods for DSGE Models (lecturer: Kristoffer Nimark).

Type: training
Date: July 2013
Place: Clare College, University of Cambridge
Objective: Cambridge Econometrics Summer School: Time series modelling & analysis (lecturer: Prof. Andrew Harvey), Macroeconomic modelling & forecasting (lecturer: Prof. Sean Holly), Microeconometrics (lecturer: Prof. Melvyn Weeks).

Award of the Rector and Chancellor of UITM for innovative research (2018)

Award of the Rector and Chancellor of UITM for scientific activity (2017)

Award of the Rector and Chancellor of UITM for the entire academic work (2016)

Award of the Rector and Chancellor of UITM for scientific activity (2012)

Most important speeches at international and national conferences (papers prepared only by me, unless otherwise indicated)

Conference title: European Skills, Qualifications and Occupations
Type of conference (national, international): international
Date: April 2-3, 2019.
Place: the European Commission Representation Office in Poland, ul. Jasna 14 / 16A, Warsaw
Organizer: ESCO group, European Commission
The title of the paper: Horizontal educational mismatch: a new method of measurement with application to Poland.

Conference title: Conference on New Techniques and Technologies for official Statistics (NTTS 2019)
Type of conference (national, international): international
Date: March 12-14, 2019.
Place: the Charlemagne building, 170 Rue de la Loi, Brussels, Belgium
Organizer: Eurostat, European Commission
The title of the paper: Extraction of occupation, competences and qualifications from Internet job offers for official statistics (with Maciej Beręsewicz and Łukasz Cywiński).

Conference title: Imperfections of the modern labour market. The scope and manifestations of unpaid work
Type of conference (national, international): international
Date: December 13, 2018
Place: University of Rzeszów, Faculty of Economics, al. Rejtana 16c, 35-959 Rzeszów
Organizer: Department of Macroeconomics and International Economic Relations, University of Rzeszów
The title of the paper: Research on the demand for skills, qualifications and occupations at a detailed level.

Conference title: Economic growth – Labour market – Innovation of the economy
Type of conference (national, international): national
Date: June 28-29, 2018
Place: ul. Rewolucji 1905 r. No. 41, 90-214 Łódź
Organizer: National Bank of Poland, and University of Lodz, Faculty of Economics and Sociology, Department of Microeconomics and Department of Macroeconomics
The title of the paper: Determinants of qualification, occupational and spatial mobility of Poles (with Ewa Gałecka-Burdziak and Łukasz Cywiński).

Conference title: Skill mismatch: measurement issues and consequences for innovative and inclusive societies
Type of conference (national, international): international
Date: June 29-30, 2017
Place: Lungo Dora Siena, 100 / A, 10153 Torino, Italy
Organizer: Department of Economics and Statistics, University of Turin
The title of the paper: Let's help job seekers: A tool for measuring demand for workers' competences with the use of Internet job offers (with Jarosław Szkoła and Marcin Kozak).

Conference title: 9th International Conference on Applied Economics. Contemporary Issues in Economy
Type of conference (national, international): international
Date: June 22-23, 2017.
Place: ul. Gagarina 13A, 87-100 Toruń
Organizer: Department of Economics and Management, Torun University
The title of the paper: Optimal capital and labour in the Polish public sector (with Łukasz Cywiński)
Chairing sessions or participating in an organizational committee: chairing a session: Government regulation and public sector.

Conference title: Imperfections of the modern labour market
Type of conference (national, international): international
Date: May 13, 2016
Place: University of Rzeszów, Faculty of Economics, al. Rejtana 16c, 35-959 Rzeszów
Organizer: Department of Macroeconomics and International Economic Relations, University of Rzeszów
The title of the paper: The efficiency of matching in the Polish labour market at various levels of spatial aggregation.

Conference title: 2015 CIRET Workshop on Economic Cycles and Uncertainty
Type of conference (national, international): international
Date: October 9-10, 2015.
Place: Warsaw School of Economics, al. Niepodległości 128, Warsaw
Organizer: CIRET (Center for International Research on Economic Tendency Surveys)
The title of the paper: Business Cycles and the Structure of the Economy.

Conference title: CERGE-EI 2015 Research Competition
Type of conference (national, international): international
Date: August 15-18, 2015.
Place: Politických vězňů 7, 111 21 Prague 1, Czech Republic
Organizer: CERGE-EI (Center for Economic Research and Graduate Education – Economics Institute)
The title of the paper: Data Spatial Aggregation in Labour Market Matching (with Elżbieta Antczak and Ewa Gałecka-Burdziak).

Conference title: Economic Tendency Surveys and Economic Policy. Measurement beyond GDP – the Use of Surveys
Type of conference (national, international): international
Date: September 5-8, 2012.
Place: Wiedner Hauptstraße 63, 1040 Vienna
Organizer: CIRET (Center for International Research on Economic Tendency Surveys), Austrian Economic Chamber
The title of the paper: The dynamics of business cycles.

Conference title: Determinants of Regional Development in the Context of the Globalization Process
Type of conference (national, international): international
Date: May 17-18, 2012.
Place: Rzeszów
Organizer: Faculty of Economics, University of Rzeszów
The title of the paper: Innovation and its changes in the Podkarpackie Region on the background of the European Union – classification results for 2000-2009.

Co-organization of scientific conferences and workshops

Conference title: Research on the cyclicality of labour participation and structural mismatch in the labour market (with Ewa Gałecka-Burdziak)
Type of conference (national, international): international
Date: March 1, 2019.
Place: Warsaw School of Economics, Al. Niepodległości 128, Warsaw
Organizer: Department of Economics, Warsaw School of Economics, and Department of Economics, UITM in Rzeszów
The title of the paper: The method of continuous and detailed measurement of skills mismatch: theoretical advancements and policy applications.

Conference title: Polish labour market: what do we learn about the unemployment patterns from the administrative individual data (z Ewą Gałecką-Burdziak)
Type of conference (national, international): national
Date: April 8, 2016
Place: Warsaw School of Economics, Al. Niepodległości 128, Warsaw
Organizer: Department of Economics I, Warsaw School of Economics
The title of the paper: Spatial Labour Market Matching (with Elżbieta Antczak and Ewa Gałecka-Burdziak).
Activities for the scientific community

Membership in scientific organizations

Journal: Regional Barometer. Analyses and Forecasts
Publisher: University of Management and Administration, Zamosc, Poland
Editor-in-chief: dr hab. Mieczysław Kowerski
Number of points for publication in the journal (according to Minister NiSW): 14
Function: Theme editor

Organization: European Association of Labor Economists (EALE)
Starting date: September 2014
Function: member

Conducting peer-reviews (number)

Acta Oeconomica (1)

European Planning Studies (1)

International Journal of Occupational Safety and Ergonomics (1)

Journal of Applied Economics (2)

Social Indicators Research (3)

Statutory research of the Collegium of Economic Analysis at the Warsaw School of Economics, Department of Economics I (1)

TH! NK Student Scientific Internet Journal (6)

Monograph entitled: The condition of the global economy: uncertainty and slowdown in economic growth, by Kazimierz W. Tarchalski

Expert activity and activity popularizing science

I regularly cooperate with two research institutions.

Institution name: Institut für Wirtschaftsforschung (Ifo) in Munich
Date: from June 2008 to present
The scope of cooperation: analysis and forecast of the economic situation in Poland using the expert method

Institution name: Bureau for Investments and Economic Cycles (BIEC) in Warsaw
Date: from April 2006 to present
The scope of cooperation: analysis and short-term forecast of the situation in the Polish labour market using leading indicators; analysis of the vacancy market using online job offers.

Since 2004 I have been continuously publishing the Job Offers Barometer in cooperation with BIEC, based on the data collected by me on vacancies from online job offers. Since 2012, I have been the head of this research, developing its methodology and deepening the analysis. At the beginning, they the analyses focused on forecasting the labour market situation. Since 2012, I have been studying the structure of vacancies, with particular emphasis on the educational structure. Reports from the research on are published by main media in Poland. Notes from these reports appear on major Internet portals in Poland, including in: money.pl, bankier.pl, wyborcza.biz, stooq.com, inwestycje.pl, biznes.pap.pl, alebank.pl, macronext.pl, wgospodarce.pl, 4stars.pl, biznessinsider.com.pl.

In 2013, I was regularly interviewed by TVN Biznes on changes in the vacancy market in Poland. In 2014, I cooperated with Forbes magazine, preparing reports on changes in the vacancy market in Poland. I cooperate with the Rzeczpospolita newspaper, giving interviews on the state of the vacancy market in Poland and its impact on the prospects for the development of the labour market.

Since 2011, I have been preparing a monthly report and statistical data from online job offers for the National Bank of Poland.

In 2011, I worked with the Polish Market magazine. I co-wrote (as a group leader) reports on the condition of the Polish economy. Their goal was mainly to obtain synthetic information about the economy by foreign investors.

1) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. July 2011. Polish Market 10 (182), pp. 107-118.
2) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. June 2011. Polish Market 9 (181), pp. 75-86.
3) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. May 2011. Polish Market 7-8 (180), pp. 115-126.
4) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. April 2011. Polish Market 6 (179), pp. 106-118.
5) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. March 2011. Polish Market 5 (178), pp. 99-110.

6) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. February 2011. Polish Market 4 (177), pp. 91-102.
7) Pater R., Cywiński Ł., Soliński T. (2011). Economic Monitor. January 2011. Polish Market 3 (176), pp. 97-110.

I took part in two projects financed from state resources, aimed at practical application – support for enterprises trying to introduce new products and enterprises of spa communes.

Subject: Analysis of success
Head: J&P Moritz Consulting Group
Financing institution: European Social Fund, Operational Program Human Capital
Starting date: November 1, 2014
End date: June 30, 2015
Effects: support of marketing research in terms of introducing a new product to the market for 36 business entities

Subject: Cooperation between the municipalities of Krasnobród, Solec-Zdrój and Rymanów in the field of development of spa and tourist competences
Head: dr. Barbara Przywara
Financing institution: National Cohesion Strategy, Development of Eastern Poland
Starting date: 2013
End date: 2014
Effects: assessment of the investment climate of three spa communes of South-Eastern Poland

I took part in the preparation of expert opinions ordered by public entities at the national, regional and local level.

1) Pater R. (2017). Modelowanie ekonometryczne [Econometric modelling], In: (group work) Wpływ realizacji NSRO 2007-2013 na poziom i jakość zatrudnienia w Polsce. Warszawa: WYG PSDB Sp. z o.o. i Agrotec Polska Sp. z o.o., pp. 71-74.
2) Czyżewska M., Lewandowska A., Pater R., Soliński T. (2011). Założenia do aktualizacji Strategii Rozwoju Województwa Podkarpackiego na lata 2007-2020 [Assumptions for updating the Development Strategy of the Podkarpackie Region for the years 2007-2020]. Urząd Marszałkowski Województwa Podkarpackiego.
3) Pater R., Cywiński Ł., Krypel T., Góra R. (2015). Strategia Zintegrowanych Inwestycji Terytorialnych Miejskiego Obszaru Funkcjonalnego Krosno [Strategy of Integrated Territorial Investments of the Municipal Functional Area in Krosno]. Urząd Gminy i Miasta Krosna.
4) Pater R., Soliński T. (2012). Nakłady inwestycyjne podmiotów gospodarczych w Rzeszowie w latach 2004-2010 [Investment expenditures of business entities in Rzeszów in the years 2004-2010]. Urząd Miasta Rzeszowa.

I also participated in preparation of five development strategies for the Podkarpackie region municipalities.

7. Teaching achievements

After defending my doctoral dissertation, I was involved in teaching:

a) lectures and recitations classes on econometrics and macroeconomics (graduate courses),
b) master's seminars,
c) in the academic years 2017/2018 and 2018/2019 lectures and recitation classes on fundamentals of macroeconomics (undergraduate course in English),
d) lectures and recitation classes on: fundamentals of macroeconomics, econometrics, microeconomics, fundamentals of economics, economics (undergraduate courses),
e) recitation classes on: international economic relations, economics and financing in health care (undergraduate courses),
f) diploma seminars (for bachelor studies).

A summary of the achievements in the promotion of diploma theses (undergraduate studies – first cycle) and master's studies (graduate – second cycle studies), as well as reviews of diploma theses are shown in Table 3.

Table 3 Number of promoted bachelors and masters, as well as diploma thesis reviews

Type of studies	Reviews	Promotion	Sum
First cycle (bachelor)	101	94	195
Second cycle (master)	59	30	89
Sum	160	124	284

I have promoted 30 masters and 94 bachelors. I have completed 59 reviews of master's thesis and 101 reviews of bachelor's thesis.

In 2011-2014, together with Łukasz Cywiński MA, I was the supervisor of the Scientific Circle of Empirical Macroeconomics at UITM. The subject of the Circle's interest was to carry out empirical macroeconomic analyses. Circle members dealt with processing of data from online job offers and the analysis of foreign direct investments.

8. References

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