Regional Specific Idiosyncrasies and Fiscal Policy: Evidence from 47 Regions of the Central and Eastern European Countries

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Abstract:

Purpose: The purpose of our article is to explore and study how shocks of fiscal policy are transmitted across Central and Eastern European (CEE) regions.
Design/Methodology/Approach: We employ Bayesian panel VAR model to estimate and study the dynamic effects of fiscal policy on regional economic activity. Our sample of study includes 47 regions focusing on the CEE countries over the period 2001-2016.
Findings: Having incorporated a possible structural break following the aftermath of the 2007 Crisis, the impulse response functions derived from the estimated models reveal cross-region variations in policy responses in terms of their magnitude and timing. Given the fact that the asymmetric effects of fiscal policy shocks across regions exist, we proceed in examining the sources of regional heterogeneities. We show that liquidity constraints, access to banking sector and participant rate in tertiary education have significant impact on regional fiscal multipliers.
Practical Implications: The results have practical implication for macroeconomic policy - they show regional heterogeneities of fiscal policy effectiveness.
Originality/value: The main value added of our paper is explaining heterogeneity of fiscal policy effects within the theoretical background of Ricardian and non-Ricardian households. Firstly, we are the first to show that regional fiscal multipliers depend on households' access to banking sector. Secondly, the novelty of our paper is that we show that participant rate in tertiary education significantly decreases regional fiscal multipliers.

Keywords: Fiscal Policy, regional economic activity, non-Ricardian households, regional heterogeneity.

JEL classification: E62, R10.

Paper Type: Research study.

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1. Introduction

The issue of whether fiscal policy enhances or retards economic activity has long been debated in the literature. The interest in fiscal policy has been strengthened by governments, policy makers and the academia after the financial turmoil in 2007 and the crisis that followed. The classical question in the research area conventionally posits whether government spending has an impact on real economic activity within the cycle, and if so, how large these effects are. Most of the research in this area, by nature of the topic, has been concentrating on the aggregate level of the economy. Hence, empirically, most studies examine the effects of fiscal policies in one country or across countries by assessing its transmission mechanism at the aggregate level and evaluating its impact mainly on the production, consumption and employment levels, while the measurement of the effect of fiscal policy shocks has been addressed in many studies by structural vector autoregressive (SVAR) models. Some early significant contributions in the literature are among others, by Fatás and Mihov (2001), Blanchard and Perotti (2002), Mountford and Uhlig (2009), while some later studies include Fazzari *et al.* (2015), Caldara and Kamps (2017), Canova, Hamidi, and Sahneh (2018). A review of the main identification methods and an extensive summary of the existing results of most relevant studies has been provided among others by Castelnuovo and Lim (2019) and Ramey (2019).

The above type of empirical analysis predicates a homogeneous and an undifferentiated effect at the national level, ignoring the fact that any national economy is composed by diverse interlinked regions with different economic characteristics and activities (Marelli, 1985). Since, the re-emergence and fast development of regional science has been regaining momentum, especially in the last decade, after the period of "crisis", it is widely accepted that economic policies may have effects on the spatial allocation of economic activities and on their performance. This is attributed to the fact that the various regions of an economic entity differ a) in their economic structure, productive capacities, technologies and localisation factors, b) in the behaviour of their economic agents, and finally c) in the direct implementation of national economic policies, particularly in the case of the decentralised procedures (e.g. regional distribution of public expenditures). Therefore, asymmetries may arise from the transmission of any national policy shocks in specific regions. Shocks of any policy hitting the national economy may have drastic effects in some regions and small effects in others due to the above-mentioned differences. Furthermore, the impulses and the transmission system of uniform policies may have diverse distributional implications for each region.

Unfortunately, the vast above-mentioned literature has so far overlooked regional heterogeneity of the effects of fiscal policy. There is still little attention devoted to the role of fiscal policy in regional cyclical fluctuations, and the empirical evidence that is currently available to shed light of the importance of fiscal policy in determining regional economic activity is sparse.

Against this background and given the existence of dynamic heterogeneities, it is

imperative to explore and study how shocks of fiscal policy are transmitted across regions. Hereafter, our study takes the liberty to explore and study how shocks of fiscal policy are transmitted across the CEE regions by employing a Bayesian Panel VAR model to estimate and study the dynamic effects of fiscal policy on regional economic activity across 47 regions focusing on Central and Eastern European countries (CEE) over the period 2001-2016. Given the fact that the asymmetric effects of fiscal policy shocks across regions exist, we proceed in examining the sources of regional heterogeneities and explaining these asymmetries within the theoretical background of Ricardian and non- Ricardian households.

This paper proceeds as follows: Sections 2 and 3 employ a Bayesian panel VAR model to estimate the effects of fiscal policy shocks on regional output and employment of 47 regions focusing on Central and Eastern European countries (CEE) and present the empirical results by analysing the impulse response functions obtained from the estimated models. The results show that fiscal policy shocks generate asymmetric effects across the 47 regions' economic activity. Section 4 attempts to explain these asymmetries within the theoretical background of Ricardian and non-Ricardian households. Section 5 concludes by providing policy implications and some guidance to policymakers in formulating policy decisions.

2. The Empirical Model: A Bayesian Panel VAR Model

In order to carry out the first part of our analysis, we estimate a panel VAR model developed by Canova and Ciccarelli (2004), which is based on the Bayesian shrinkage estimators and predictors proposed by Garcia Ferrer *et al.* (1987), Zellner and Hong (1989), Zellner *et al.* (1991).

In general, the model specification in the above studies is as follows:

$$y_{it} = A(L)y_{it-1} + \varepsilon_{it} \tag{1}$$

$$\varepsilon_{it} = \alpha_i + \delta_t + u_{it} \tag{2}$$

where y_{it} is $Gx1$ vector; $i = 1, ..., N$; $A(L)$ is a matrix in the lag operator; δ_t is a time effect; α_i is a unit specific effect; u_{it} a disturbance term. According to Canova and Ciccarelli (2004), two main restrictions characterize this specification. First, it assumes common slope coefficients. Second, it does not allow for interdependencies across units. With these restrictions, the interest is typically in estimating the average dynamics in response to shocks (the matrix *A(L)*). Pesaran and Smith (1995), instead, use a univariate dynamic model of the form:

$$y_{it} = \alpha_i + \rho_i y_{it-1} + x'_{it}\beta_i + v'_{it}\delta_i + \varepsilon_{it} \tag{3}$$

where y_{it} is a scalar, x_{it} is a set of *k* exogenous unit specific regressors, v_{it} is a set of *h* exogenous regressors common to all units, while, ρ_i, β_i, and δ_i are unit specific

vectors of coefficients. Canova and Ciccarelli (2004) relax the above two restrictions and study the issues of specification, estimation and forecasting in a macro-panel VAR model, taking into consideration the Bayesian view of VAR analysis. Such an approach has been widely used in the VAR literature since the works of Doan et al. (1984), Litterman (1986), and Sims and Zha (1998) and provides a convenient framework where one can allow for both interdependencies and meaningful time variations in the coefficients. We should note here that the above-mentioned VAR approach allows us to address the endogeneity problem by allowing the endogenous interaction between the variables in the system. Following Canova and Ciccarelli (2004), we adapt the so-called Minnesota prior to a panel VAR framework.

3. Data, regional characteristics and model estimation

3.1 The data

The model is estimated for 47 regions focusing on Central and Eastern European countries (CEE): Bulgaria (BG-6 regions) Czech Republic (CZ-8 regions), Croatia (CR-2 regions), Hungary (HU-7 regions), Poland (PL-16 regions), Romania (RO-8 regions), using core macroeconomic variables.

The sample spans the time period 2001-2016. This span of data includes the financial crisis of 2007; therefore, a dummy variable is employed to capture the event. We retain the following variables in our empirical analysis: general government spending proxying fiscal policy; regional GDP and regional employment proxying regional economic activity. Regional GDP is calculated by deflating annual data on nominal GDP for each region during the period 2001-2016 with the national CPI. The use of national CPI is forced due to the unavailability of the regional price indices. All variables are extracted from the EUROSTAT database and they are all expressed in logarithms. Figure 1 present statistical characteristics of variables used in panel VAR model, for regional and country dimension.

Data presented in Figure1 show that, among analysed countries, for Czech Republic we can observe the highest levels in the presented macroeconomic categories. In the regional dimension it is clearly visible that capital regions dominate in the levels of GDP and employment. We can also observe that regions with the lowest levels of GDP are characterized by the most considerable dynamics of this indicator, i.e. all regions of Romania.

What is also noteworthy, in Romanian regions there is a very low dynamics of employment. In south part of a country, employment decreased over the analysed period. In terms of government spending, we can notice a significant rise in dynamics in all countries throughout the sample. The highest increase can be noticed in Romania, while the lowest is observed in Croatia, Czech Republic and Hungary.

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Figure 1. *Regional and national disparities in Gross Domestic Product, Employment and Government Spending (sample averages)*

A) *Levels:*
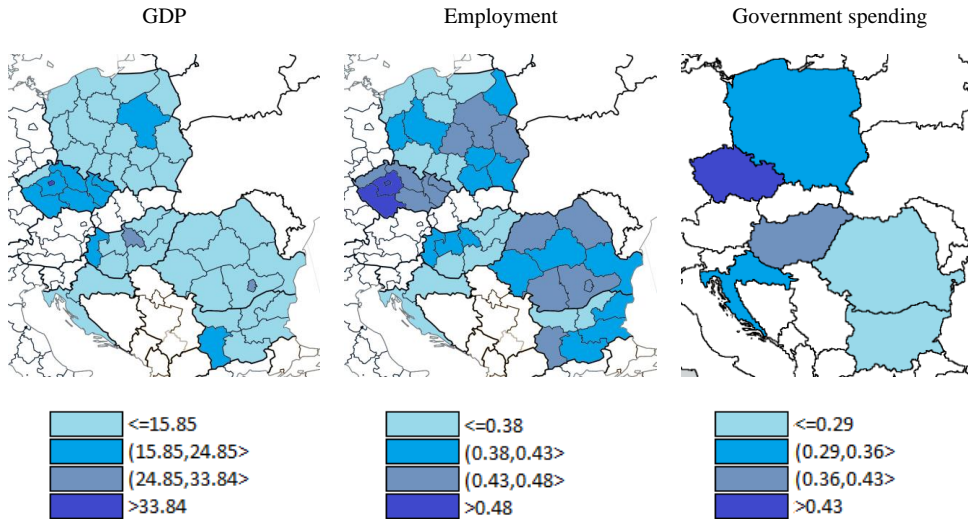
B) *Year to year dynacmics:*
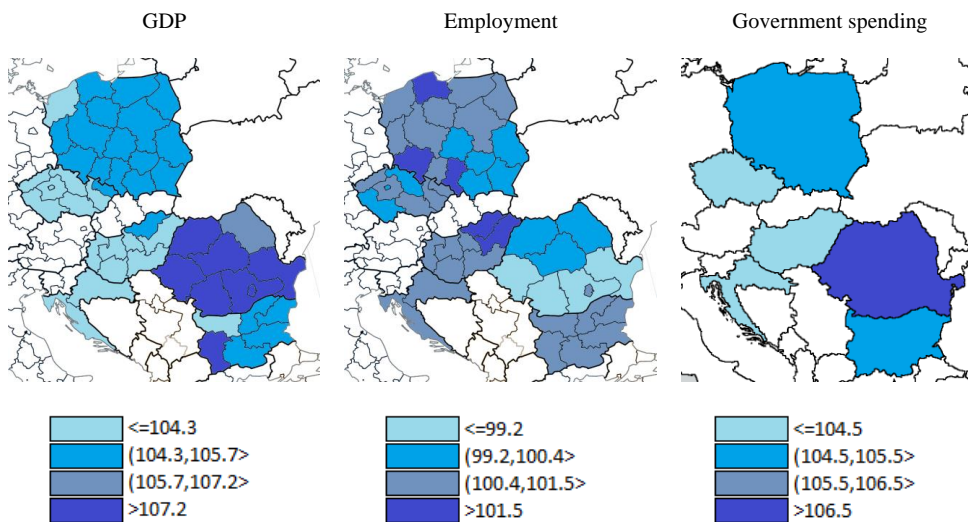
3.2 Model Estimation and Empirical Findings

Based on the influential work of Blanchard and Perotti (2002) in studying the fiscal policy effects, we establish our PVAR model containing three variables: general government spending and two regional economic activity variables namely, regional gross domestic product in constant prices, and regional employment. Hence, the Bayesian panel VAR model expressed as follows:

$$z_{it} = (gexp_t^n, y_{it}^r, empl_{it}^r) \tag{4}$$

where *i=1,2,3,...,N* indexes regions and *t=1,2,3,...,T* indexes time; $gexp_t^n$ is the national government expenditure, $empl_{it}^r$ is the regional employment; y_{it}^r is the real regional GDP. In our three-variable PVAR model, the speed and degree of adjustment of the regional economic activity variables due to a government spending shock is investigated. The estimated model captures the dynamic feedback effects in a relatively unconstrained fashion and is therefore a good approximation of the true data-generating process. Before getting into the analysis of impulse response functions, we have to mention that unit root tests on all variables of our models provide evidence for I(1) processes. Following the fact that all of our VAR models estimated involve variables admitting stationary linear combinations, we estimate the Bayesian panel VAR in levels rather than cointegrated VARs (arguments on this can be found in Sims *et al.,* 1990). The model is estimated in RATS software.

3.3 Impulse Response Functions

Once the model is estimated, we examine how a positive shock to the government spending is transmitted to the regional economic activity, by examining the impulse responses of the 47 regions' GDP. More specifically, impulse responses (IRFs) give the dynamic responses of each variable to an innovation of this variable as well as of the other variables included in the VAR system. In our case, IRFs are used to show the dynamic response of regional GDP to a standard deviation fiscal policy shock. If there are statistically significant differences among IRFs, fiscal policy is generating heterogeneous regional effects.

In Table 1 we present the impulse responses of national and regional output to a positive government spending shock under standard Choleski decompositions (responses to one S.D. innovations). As expected by the theory an expansionary fiscal policy has a significant positive effect on aggregate gross domestic product with a significant lag. The effect on the latter seems to hold a little bit more than the former. Nevertheless, when the analysis proceeds further, we observe that the effects on regional data are not uniform but rather heterogeneous. The heterogeneity can be seen both in the strength of reaction and its persistence.

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Table 2. *IRFs at 12 months, 24 months and 36 months for each region relative to the national ones*

A) Regional IRFs for Bulgaria

	IRFs 12 mon		IRFs 24 mon		IRFs36 mon		IRFs48 mon
BG41	0.45251705	BG	0.33576168	BG	0.105582927	BG	-0.02611523
BG	0.47069482	BG41	0.45378073	BG34	0.397276569	BG34	0.32306398
BG31	0.47699886	BG34	0.47564514	BG41	0.399048846	BG41	0.342949977
BG34	0.48794148	BG31	0.4921377	BG42	0.429409596	BG33	0.364669226
BG42	0.49761837	BG42	0.49430085	BG33	0.437810921	BG42	0.368330076
BG33	0.50279516	BG33	0.50781372	BG31	0.442879219	BG31	0.389284465
BG32	0.50409552	BG32	0.51638443	BG32	0.456898598	BG32	0.392157164

Note: BG31 - Severozapaden, BG32 -   Severen tsentralen, BG33 - Severoiztochen, BG34 -Yugoiztochen, BG41 - Yugozapaden, BG42 - Yuzhen tsentralen

B) Regional IRFs for Croatia

	IRFs 12 mon		IRFs 24 mon		IRFs36 mon		IRFs48 mon
HR03	0.303173	HR03	0.080993	HR03	-0.01437	HR04	-0.07576
HR04	0.304006	HR04	0.081652	HR04	-0.01436	HR03	-0.07463
HR	0.46825142	HR	0.32851616	HR	0.101737096	HR	-0.0269922

Note: HR03 - Jadranska Hrvatska, HR04 - Kontinentalna Hrvatska

C) Regional IRFs for Czech Republic

	IRFs 12 mon		IRFs 24 mon		IRFs36 mon		IRFs48 mon
CZ07	0.00018	CZ07	-0.09501	CZ07	-0.0727	CZ07	-0.04012
CZ03	0.05173	CZ02	-0.04251	CZ04	-0.03581	CZ	-0.02567159
CZ02	0.054873	CZ03	-0.04018	CZ03	-0.03458	CZ04	-0.01952
CZ04	0.05768	CZ04	-0.03918	CZ01	-0.03237	CZ03	-0.019
CZ01	0.058415	CZ01	-0.0379	CZ02	-0.0304	CZ01	-0.01663
CZ08	0.060089	CZ08	-0.03614	CZ08	-0.0278	CZ02	-0.01421
CZ06	0.069955	CZ05	-0.02906	CZ05	-0.02777	CZ05	-0.01413
CZ05	0.082051	CZ06	-0.02871	CZ06	-0.02437	CZ08	-0.01397
CZ	0.4713049	CZ	0.3311	CZ	0.103159692	CZ06	-0.01256

Note: CZ01 - Praha, CZ02 -   Strední Cechy, CZ03 - Jihozápad, CZ04 - Severozápad, CZ05 - Severovýchod, CZ06 - Jihovýchod, CZ07 - Strední Morava, CZ08 - Moravskoslezsko

D) Regional IRFs for Hungary

	IRFs 12 mon		IRFs 24 mon		IRFs36 mon		IRFs48 mon
HU23	0.446733	HU	0.3528228	HU	0.084097222	HU	-0.057586
HU32	0.45206	HU22	0.580127	HU22	0.597575	HU21	0.548127
HU31	0.45727	HU23	0.587739	HU23	0.605208	HU23	0.574421
HU12	0.466667	HU33	0.636992	HU21	0.632824	HU22	0.587146
HU22	0.467167	HU21	0.656312	HU33	0.657363	HU33	0.608254
HU33	0.467341	HU12	0.687979	HU12	0.733706	HU12	0.679231
HU	0.48892107	HU31	0.742803	HU31	0.831704	HU31	0.777296
HU21	0.504763	HU32	0.744859	HU32	0.866279	HU32	0.853778

Note: HU12 - Közép-Magyarország, HU21 - Közép-Dunántúl, HU22 - Nyugat-Dunántúl, HU23 - Dél-Dunántúl, HU31- Észak-Magyarország, HU32 - Észak-Alföld, HU33 - Dél-Alföld.

E)   *Regional IRFs for Poland*

	IRFs 12 mon		IRFs 24 mon		IRFs36 mon		IRFs48 mon
PL92	0.400875	PL92	0.07022	PL92	0.002813	PL	-0.0532518
PL21	0.405508	PL21	0.104994	PL81	0.027055	PL92	-0.02042
PL72	0.405862	PL72	0.108507	PL21	0.027355	PL81	-0.01416
PL81	0.414575	PL81	0.117375	PL72	0.027581	PL21	-0.00475
PL82	0.415751	PL84	0.183147	PL	0.0565157	PL72	-0.00084
PL71	0.416745	PL82	0.187812	PL84	0.126197	PL71	0.090309
PL84	0.417307	PL71	0.190127	PL71	0.127551	PL22	0.093465
PL22	0.426386	PL22	0.196302	PL22	0.134061	PL84	0.094051
PL	0.4793712	PL	0.3077097	PL82	0.159124	PL82	0.132926
PL43	0.767596	PL43	0.696797	PL43	0.463099	PL43	0.269522
PL62	0.77699	PL62	0.752651	PL62	0.569085	PL62	0.396431
PL52	0.794825	PL63	0.833274	PL61	0.68356	PL52	0.520165
PL63	0.796337	PL61	0.834028	PL63	0.688395	PL61	0.529029
PL61	0.817844	PL52	0.837385	PL52	0.689216	PL63	0.530786
PL51	0.8272	PL42	0.897295	PL42	0.716308	PL42	0.537164
PL41	0.828655	PL51	0.901404	PL51	0.758068	PL41	0.589354
PL42	0.893772	PL41	0.906724	PL41	0.763647	PL51	0.590792

Note: PL21 - Malopolskie, PL22 - Slaskie, PL41 - Wielkopolskie, PL42 - Zachodniopomorskie,
PL43 - Lubuskie, PL51 - Dolnoslaskie, PL52 - Opolskie, PL61 - Kujawsko-Pomorskie, PL62 - Warminsko-Mazurskie, PL63 - Pomorskie, PL71 - Lódzkie, PL72 - Swietokrzyskie, PL81 - Lubelskie, PL82 - Podkarpackie, PL84 - Podlaskie, PL92 – Mazowieckie

F)   *Regional IRFs for Romania*

	IRFs 12 mon		IRFs 24 mon		IRFs36 mon		IRFs48 mon
RO41	0.036039	RO41	0.053382	RO41	0.059227	RO	-0.0279928
RO12	0.066232	RO12	0.082246	RO12	0.076242	RO41	0.058334
RO21	0.067468	RO21	0.084853	RO21	0.080095	RO12	0.062465
RO11	0.06887	RO31	0.086813	RO31	0.081742	RO21	0.067242
RO31	0.069102	RO11	0.090129	RO	0.0840972	RO31	0.068345
RO22	0.072552	RO22	0.090725	RO22	0.08454	RO22	0.069448
RO32	0.075561	RO42	0.097446	RO11	0.08838	RO42	0.072016
RO42	0.080033	RO32	0.100605	RO42	0.088923	RO11	0.076935
RO	0.4685254	RO	0.3006136	RO32	0.099959	RO32	0.087752

Note: RO11 - Nord-Vest, RO12 - Centru, RO21 - Nord-Est, RO22 - Sud-Est, RO31 - Sud – Muntenia, RO32 - Bucuresti – Ilfov, RO41 - Sud-Vest Oltenia, RO42 - Vest

The impulse responses indicate that fiscal policy shocks have their maximum impact on Hungarian regional output at the 3rd year six out of seven regions, while the maximum impact occurs in the 2nd year in only one region. In the case of Croatian and Chech Republic regions, the maximum impact occurs in the 1st year in all regions. In the Polish regions, we observe that the maximum impact occurs in the 1st year for 10 out of s16 regions, while for the other six regions the maximum impact occurs in the 2nd year. In the case of the Romanian regions, in seven out eight regions the maximum impact is occurred in the second year, while for the remaining one region the maximum impact of the fiscal policy shock occurs in the 3rd year.

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Furthermore, the magnitude of the responses is very different across regions of the six countries. Generally speaking, an expansionary fiscal policy seems to affect significantly in magnitude Poland, Bulgaria and Hungary, but with a less degree the magnitude the regions of Croatia, Czech Republic and to even a lesser degree the Romanian Regions.

4. Explaining the Asymmetric Effects of Fiscal Policy

4.1 Factors of Regional Heterogeneity of Fiscal Policy Effects

Our general findings from the preceding Bayesian PVAR analysis have shown compelling evidence of differences in regional responses following fiscal policy actions in both the magnitude and timing. The empirical studies for US identify two potential factors of regional heterogeneity of fiscal policy effects: a) level of regional income (Serrato and Wingender, 2014), and b) the economic structure of regions (Ouyang and Zubairy 2013; Hayo and Uhl, 2015). Serrato and Wingender (2014) show for US counties that fiscal multipliers are higher if the level of income per capita is lower. We proceed in investigating this relationship for the CEE regions in a broader context, that is within the theoretical background of Ricardian and non-Ricardian households.

Ricardian households behave according to Ricardian equivalence postulated by Barro (1974). On the contrary, non-Ricardians use rule-of-thumb rules based on current income due to liquidity constraints, myopia, fear of saving or ignorance of opportunities (Stiglitz and Weiss, 1981; Galí *et al.,* 2004; Coenen and Straub, 2005; Andersson, 2010). Galí *et al.* (2007) in their seminal paper show that the higher the share of non-Ricardians the higher the level of fiscal-multipliers.

In our study, we verify the impact of non-Ricardian households' attitude on fiscal multipliers across CEE regions. As indicated by Mankiw (2000), non-Ricardian behaviour is typical for low disposable income households, which do not save and are not able to smooth consumption (see also Coenen and Straub, 2005; Coenen *et al.,* 2012; Albonico *et al.,* 2016). However, we consider broader than disposable income per capita set of variables, which are a proxy of the share of non-Ricardian households. The potential reasons for rule-of thumb non optimizing behaviour of non-Ricardian households is economic constraints, myopia or lack of access to banking sector. Thus, we consider both economic constraints, knowledge, and banking access indicators.

Within the economic factors, showing the importance of economic liquidity constraints, we take into account: a) the net income of households per inhabitant (purchasing power standard), and b) the long-term unemployment rate (from 15 to 74 years). The higher the household's disposable income per capita, the lower the liquidity constraints (Mankiw, 2000), whereas long-term unemployment increases liquidity constraints of households. Within the potential factors decreasing myopia of households, we employ two variables In our analysis: a) the participant rate in

tertiary education (levels 5-6), and b) the rate of individuals who used the internet once a week. Finally, as an indicator of access to internet banking, we use data on the rate of individuals who used internet banking.

Taking into account that on the one hand the liquidity constraints, myopia and lack of access to banking sector increase the role of non-Ricardian households (Stiglitz and Weiss, 1981; Andersson, 2010) and on the other hand, the high share of non-Ricardian households increases the fiscal multiplier (Galí *et al.,* 2004; 2007), we may predict the sign of the above analysed variables on fiscal multipliers. The predicted signs of discussed variables are presented in Table 2.

Table 2. *Expected sign of explanatory variables impact on fiscal multipliers*

| VARIABLE	EXPECTED SIGN
Net Income Of Households Per Inhabitant (Dy)	-
Long-Term Unemployment Rate (Ur)	+
Participant Rate In Tertiary Education (Hc)	-
Rate Of Individuals Who Used The Internet (Inter)	-
Access To Internet Banking (Ibank)	-

Source: *Own study.*

The regional heterogeneity of the analysed set of non-Ricardian behaviour of households is presented in Figure 2. We can notice that, in general, in Czech Republic, Poland, Hungary and capital regions of other countries there are the highest levels of disposable income and education participation rate. During studied period unemployment was the biggest problem in central and western regions of Poland, in Croatia and southern regions of Romania and in Bulgaria. Internet banking access in most popular in Czech Republic, Hungary and in Poland (except for eastern regions in the latter two countries). In Romania and Bulgaria, the percentage of individuals who use internet banking is visibly lower than in other countries.

As mentioned before, another potential source of regional heterogeneity of fiscal effects is the economic structure of the regions. For example, the empirical studies for US states show, that fiscal multipliers are relatively high in more industrial states (Ouyang and Zubairy, 2013). Thus, in our study, we also incorporate the effects of regional heterogeneity of regional economic structure within the CEE countries. We define a sectoral specialization as a share of the particular sector in value-added of the region, and we include the following sectors: agriculture, forestry and fishing, industry (except construction), construction, wholesale and retail trade, transport, accommodation and food service activities, information and communication, financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative and support service activities, public administration, defence, education, human health and social work activities.

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Figure 2. *Heterogeneity of proxies of non-Ricardian behaviour of households*
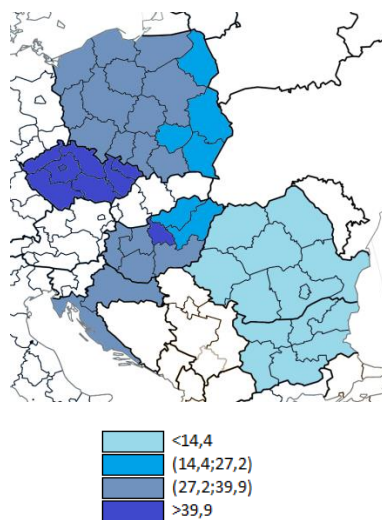
A) *Economic factors showing the importance of economic liquidity constraints*
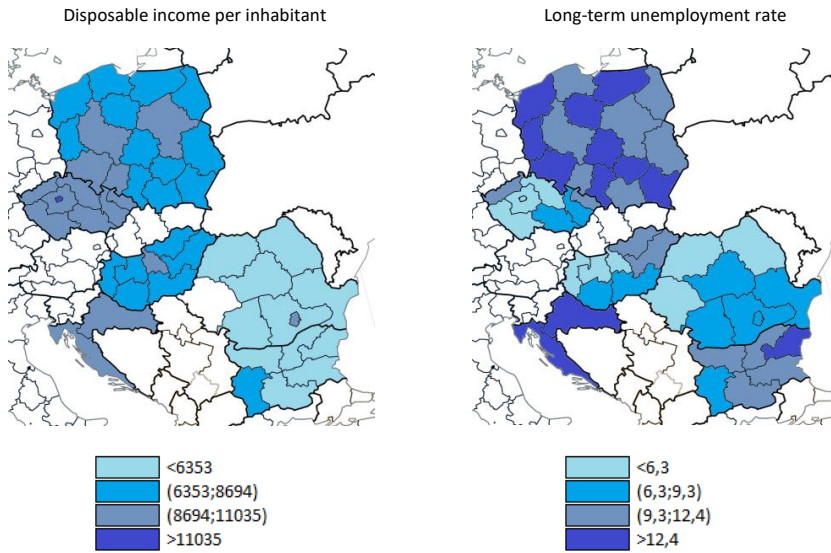
B) *Factors describing myopia of households*
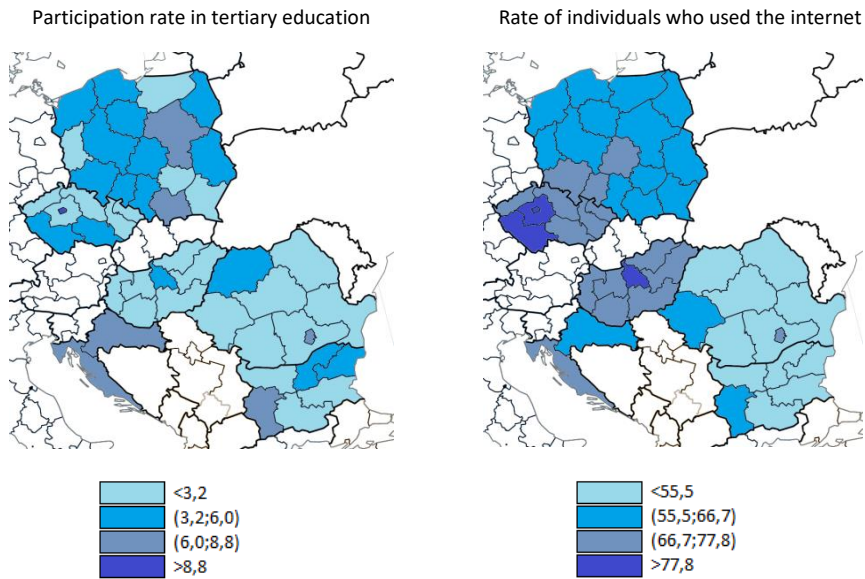
C) *Indicator of banking access - rate of individuals who used Internet banking*

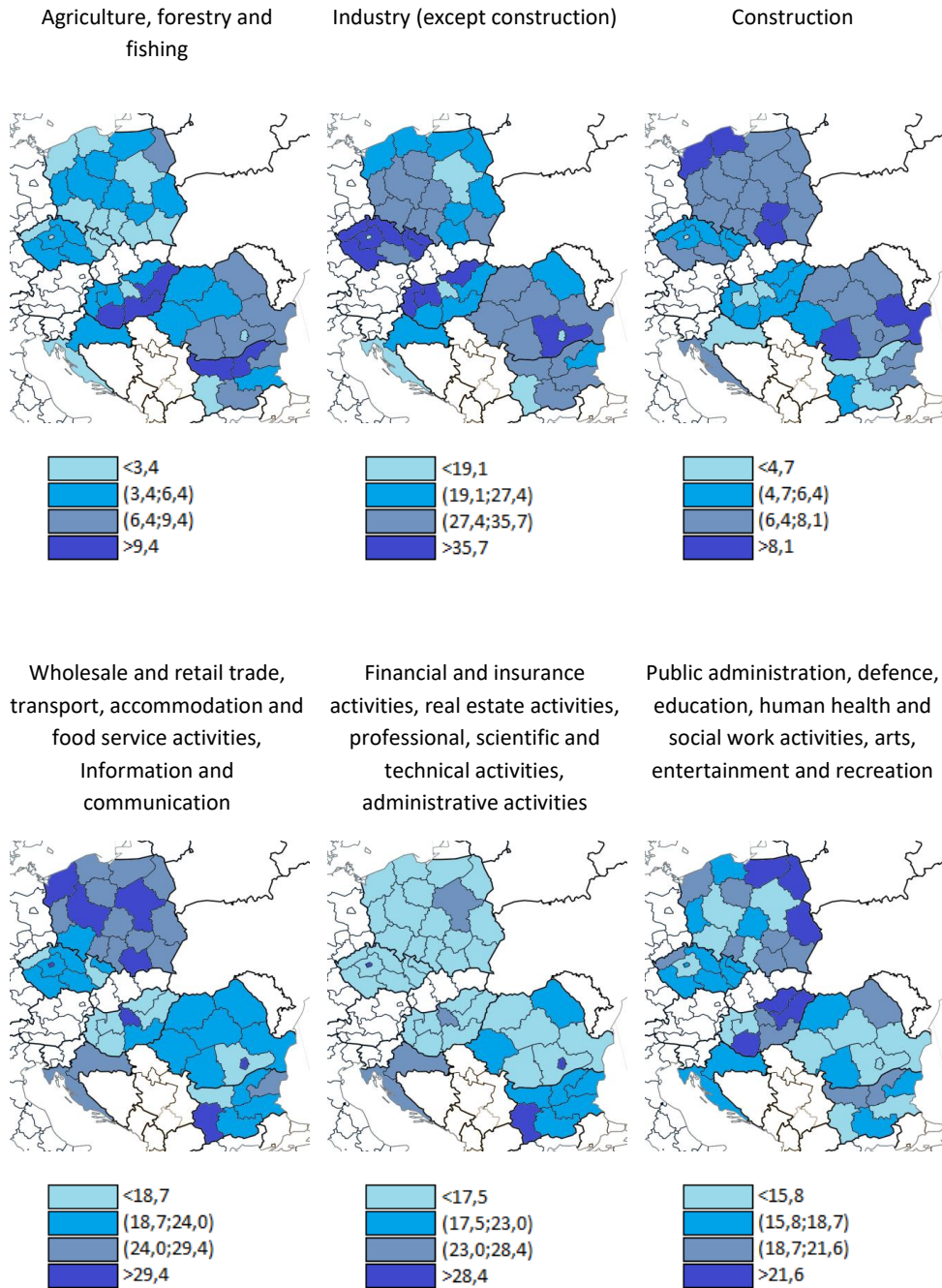|	
	<14,4
	(14,4;27,2)
	(27,2;39,9)
	>39,9

The regional heterogeneity of regional economic structure is presented in Figure 3. The share of financial, technical, administrative and scientific activities in value added is generally concentrated in capital regions. Similar regularity we can notice for wholesale, transport, accommodation and information sector. Agriculture, forestry and fishing is a domain of southern regions of Hungary and Romania as well as northern part of Bulgaria. The share of construction sector in value added is relatively higher in Polish and Romanian regions.

Although empirical evidence for United States suggests that military fiscal multipliers are higher in industrial regions, we do not make any assumptions on the sign of sectors structure impact on fiscal multipliers. The main reasons for that are: a) the role of military spending is much lower in CEE countries than in US; and b) the sign of the impact may depend on the nature of fiscal shocks - public infrastructural projects will presumably influence mostly regions with big share of construction in value added, whereas increase in spending on education staff will affect mostly regions with high share of non-market services.

The objective of the second part of our empirical analysis is to answer the above raised question by investigating whether the absolute value of the asymmetric regional impulse responses to fiscal policy shocks obtained from the Bayesian PVAR estimates, regardless of the sign, can be explained by the above described factors; this leads to the following empirical analysis.

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Figure 3. *Regional heterogeneity of economic structure*

Agriculture, forestry and fishing	Industry (except construction)	Construction

<3,4	<19,1	<4,7
(3,4;6,4)	(19,1;27,4)	(4,7;6,4)
(6,4;9,4)	(27,4;35,7)	(6,4;8,1)
>9,4	>35,7	>8,1

Wholesale and retail trade, transport, accommodation and food service activities, Information and communication	Financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative activities	Public administration, defence, education, human health and social work activities, arts, entertainment and recreation

<18,7	<17,5	<15,8
(18,7;24,0)	(17,5;23,0)	(15,8;18,7)
(24,0;29,4)	(23,0;28,4)	(18,7;21,6)
>29,4	>28,4	>21,6

4.2 Empirical Analysis

In order to explain the regional asymmetric effects of fiscal evidenced in section 3 of our paper and using the specific regional idiosyncrasies of the regions explained in Section above, firstly, we computed the absolute values of the 12-month, 24-month, 26-month and 48-month impulse responses obtained from the estimated Bayesian PVAR model. Secondly, we employed the following non-Ricardian data variables for all 47 regions: Unemployment rate (%) - from 15 to 74 years; Disposable income, of households, net (purchasing power standard based on final consumption per inhabitant); Participation rate in tertiary education (levels 5-8); Individuals who used the internet once a week (percentage of individuals); Individuals who used Internet banking (percentage of individuals).

Finally, we defined the sectoral specialisation as a share of the sector in value-added of the region and go on in analysing employing the following variables: agriculture, forestry and fishing, industry (except construction), construction, wholesale and retail trade, transport, accommodation and food service activities, information and communication, financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative and support service activities, public administration, defence, education, human health and social work activities.

The above data came from the sources of EUROSTAT for the year 2016 and all the variables are in constant prices. From the above data, we computed the following main variables that were used in our analysis.

Our model is empirically specified as follows:

$$AIRF(no.mon)_i = \alpha + \beta_1 ur_i + \beta_2 dy_i + \beta_3 hc_i + \beta_4 inter_i + \beta_5 ibank_i + \beta_6 aff_i + \beta_7 indus_i + \beta_8 constr_i + \beta_9 wrta_i + + \beta_{10} fs_i + \beta_{11} pubadm_i + \varepsilon_i \qquad (5)$$

where *i=1,23,...N* indexes the number of regions; $AIRF(no.mon)_i$ are the absolute values of the impulse responses at 12-month, 24-month 36-month period and 48-month period obtained from the estimated Bayesian PVARs; ur_i is the unemployment rate (%) - from 15 to 74 years; dy_i is the disposable income, of households, net (purchasing power standard based on final consumption per inhabitant); hc_i is a proxy of human capital measured as the participation rate in tertiary education; $inter_i$ is the individuals who used the internet once a week (percentage of individuals); $ibank_i$ is the individuals who used Internet banking.

Furthermore, by defining the sectoral specialisation as a share of the sector in value-added of the region we employed the following variables: aff_i: - agriculture, forestry and fishing, $indus_i$ - industry (except construction), $constr_i$ - construction, $wrta_i$ - wholesale and retail trade, transport, accommodation and food service activities, information and communication, fs_i - financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative

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and support service activities, $pubadm_i$ - public administration, defence, education, human health and social work activities. ε_i refers to the disturbance term. The above model is estimated for the 47 observation, using the standard OLS method. All regressions were checked for heteroskedasticity using the Breusch-Pagan Test, and where evidence of heteroskedasticity found, the models were re-estimated using robust standard errors. The results are presented in Table 3.

Table 3. *Using the regional specific idiosyncrasies to explain the asymmetric effects of fiscal policy shocks in the 47 CEE regions*

A) Full model

Variables	AIRF (12 month)		AIRF (24 month)		AIRF (36 month)		AIRF (48 month)	
	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat
constant	-83.115	-0.22	-450.1056	-0.79	-428.3904	-0.82	-359.6938	-0.80
gdp	1.18E-05	1.12	2.85E-05	1.75*	2.84E-05	1.86*	1.90E-05	1.50
ur	0.070538	5.64**	0.078985	3.94**	0.066189	3.57**	0.051971	3.35**
dy	-0.00015	-2.54**	-0.000251	-2.90**	-0.000241	-3.02**	-0.000196	-2.86**
hc	-0.038255	-2.15**	-0.067226	-2.44**	-0.063015	-2.41**	-0.04759	-2.03**
inter	0.029818	3.47**	0.053093	4.93**	0.054056	5.60**	0.0474	5.49**
ibank	1.68E-03	0.51	-0.002511	-0.45	-4.87E-03	-0.88	-0.00504	-0.99
aff	0.847572	0.23	4.514882	0.79	4.293869	0.82	3.605547	0.81
indus	0.815385	0.22	4.477323	0.78	4.260389	0.82	3.576116	0.80
constr	0.812731	0.22	4.492621	0.79	4.274064	0.82	3.585244	0.80
wrta	0.846494	0.23	4.499352	0.79	4.275963	0.82	3.585976	0.80
fs	0.815822	0.22	4.484042	0.79	4.266874	0.82	3.585346	0.80
pubadmin	0.788631	0.21	4.44531	0.78	4.237178	0.81	3.559518	0.80
R-squared	69.03%		58.33%		59.26%		60.05%	
Adjusted R-squared	58.10%		43.63%		44.88%		46.62%	

Note: ****, **, and * significant at 1%, 5%, and 10% significance level respectively.*

B) Final model

Variables	AIRF (12 month)		AIRF (24 month)		AIRF (36 month)		AIRF (48 month)	
	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat
C	-1.686277	-5.84**	-2.045281	-6.67**	-2.007261	-6.49**	-1.728329	-5.82**
UR	1.18E-05	8.14**	5.57E-02	5.01**	4.52E-02	4.33**	3.62E-02	4.21**
DY	0.071654	-2.89**	-0.00012	-2.86**	-0.000129	-3.26**	-0.000121	-3.45**
HC	-0.000142	-2.10**	-0.043785	-1.87*	-0.038094	-1.74**	-0.022434	-1.33
INTER	-0.038965	4.59**	0.045452	7.64**	0.048849	7.69**	0.044832	6.91**
IBANK	0.030951	-1.24	-0.011554	-3.06**	-0.012745	-3.48**	-0.011919	-3.45**
WRTA	0.032343	2.79**	0.012054	1.10	0.007023	0.68	0.001871	0.22
R-squared	63.09%		48.81%		50.32%		52.73%	
Adjusted R-squared	57.56%		41.14%		42.87%		45.64%	

Note: ****, **, and * significant at 1%, 5%, and 10% significance level respectively.*
Source: *Own study.*

The estimation results indicate that economic factors, reflecting the importance of economic liquidity constraints, have significant impact on fiscal multiplier. According to the theoretical background concerning non-Ricardian behaviour of households (Galí *et al.,* 2007) we can observe that that economic liquidity constraints strengthen the effects of government spending: on the one hand, economic factor decreasing economic liquidity constraint - that is disposable income of households per inhabitant - increases fiscal multiplier; on the other hand, economic factor increasing economic liquidity constraint - that is long term unemployment rate - decreases fiscal multiplier.

Another potential factor influencing non-Ricardian behaviour of households, and consequently fiscal multiplier, is myopia of households. However, our estimations indicate that among two analysed indicators only impact of tertiary education is consistent with the theoretical model. That is, our estimations show that higher participant rate in tertiary education increases fiscal multiplier. Within the theoretical background the explanation is as follows - the higher participant rate in tertiary education decreases myopia, what leads to Ricardian behaviour of households and consequently decreases government spending impact on economy. However, our estimations also show that, contrary to tertiary education, access to internet is not a factor decreasing myopia of households. The explanation of the positive sign of the relationship between access to internet and fiscal multiplier is interesting field for further research.

In case of the last of analysed factors of non-Ricardian behaviour, which is access to banking sector, we got that better access to internet banking decreases fiscal multiplier. The reason is that the access to banking sector is a factor enabling households to make decisions based on intertemporary budget constraint rather than current income. This in turn, according to model of Galí *et al.* (2007), increases impact of government spending on GDP.

As mentioned before, the empirical study of Ouyang and Zubairy (2013) for US states shows that potential source of regional heterogeneity of fiscal effects is also the economic structure of the regions. Nevertheless, our estimations show that for CEE countries in most cases there is no relationship between share of the particular sector in value-added of the region and regional fiscal multiplier. Economic structure is statistically important factor influencing the effects of fiscal policy only in case of "wholesale and retail trade, transport, accommodation and food service activities, information and communication".

However, the explanation of the positive impact of this sector on regional fiscal multipliers is unclear, because of very heterogeneous character of the sector. One of potential explanations of observed phenomena is that public transport, which is a part of above-mentioned sector, significantly depends on government spending. The verification of this hypothesis is field for further research and require deeper decomposition of sectors.

5. Conclusions

Our paper takes the liberty to explore and study how shocks of fiscal policy are transmitted across Central and Eastern European (CEE) regions by employing a Bayesian panel VAR model.

The Bayesian panel VAR model employed includes regional real variables such as regional GDP and employment in order to identify the responses to fiscal policy. The results show that the fiscal policy shocks do generate asymmetric effects across regional economic activity. Generally speaking, an expansionary fiscal policy shock in government expenditures at the national level seems to affect significantly in magnitude and time across the CEE regions. More specifically and as expected by the theory an expansionary fiscal policy has a significant positive effect on aggregate gross domestic product and employment with a significant lag. Furthermore, when the analysis proceeds further, we observe that the effects on regional data are not uniform but rather heterogeneous. The heterogeneity can be seen both in the strength of reaction and its persistence.

The dynamic general equilibrium models predict that fiscal multipliers depend on the share of non-Ricardian households, which in turn may be determined by economic liquidity constraints, lack of access to banking sector and myopia. Our empirical results based on regional data confirm that all this factors significantly influence fiscal multipliers.

Firstly, we show that economic liquidity constraints increase impact of fiscal policy on economic activity. On the one hand our empirical results indicate that disposable income of households per inhabitant - that is economic factor decreasing economic liquidity constraint - strengthen the effects of government spending. On the other hand, we show that long term unemployment rate - that is economic factor increasing economic liquidity constraint - weaken the effects of government spending.

Secondly, our empirical results confirm that fiscal multipliers also depend on households' access to banking sector. We show that better access to internet banking, which is a proxy of access to whole banking sector enabling decisions based on intertemporary budget constraint, decreases the effects of fiscal policy within the business cycle.

Thirdly, we show that one of two analysed measures of lack of myopia - that is participant rate in tertiary education – significantly decreases fiscal multipliers. However, it should be noticed that, surprisingly, we didn't observe similar results in case of another measure of lack of myopia - access to internet.

Among potential sources of regional heterogeneity of fiscal multipliers we analysed not only the heterogeneity of non-Ricardian behaviour of households but also the economic structure of the regions. Nevertheless, our estimations show that for CEE

countries in most cases there is no relationship between share of the particular sector in value-added of the region and regional fiscal multiplier. Economic structure is statistically important factor influencing the effects of fiscal policy only in case of "wholesale and retail trade, transport, accommodation and food service activities, information and communication". However, contrary to analysis within the theoretical background of Ricardian and non-Ricardian households, this positive impact has no clear economic interpretation.

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