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*IJ* **BESAR**

The logo features the letters 'IJ' in a large, elegant, gold-colored script font. To the right of 'IJ', the word 'BESAR' is written in a smaller, gold-colored, all-caps serif font. A decorative, flowing gold-colored flourish extends from the bottom of the 'R' in 'BESAR' across the page.

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## Government Size and Quality of Governance: Does State Size Matter?

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ARTICLE INFO	ABSTRACT
<p>Article History</p> <p>Received 1 August 2020; Accepted 11 January 2021</p> <hr/> <p><i>JEL Classifications</i> H11, H50, H83</p>	<p><b>Purpose:</b> Small state studies has emerged as a discipline, and this discipline has been initially dominated mainly by the issues of vulnerability and a lack of capacities of small states, although these issues have been gradually replaced by the discussions on the potential opportunities of small states, not just their challenges. Within this framework, the consideration needs to be done also on the effect of the state size on the economics, governance and public management, among others.</p> <p><b>Design/methodology/approach:</b> The current theorizing in small state studies focuses on the specifics of the small economy modelling and governance. The existing economic literature has occasionally stressed the relations between the size of the state and size of government, but with rather mixed empirical results. Moreover, relations between state size and quality of governance has also been emerging issue. This study would like to integrate both approaches. The empirical research utilizes cross-national comparative investigation based on the data for 44 European states; and we specifically assess, in addition to the existing approaches, how budgetary and non-budgetary scope of government differentiates among smaller and larger states.</p> <p><b>Findings:</b> The results of the study suggest that the effect of the size of the state does not necessary favour larger states in respect to the smaller size of government and quality of governance. Thus, although potential scale economies matter regarding the public services' provision, the structure of spending, institutional context, and innovations in public service delivery modes also have the role in shaping scope and functions of the government, whereas quality of governance seems to be independent regarding the state size, at least in the European context.</p> <p><b>Research limitations/implications:</b> Analysis is limited to the cluster of European states, and the results should be interpreted within this context.</p> <p><b>Originality/value:</b> After the World War II the number of states has increased substantially, in fact, it has tripled. We are currently living in the era of small states, as more than one third of the existing two hundred and more states around the globe are actually small, if we assess the multiple criteria combination. In this context, this paper would like to add to the development of the field of small state studies.</p>

**Keywords:**

Small states; Governance;  
Governmental  
interventionism; Public  
goods and services;  
Innovations; Great  
Lockdown

### 1. Introduction

Numerous categorizations or classifications of states (i.e., "independent" countries, as labels can simply be utilized interchangeably) exist in the literature; i.e., strong versus weak states, high-income versus low-income states, sustainable versus fragile states, developed versus developing states, small versus large states, etc. These classifications depend on the criteria being used for categorization, and often ranks in between exists between the extremes. Small versus large states classification uses the size of the country as the main criterion, although this criterion can have several inputs, e.g. number of population, surface, GDP etc., which can be applied also simultaneously. In practice, the number of population usually serves as the main input for classification of states into various size-based categories: micro, small, medium-sized, and large states. Specifically, if the number of population is taken as the main criterion for categorizing states according to the size, the World Bank stipulates that 1.5 million

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residents is officially threshold for small states, but this threshold is heavily challenged by some due to the population and globalization shifts, where 10 million threshold is taken as more appropriate (see, e.g., Maass, 2009).

When addressing the topics related to small state studies, we should bear in mind that state size, which is being micro, small, medium or large state, is actually and endogenous variable as states are formed and are able to survive given the appropriate economic, political and social conditions. The elaboration on the state size as the endogenous variable has been promoted by Alesina (2003), since the evidence indicates that the size of the countries is very diverse, that their numbers varied very much throughout the history and also the meaning, functioning and role of the state varies. In this context, what we can observe that after the World War II, in particular, the number of states has increased substantially. In fact, this number has tripled. It can be argued that we are currently living in the era of small states, as more than one third of the existing 215 states around the globe are actually small (see, e.g., Brito, 2015), if we assess the multiple criteria combination. It might be argued, that we are experiencing the area of small states.

Consequently, small state studies has emerged as a discipline, and this discipline has been initially dominated mainly by the issues of vulnerability and a lack of capacities of small states, although these issues have been gradually replaced by the discussions on the potential opportunities of small states, not just their challenges (see, e.g., Thorhallson, 2019). The current theorizing thus focuses also on the specifics of the small economy modelling that has been viable due to the globalization trends (see, e.g., Skilling, 2018; Farrell, 2020), as globalization processes increase transmission of economic disturbances and pose further exposure of states with larger share of fixed budgetary expenditures (Bukowski and Bukowska, 2017). In this context, these trends have been further reinforced with the onset of the COVID-19 induced pandemic, which is alternatively labelled the Great Lockdown crisis.

Within this framework, the consideration needs to be done also on the effect of the state size on the economics, governance and public management, among others. The current theorizing in small state studies focuses on the specifics of the small economy modelling and governance, whereas the existing economic literature has occasionally stressed the relations among the size of the state and size of government, and relations among size of the state and quality of governance. This study would like to integrate both approaches, and put additional evidence to assess the issue of specifics both in the form of governmental interventionism as well as in the dimensions of governance, when we observe states with different size. This paper proposal intends to address the question if there is any difference regarding the size and scope of government between smaller and larger states, and if this difference can be observed potentially in the quality of governance.

## **2. Theoretical Framework**

The economics of the state size thus treats it basically as the trade-off between the benefits of the size versus the costs of heterogeneity of population preferences (Alesina et al., 2005). Namely, the clear benefits of the larger state size are related to larger available domestic market size and thus implicitly less reliance on foreign trade, more diverse industry structure, larger availability of human potential, both in numbers as well as in their diverse capabilities. Moreover, per capita costs of several public goods and services are lower, either because more taxpayers can pay for them, or they have important scale economies or simply because the indivisibility is not implicitly increasing them. Notwithstanding, the aforementioned benefits are mostly economic in their nature, but there are also political and social benefits to the size, like increased military security, larger bargaining power in comparison to other states, larger international role of the state, larger possibility for internal redistribution etc. Since the focus of the paper stands on economic issues, only those are addressed. In contrast, larger states might experience also some costs that come from the heterogeneity of population, which means that different preferences should be followed, which increases the costs, like distributional ones, and also the ties that are connecting the people might be looser, which generates difficulties in creating uniform and sustainable policies. Consequently, there is a trade off, and like in any organization, you might have also in the context of the state size the diseconomies of scale, arising mostly through administrative and congestion costs. We might argue that there is some ground also for the theory on the optimal size of state. Nonetheless, we will focus only on the economics of small states.

Economic literature has stressed the relations among the size of the country and governmental interventionism. For example, Alesina and Wacziarg (1998) argue that the size of government correlates negatively with country size and positively with trade openness. They have shown that smaller states have a larger share of government consumption in GDP, and are also more open to trade. Moreover, they argue that these empirical observations are consistent with recent theoretical models explaining country formation and break up. Namely, larger states can afford to be closed, while small states face stronger incentives to remain open; conversely, as trade liberalizes, regional and cultural minorities can afford to split because political borders do not identify the size of market. Similarly, Rodrik (1998) has found a strong positive association between openness and government size. He explains this paradox by arguing that government expenditures are used to provide social insurance against the risk of terms of trade shocks that open economies face. This indicates that government consumption and expenditures play a risk-reducing role in economies exposed to a significant amount of external risk. Goldsmith (1999) has justified the observation on the activist government in small states as being a buffer to vulnerability. Following, this should effect the optimal size of welfare state, which is bound to be larger the higher are the risks that it cannot insure, which are referenced as the so-called background risks (Eichner and Wagener, 2002). Some recent studies have tried to put additional evidence on the relations among state size and government size. For instance, Jetter and Parmeter (2015) have pointed out that economies that are more open not necessarily have bigger governments, but country size may be related to

government size, as smaller states should have bigger government, although they admit that using different datasets, timeframes, and sample countries changes conclusions.

In addition, the existing literature has also investigated the relationships between state size and the quality of governance (i.e., the rule of law, regulatory involvement of government in economy and society, investor friendliness, etc.). These are indicators that point to the other part of governmental interventionism, which is not observed in governmental finances, but it is also very important. Since it is often hidden, i.e. not directly and explicitly observed, we can label this as the non-budgetary government, although this can be of particular relevance for the regulation. The other indicators tend to correspond more suitably to the quality of governance, although the distinction is not straightforward as regulation might also be part of quality of governance and not measure of government size per se (Kaufmann et al., 2007), or they might be also measures of governmental effectiveness (TheGlobalEconomy, 2020).

For instance, Streeten (1993) has stated that collective action problems can be solved more easily in smaller states, and supervision is much easier to be performed. Rodrik (2000) has stressed that quality of institutions is much more important in smaller states, as they function as the tool for conflict management, and this is more important for smaller states to balance the impacts of shocks. Pryor (2001) has hypothesized that state size and laissez-faire are negatively correlated, in some way reflecting a desire by the citizenry in larger states for greater protection against possible excesses of larger (and more influential) enterprises; thus smaller states should be less regulated. Moreover, Olsson and Hansson (2011) have pointed out the negative relationship between the size of the country and the rule of law, as the institutional quality has a character of local public good.

This theoretical insight suggest that relationship between state size and size of government is a rather complex issue, and empirical investigations are warranted. If we would follow assumptions stated above, smaller states should have larger budgetary government and smaller non-budgetary government, on average at least, in comparison to larger states. Given the context, this study would like add to the existing research by providing some additional data-based evidence on the relations among state size, government size and quality of governance. Specifically, the paper follows the logic of observational study, as we do not either make involvements into observed units nor do we control for the effects of secondary variables (National Research Council, 2012).

### 3. Methodology and Data

The cross-national comparative investigation based on the data for 44 European countries is utilized to assess the relationships among state size and government size. Specifically, we introduce the notion of budgetary and non-budgetary scope of government, and how these two clusters differentiate among smaller and larger states. Under budgetary government, we assume and assess the various types of governmental spending categories (consumption spending, transfer spending, total spending) and tax burden, all these measured in relative terms as a share of gross domestic product (GDP). These spending categories are perceived as standard measures of direct governmental interventionism. Under non-budgetary government, we assume and assess the so-called not directly observable and foremost not directly measurable governmental activities, which come into the forms of regulation, investment freedom, judicial effectiveness, legal system and property rights, and government integrity. Although there is a tendency to describe this part of not directly measurable governmental interventionism only as regulation, as pointed in the previous chapter, we decided to investigate also additional indicators that are associated, according to the World Bank, with the dimensions and quality of governance, as we assume there might be some relations also among those indicators and state size.

This study is based on the exploratory research, i.e. we are investigating the issue that is not clearly defined and we thus want to give a better understanding of this issue and potential directions for additional future research endeavours (Babbie, 2007). Our sample of 44 European countries is split into several clusters, the first cluster containing countries, which have less than 1.5 million residents, which is corresponds to the strictest, World Bank induced, definition of small state. This cluster includes states like Iceland, Malta, Luxembourg, Montenegro, Cyprus, and Estonia. The second cluster contains countries with the population between 1.5 and 4 million residents, and this includes states like Slovenia, North Macedonia, Latvia, Armenia, Albania, and Lithuania. The third cluster includes countries that have less than 7.5 million residents. This cluster includes Ireland, Moldova, Croatia, Bosnia and Herzegovina, Norway, Georgia, Finland, Slovakia, Denmark, and Israel. The fourth cluster includes states that have population in the range 7.5 to 10 million residents, which corresponds to one of the most recent demarcations on the threshold for small state definition Bulgaria, Switzerland, Austria, Sweden, Serbia, and Hungary. The fifth cluster of states includes the medium-sized one with the population between 10 and 25 million, which contains states like Czechia, Belarus, Belgium, Portugal, Greece, Netherlands, and Romania. The last, sixth, cluster includes both medium-sized and large European states that have population larger than 25 million. This cluster includes states like Poland, Spain, Ukraine, Italy, United Kingdom, France, Turkey, Germany, and Russia. It needs to be acknowledged that the states are clustered only according to the criteria of state size, and clusters are not symmetrical, since within the Europe mainly small states prevail, and this needs to be taken into account when doing clustering. More specifically, for the purpose of empirical analysis we consider states belonging to cluster 1-4 as smaller states, and states belonging to clusters 5 and 6 as larger states. Thus, the empirical part follows the binary logic that prevails in the literature, but for the descriptive part, also the clusters' averages are added, in order to get an additional insight into the issue. Namely, we follow the logic of exploratory interpretative research, thus taking this analysis as a medium to get potential additional insight into the researched topic.

#### 4. Results and Discussion

Table 1 presents the outputs on the groupings of states into size clusters as described in the methodology part. Although the states analysed are all very diverse, it is evident that the size variable obviously does not play a role in influencing the size of the so-called “budgetary” government, which is not in line with theoretical predictions, in particular for the governmental consumption spending. Namely, the evidence portrayed in the table indicates that there are no major variations regarding the relative amount of governmental spending between different clusters of states, if we categorize them according to their size.

**Table 1: Evidence on the extent of budgetary part of government for selected European states**

State/ Indicator	Gov't con- sumption expen- diture % of GDP	Gov't transfer expen- diture % of GDP	Gov't Expen- diture % of GDP	Tax Burden % of GDP	State/ Indicator	Gov't con- sumption expenditure % of GDP	Gov't transfer expen- diture % of GDP	Gov't expen- diture % of GDP	Tax Burden % of GDP
Iceland	32.02	7.99	43.2	36.4	Bulgaria	20.46	15.74	34.7	28.0
Malta	25.97	13.19	38.3	33.6	Switzerland	18.24	14.07	34.3	27.8
Luxembourg	35.56	22.99	42.2	37.1	Austria	27.27	25.82	50.2	42.7
Montenegro	20.35	18.70	47.4	36.1	Sweden	37.14	20.17	49.4	44.1
Cyprus	17.83	14.32	38.7	33.6	Serbia	18.09	23.66	42.8	38.4
Estonia	28.19	14.95	40.4	34.7	Hungary	28.88	17.78	47.7	39.4
Average – c1	26.65	15.36	41.70	35.25	Average – c4	25.01	19.54	43.18	36.73
Slovenia	25.99	18.90	45.4	37.0	Czechia	29.03	24.89	40.0	34.0
N. Macedonia	19.40	20.49	31.6	24.8	Belarus	22.71	20.83	44.2	23.8
Latvia	22.68	11.44	37.8	30.2	Belgium	31.53	29.82	53.2	44.2
Armenia	15.30	8.76	26.4	21.3	Portugal	21.57	19.88	46.3	34.4
Albania	12.01	9.64	29.5	24.9	Greece	22.45	23.05	50.6	38.6
Lithuania	21.07	13.84	34.1	30.2	Netherlands	35.86	24.30	43.6	38.8
Average – c2	19.41	13.84	34.13	28.07	Romania	18.55	11.42	32.1	26.0
Ireland	27.30	11.46	27.4	23.0	Average – c5	25.96	22.03	44.29	34.25
Moldova	17.99	13.26	36.9	31.5	Poland	23.38	16.61	41.3	33.6
Croatia	24.91	21.43	47.1	37.9	Spain	24.64	20.46	42.3	33.5
Bosnia- Herzegovina	21.02	17.56	42.4	37.0	Ukraine	23.09	19.33	42.1	33.1
Norway	34.81	19.02	49.9	38.0	Italy	23.56	24.52	49.5	42.9
Georgia	22.14	11.94	29.6	25.8	United Kingdom	22.28	17.21	41.6	33.2
Finland	30.28	25.29	55.6	44.1	France	29.93	28.32	56.6	45.3
Slovakia	26.23	19.55	42.4	32.7	Turkey	19.87	13.77	34.1	25.5
Denmark	34.88	20.57	53.4	45.9	Germany	26.88	25.95	43.9	37.6
Israel	28.86	12.49	39.8	31.2	Russia	25.99	18.01	35.4	22.2
Average – c3	26.84	17.26	42.45	34.72	Average – c6	24.40	20.47	42.98	34.09

Sources: IEF, 2019; EFW, 2019; own calculations.

In addition, if the statistical analysis is performed, i.e., two-sample t-test assuming unequal variances, it is evident that we cannot deliver a proposition that larger European states (more than 10 million residents) have smaller budgetary government than smaller European states (less than 10 million residents). Threshold of 10 million residents to distinguish smaller and larger states is taken in order to increase the compared sample sizes for the statistical considerations. The observed difference between the sample means for three budgetary categories, i.e. governmental consumption spending, governmental total spending, and tax burden is not convincing enough to say that the average share of the stated categories between smaller and larger states differs significantly (see Table 2).

In fact, the vice versa even holds for the governmental transfer expenditures, which tend to be on average even lower in smaller states, the fact that can be partially attributed that the data are from the period when the majority of European countries experienced economic boom, which tends to, according to prepositions, benefit relatively more to more open economies. Since economic openness is also related to the size of state with negative relationship, this tends to suggest that during the economic boom, smaller states are better off, and they consequently have fewer social problems on average, but this problem explodes during the economic downturn.

**Table 2: Testing the sample means of budgetary categories for smaller and larger states**

	Consumption spending		Transfer spending		Total spending		Tax burden	
	Smaller states, N=28	Larger states, N=16						
Mean	24.81679	25.0825	16.60786	21.14813	40.66429	43.55	33.83571	34.16875
Variance	42.89792	20.85579	24.66271	25.94204	62.08683	44.57333	43.5172	49.94629
t Stat	-0.1578		-2.87026		-1.29012		-0.15401	
P(T<=t) one-tail	0.437706		0.003663		0.102618		0.439315	
t Critical one-tail	1.683851		1.695519		1.688298		1.697261	
P(T<=t) two-tail	0.875411		0.007326		0.205236		0.87863	
t Critical two-tail	2.021075		2.039513		2.028094		2.042272	

Source: own calculations based on the data from Table 1.

Table 3 represents the so-called non-budgetary government and quality of governance indicators, represented by five indicators, ranging from the extent of regulation to the perception of governmental integrity. Here the higher number indicates the better outcome, i.e. less regulation, more investment freedom, larger judicial effectiveness, better functioning legal system and property rights, as well as larger governmental integrity. We further acknowledge that the indicators like investment freedom, judicial effectiveness, functioning of the legal system and government integrity level also directly correspond to the indicators of the quality of governance, whereas regulation relates more to indicating one of the dimensions of the size and scope of government, as pointed out earlier.

**Table 3: Non-budgetary government and quality of governance indicators for selected European states**

State/ Indicator	Regulation	Inv. Freedom	Judicial Effect.	Legal system and property rights	Gov't Integrity	State/ Indicator	Regulation	Inv. Freedom	Judicial Effect.	Legal system and property rights	Gov't Integrity
Iceland	8.01	85	63.8	8.40	83.8	Bulgaria	7.61	70	41.9	4.83	35.1
Malta	8.17	85	50.4	6.65	50.3	Switzerland	8.48	85	82.0	8.50	88.0
Luxembourg	7.87	95	72.4	8.35	85.8	Austria	7.37	90	71.3	7.92	77.4
Montenegro	6.94	75	51.8	4.92	39.5	Sweden	8.23	85	84.0	7.82	88.0
Cyprus	7.55	75	48.1	5.94	43.7	Serbia	7.15	70	44.8	4.95	37.2
Estonia	8.20	90	76.0	7.44	73.1	Hungary	7.63	80	45.2	5.92	35.3
Average – c1	7.79	84.17	60.42	6.95	62.70	Average – c4	7.75	80.00	61.53	6.65	60.17
Slovenia	6.85	70	46.5	6.22	53.6	Czechia	8.09	80	47.6	6.30	52.1
N. Macedonia	8.20	65	60.7	5.07	44.7	Belarus	6.38	30	51.7	5.53	37.7
Latvia	7.66	85	48.4	6.20	35.5	Belgium	8.10	85	61.6	7.07	72.5
Armenia	7.38	75	46.3	5.81	38.6	Portugal	7.18	70	64.3	6.98	59.5
Albania	6.91	70	30.6	5.07	40.4	Greece	6.43	55	49.5	5.78	37.7
Lithuania	8.04	80	61.2	6.50	47.8	Netherlands	8.27	90	74.7	8.16	89.1
Average – c2	7.50	74.17	48.95	5.81	43.43	Romania	7.78	70	51.9	6.04	39.8

Ireland	8.47	90	68.4	7.72	78.0	Average – c5	7.46	68.57	57.33	6.55	55.49
Moldova	6.91	55	29.6	4.34	25.4	Poland	7.59	80	44.0	5.56	49.8
Croatia	7.29	75	42.9	5.48	38.6	Spain	7.43	85	51.4	6.80	51.9
Bosnia-Herzegovina	7.41	65	37.9	4.13	30.2	Ukraine	6.86	35	31.5	4.52	29.6
Norway	7.73	75	81.2	8.68	92.3	Italy	7.49	85	49.8	5.71	43.7
Georgia	8.49	80	54.6	6.31	58.5	United Kingdom	8.23	90	85.9	7.85	83.8
Finland	7.72	85	81.2	8.80	92.5	France	7.46	75	66.1	6.92	67.9
Slovakia	7.58	75	37.2	5.59	37.7	Turkey	6.63	70	49.8	4.78	41.2
Denmark	8.32	90	77.8	8.08	85.8	Germany	7.99	80	75.4	7.44	81.3
Israel	7.41	75	73.4	6.16	67.9	Russia	6.53	30	45.1	4.96	36.6
Average – c3	7.73	76.50	58.42	6.53	60.69	Average – c6	7.36	70.00	55.44	6.06	53.98

Sources: IEF, 2019; EFW, 2018; own calculations.

Following, statistical analysis below presents the outcome of group tests, where 10 million residents is taken as a threshold to distinguish smaller and larger European states. This is performed in order to increase the compared sample sizes for the statistical considerations. We can observe that there is actually major difference only in relation to the extent of regulation and investment freedom, where smaller states are less regulated and more investor friendly in comparison to larger states, but only if we liberally assume 10% statistical significance margin (see Table 4). Interestingly, there is no statistically significant difference in relation to the other indicators for the quality of governance, thus, the state size is not one of the factors that would affect those outcomes, at least not in the European context. Still, it needs to be acknowledged that smaller states tend to have, on average, larger judicial effectiveness, better legal system, and government integrity is larger, as indicated by the results in the table below, but the differences between smaller and larger states are not statistically significant.

**Table 4: Testing the sample means of non-budgetary categories for smaller and larger states**

	Regulation		Investment Freedom		Judicial Effectiveness		Legal System		Integrity	
	Smaller states, N=28	Larger states, N=16	Smaller states, N=28	Larger states, N=16	Smaller states, N=28	Larger states, N=16	Smaller states, N=28	Larger states, N=16	Smaller states, N=28	Larger states, N=16
Mean	7.6993	7.4025	78.393	69.375	57.486	56.269	6.4928	6.275	57.311	54.637
Variance	0.2557	0.4416	87.136	429.58	281.64	195.36	2.0407	1.196	506.02	356.75
t Stat	1.5485		1.647		0.2579		0.5670		0.4207	
P(T<=t) one-tail	0.0670		0.0579		0.3990		0.2870		0.3382	
t Critical one-tail	1.7081		1.7291		1.6883		1.6859		1.6883	
P(T<=t) two-tail	0.1341		0.1159		0.7980		0.5741		0.6764	
t Critical two-tail	2.0595		2.0930		2.0281		2.0244		2.0281	

Sources: own calculations based on the data from Table 3.

The results of the study suggest that the effect of the size of the state does not necessary favor larger states in respect to the smaller size of government due to the potential scale economies. Namely, the structure of spending, institutional context, and innovations in public service delivery modes do matter, among others. Namely, what the existing literature has recognized that the concept of administrative capacity itself is changing particularly so for small states. Here, regulation is often based on governance structures that are widely dispersed, and they are located outside the traditional boundaries of the administration. In these states, governance is transformed into a type of meta-governance that consists of the enrolment, legitimization and monitoring of the various governance and regulatory resources. In this context, since size of small states creates limits and international dependency grows; small states are seeking to oversize international presence by being innovative and open, and more importantly, by being economically unique, both in terms of domestic markets and societies, as well as in terms of exports. Thus, innovative approach of small states is that they replace the economies of scale with highly specialized economies of scope that can be scaled up to global markets (Kattel et al., 2011).

Moreover, small states are overcoming the handicaps of their size, and the prime importance in that effort has been in finding ways how to reduce the costs and increase the effectiveness of public goods and services. This has been done through the use of international cooperation to reduce the per-unit costs of physical infrastructure, and through the use of outsourcing of government functions as a means of reducing the costs and improving the quality of some public goods and services (Favaro, 2008). Namely, small states have been experiencing, other things being equal, high per unit costs of production, especially in activities where fixed costs are significant, which led to the high share of government consumption in GDP, and this has been an indicator of the high cost of production of public goods and services (Rodrik, 1998). This problem was addressed by the outsourcing of public service provision, through cooperation with other countries, through the outsourcing of government functions to regional organizations, or through the outsourcing via international treaties (e.g., defence). Still, the most common form of outsourcing has been creating regional bodies to handle certain functions that would otherwise be carried out by individual states (see, e.g., Favaro, 2008).

In the context of the presented research, what are the implications that are to be delivered from the current COVID-19 related crisis? The current coronavirus (COVID-19) pandemic has caused one of the largest global health crises, and caused the situation of the Great Lockdown, term describing the current crisis, as coined by the IMF. In the context of small state studies, it is to be argued that they are the ones that should be hard hit. Namely, current lockdown has caused also the enormous reduction in the foreign direct investments in the range up to 40 percent (UNIDO, 2020), and in the reduction in global exports, where particularly EU is under attack (UNCTAD, 2020). Namely, small states tend to be relatively much more open and integrated in to the global trade, thus the economic consequences of lockdown and associated return of (economic) nationalism are particularly evident for them. The data provided by the World Economic Outlook (2020) project a very harsh fall of GDP for some smaller European states in particular (e.g., Iceland, Latvia, Estonia, Lithuania, Slovenia, Croatia, San Marino etc.), in particular if we compare those projections to other larger countries. This should be evident also in the rising social security and transfer spending, in order to provide the necessary safety net for the residents.

## 5. Conclusion

The results of the study suggest that the effect of the size of the state does not necessary favour larger states in respect to the smaller size of government. But, we might argue, according to the results obtained, that smaller states tend to be less regulated and investment freedom is larger there, on average, in comparison to larger states, and this is also supported by statistical significance. Thus, although potential scale economies matter regarding the public services' provision, the structure of spending, institutional context, and innovations in public service delivery modes also have the role in shaping size and scope of the government. Moreover, also the prevailing economic environment is important, as economic booms obviously benefit smaller states also from social aspects, if we assume that transfer spending of government is highly volatile for those states. Since the research is exploratory, the intention was to give additional evidence on the issue under consideration, and additional insight into the topic is highly warranted, in particular as the sampling was based on data for selected European states. Thus, extending of sampling or redirection of its focus might reveal a new insight into the topic, in particular if the randomization is involved.

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## The Impact of CEFTA on Exports, Economic Growth and Development

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ARTICLE INFO	ABSTRACT
<p>Article History</p> <p>Received 28 September 2020; Accepted 6 November 2020</p> <p><i>JEL Classifications</i> F15, F50, F63</p> <p><b>Keywords:</b> International Economic Relation, Regional Trade Agreements, Free Trade Agreements, CEFTA</p>	<p><b>Purpose:</b> The aim of the paper is to evaluate the impact of CEFTA on exports and economic growth and development of its members. Regionalism is attractive to states and especially to developing countries, since they enhance their reliability on reforms to foreign investors and they raise their bargaining power in multilateral level, since they negotiate as a unit and not individually, especially within the WTO, achieving goals which would not had been achieved if they had acted individually. The paper is based on the theoretical context of Regional Trade Agreements. More specifically, Free Trade Agreements widens trade in goods and services, raises exports and increases distribution of production. Moreover, FTAs affect state's reliability for inward investments, since they guarantee the implementation of domestic reforms. In particular, compared to WTO, within an FTA less countries are involved therefore, it is easier for them to monitor a state and if this state deviates from its commitments then it will face direct retaliation from other regional partners. Consequently, its members are considered more reliable and they experience a boost in economic growth and volume of trade.</p> <p><b>Design/methodology/approach:</b> Methodologically it is based on analyzing quantitative macroeconomic data and qualitative data that have been quantified through a comparative analysis among members states. More specifically, the analytical framework consists of additional variables concerning economic and political freedom as well as trade volume, growth, development and income, since that all are correlated with trade liberalization.</p> <p><b>Findings:</b> In the case of CEFTA, intra-regional trade seems to be neglected since all CEFTA members prefer trading with the EU. This does not mean that CEFTA's economies could be more competitive than the EU, however, there are is no increase in intra-regional trade volume and when there is, this concerns only few of the partners. In addition, indexes show that economic environment remains protected and state centric. The fact that an FTA such as CEFTA seems that does not have any impact on GDP growth but at the same time GDP per capita and HDI are increasing, might show that there are other variables which affect these indexes. another paradox is that these positive developments happen in highly corrupted, state-centric and protectionist members of a Free Trade Agreement.</p> <p><b>Research limitations/implications:</b> FDI were not examined due to lack of data.</p> <p><b>Originality/value:</b> Up to now, there are contradictory arguments in the literature regarding the effects of CEFTA on its members. More particularly, there are scholars who argue that CEFTA'S impact on exports and economic growth and development of its members is positive while others claim that this impact is either very limited or no existent at all. The current research aims to assess CEFTA's impact on growth and development taking into consideration the domestic economic and political environment. In addition, it extends recent work assessing CEFTA's effectiveness on member-states focusing on trade, economic growth and development by taking into consideration additional macroeconomic variables as well as the domestic capabilities of each member.</p>

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## 1. Introduction

The aim of the study is to assess the impact of CEFTA on exports and economic growth and development of its members, extending the recent work taking into consideration the domestic economic and political environment. In 1947 advanced economies agreed in trade liberalization and tariff reduction, establishing the General Agreement on Trade and Tariffs, which was then turned into what we know today as the World Trade Organization. However, trade liberalization promoted both in global and regional lever. Great trading powers established Regional Trade Agreements (RTAs) in order to increase prosperity and create new markets for their products.

It is based on the theory of Regionalism, which creates the necessary conditions for deeper integration, bigger open markets and raises the flows of foreign direct investments. In particular, FTA's can increase foreign direct investments because of their impact on the cost of production. That is to say that maybe is more attractive for a company to take advantage of the labour cost within the regional market than before (Ravenhill, 2017). New Regionalism, on the other hand, results from competition for new markets. Due to trade diversion, many exporters push their government into joining an agreement (Baccini and Dür, 2012), therefore trade creation and trade diversion are important determinants in the formation of a FTA (Baier and Bergstrand, 2004).

Methodologically it is based on analyzing quantitative macroeconomic data and qualitative data that have been quantified through a comparative analysis among members states. More specifically, the analytical framework consists of additional variables concerning economic and political freedom as well as trade volume, growth, development and income, since that all are correlated with trade liberalization.

## 2. Review of Literature

### 2.1 Theoretical Review

The discourse on Regional Trade Agreements and Free Trade Agreements (FTA) in particular, is focused on the formation of FTAs as well as on their impact and implication on member's economies and trade liberalization. According to the theoretical aspects of regionalism, Regional Trade Agreements (RTA) are formed either for political or economic reasons (Ravenhill, 2017; Cooper and Massell, 1965; Cai, 2010; Gilpin 1981; Mastanduno, 1998; Higgot, 2004; Kelton 2008; Capling, 2008; Wesley, 2008; Hadjiyiannis et. al 2016). Baldwin's (1993, 1997) approach revealed that the domino effect caused by the major economic powers, such as the US, the EU and Canada is the main reason for the spread of regionalism while this was also a way to decrease discrimination effects caused by other FTAs (Baldwin and Jaimovich, 2012).

### 2.2 Previous studies

The impact of regional trade agreements on economic growth has been examined by scholars and most of them find insignificant effects (Hur and Park, 2012; Brada and Méndez, 1988; Vamvakidis, 1999; Jalles, 2012; Tumwebaze and Ijjo, 2015), while others found an increase in productivity and growth (Badinger and Breuss, 2011; Alcala and Ciccone, 2004; Karras, 2003; Liu, 2016). Regarding trade's openness, there are positive effects on growth (Dollar, 1992; Frankel and Romer, 1999; Dollar and Kraay, 2004; Freund and Bolaky, 2008; Atif et al. 2010; Kar et. al, 2008) while others argue that free trade's effects on growth are either insignificant or negative (Rodriguez and Rodrik, 2000; Wacziarg and Welch, 2008; Ramanayake and Lee, 2015). Nevertheless, there are more determinants which have been examined by scholars in order to assess to what extent regionalism, and FTA's in particular, can have a positive or negative impact on other economic components.

Regardless of the causes of FTA's formation, there are contradictory approaches about their impact on trade, especially when it comes to trade creation and trade diversion, which depends on the type of the agreement, meaning that deeper types of integration and the reduction of tariffs against non-member countries can lead to trade creation (Mattoo et al. 2017; Balassa, 1974; Richardson, 1993). More specifically, FTAs have substantial trade creation effects (Clausing, 2001; Krueger, 1999; Yang and Martinez-Zarzoso, 2014) however, sometimes cause intraregional trade diversion, especially in imports (Dai et al. 2014;)

However, trade creation can be fragile due to omitted variables that have not been taken into consideration (Ghosh and Yamarik, 2004; Baier and Bergstrand, 2007), especially when agricultural products are concerned, where tariffs remain in high levels and trade diversion is more likely (Sun and Reed, 2010; Ingco, 1995; Gibson et al. 2003; Sarker and Jayasinghe, 2007). In addition, trade diversion within a FTA is not noticeable due to growth of emerging market exports (Romalis, 2007) or due to foreign direct investments (Fukao et al. 2003).

Moreover, FTAs also increase bilateral and intra-regional trade volume (Anderson and Yotov, 2016; Baier and Bergstrand, 2007; Carrere, 2006) however, during the "New Regionalism" intra-trade volume was not significantly increased (Soloaga and Wintersb, 2001). In addition, regarding trade liberalization on poverty and income inequality, there are mixed results depending on country and region. More specifically, it is rather unclear whether gains from trade can alleviate poverty or income distribution since there are more variables that should be taken into account, such as trade policies or reforms (Borraz et al. 2012; Schejtman et al. 2009; Winters et al. 2004; Winters and Martuscelli, 2014) however, in some cases it is found that there is a positive effect between trade liberalization and income as well as reduction of income inequality (Ben-David, 1993; Cherkaoui et al. 2011; Porto, 2010; Nicita, 2009; Ariyasajakorn, 2009).

Mixed results occur as far as the impact of RTAs on foreign direct investments is concerned, depending on members and non-members as well as developed or developing economies. The correlation between FDI within a FTA is rather negative or unclear, since not all members within a RTA benefit the same (Jaumotte, 2004). More specifically, although FTA aim to promote economic activity either they decrease bilateral FDI or do not have significant impact on them (Jang, 2011; Reed et al. 2016; Kanazawa and Kang, 2019).

However, other scholars have noticed that in some cases, especially when there are liberal admission rules, regional integration is positively related to attracting FDI since there is a positive relationship between FDI and exports deriving from trade agreements, making creation effect more likely than diversion effect (Yeyati et al. 2003; Duong et al. 2019; Thangavelu and Narjoko, 2014; Li et al. 2016; Berger et al. 2013; Baltagi et al. 2008).

Summarizing, the existed literature, examines the impact of regionalism on member and non-member countries focusing more on economic growth, trade diversion and trade creation as well as FDI. Nevertheless, although there are mixed results, variables such as the economic freedom, developmental indexes with more macroeconomic indicators worth to be examined, since they may have an impact on FTA's effectiveness on economic growth and development of member-states creating a milestone which can lead to a greater integration and economic cooperation among regional partners.

In addition, more attention has been given to FTAs concerning great trade powers, such as NAFTA, MERCOSUR, or ASEAN, while little has been said for the Central European Free Trade Agreement (CEFTA) for which there are also mixed results. More precisely, CEFTA, as a sub-regional integration programme, has benefited its member-states by expanding bilateral trade, especially exports, and their governments responded positively regarding trade liberalization policies, due to the EU pre-accession process (Dangerfield, 2004; Gjonbalaj et al. 2011; Petreski, 2013, 2018; Čejvanović et al. 2014). However, according to other arguments, trade liberalization did not develop, due to political tensions among its members and if it wasn't for the pre-accession process of the EU, CEFTA's role would be eliminated (Begović, 2011; Milošević and Hrnjaz, 2018; Dangerfield, 2001).

The current research aims to assess CEFTA's impact on growth and development taking into consideration the domestic economic and political environment. In addition, it extends recent work assessing CEFTA's effectiveness on member-states focusing on trade, economic growth and development by taking into consideration additional macroeconomic variables as well as the domestic capabilities of each member.

### **3. Methodology**

Regarding the methodology, in order to achieve the aim of the paper I will apply a quantitative method in a systematic comparison among member states of CEFTA. In the existed studies, most of the scholars focus on trade volume, trade liberalization and growth. This study also includes variables some of which have been examined in other RTA's but not in CEFTA, enriching the analytical framework for assessing CEFTA's impact on its members. More specifically, CEFTA's effect on income, development, foreign direct investments as well as economic growth should not be neglected.

#### **3.1 Measurement of Study Variables**

##### **3.1.1 Dependent Variable**

CEFTA's impact on exports, economic growth and development.

##### **3.1.2 Independent Variables**

The domestic political and economic environment is also taken into account due to correlation with trade liberalization policies for the following reasons. First, domestic political and economic environment and institutions are associated with trade negotiations, especially when it has to do with integration process (Milner and Rosendorff, 1996; Lohmann and O'halloran, 1994; Goldstein and Martin, 2000; Solís, 2010; da Conceição-Heldt, 2011; Langhelle, 2013; Langbein 2016; McKibben and Taylor, 2020; Madeira, 2016).

In particular, it is proved that trade liberalization is highly correlated with democracy and good governance since elections and democratization are negatively correlated with protectionism in trade agreements and reduces the government's likelihood to use trade barriers as a strategy and political freedom is correlated with economic freedom (Milner and Rosendorff, 1997; Milner and Kubota, 2005; Frye and Mansfield, 2004; Doces and Magee, 2015; Ramanzini Júnior and Luciano, 2020; Balding, 2011).

In addition, the correlation between political stability and trade liberalization in developing countries is based on domestic winners and losers due to redistributive effects of liberalization (Bussmann et al., 2006) and according to the theory of regionalism, "the opportunity that the negotiation of a free trade area provides companies to regionalize their production will be likely to worry labour unions in relatively high-wage countries that will fear that labour-intensive stages of production will be moved to those parts of the region with lower labour costs." (Ravenhill, 2017:152). Additionally, Free Trade Agreements are more likely to be formed by unstable democracies since they reduce power from authoritarian groups (Liu and Ornelas, 2014). This is also reflected in international level where, according to scholars, RTAs reduce insecurity between states in conflict (Vicard, 2012; Martin et al., 2012).

Moreover, the correlation between rule of law and trade liberalization relies upon trust. More specifically, trade is positively correlated with trust between trade partners and increases when property rights are protected. Also, trust can be replaced by rule of law, when it operates well (Yu et al. 2015) and the quality of institutions as well as the institutional conditions are important factors which affect bilateral trade since they are positively correlated (Álvarez

et al., 2018; Benacek et al., 2014; De Groot et al., 2004; Levchenko, 2007; Nunn and Trefler, 2014). In addition, there is the argument that Free Trade Agreements, such as CETA, do not protect democratic governance, undermine civil society and prioritize economic interests (Petersmann, 2015).

In addition, as far as corruption is concerned, it is clarified that it is correlated with democratization and liberalization process. In particular, corruption affects trade liberalization and trade policies since an open economy may increase corruption unless the liberalization is rapid, while protectionist measures increase corruption levels with negative impact on exports (Blackburn and Forgues-Puccio, 2010; Tavares, 2007; Bandyopadhyay and Roy, 2007; Lee and Azfar, 2008; Narayan and Bui, 2019). In addition, rapid trade liberalization does not eliminate corruption unless democratization happens simultaneously (Tavares, 2005) while levels of corruption are higher in countries with protectionist trade (Dutt, 2009).

Trade liberalization affects development, especially in developing countries. More specifically, it is used as a developmental strategy and it is associated with income and it is negatively associated with poverty, especially in developing countries, benefiting poor people (Siddiqui, 2015; Clairzier, 2011; Sudsawasd et al. 2020; Hamid and Amin, 2013; Jawaid and Waheed, 2017; Onakoya et al. 2019; Gnanngnon, 2019).

Thus, these variables are related to qualitative characteristics, such as democracy, good governance, rule of law, development, corruption etc. which define state's capabilities in trade liberalization. Therefore, the analytical framework develops as follows: first, domestic determinants affected by CEFTA will be assessed and second, macroeconomic determinants, such as trade, FDI, development and economic growth will also be assessed, before and after the formation of CEFTA. A comparative analysis among its member-states will follow. The analytical framework is set out in Figure 1, below.

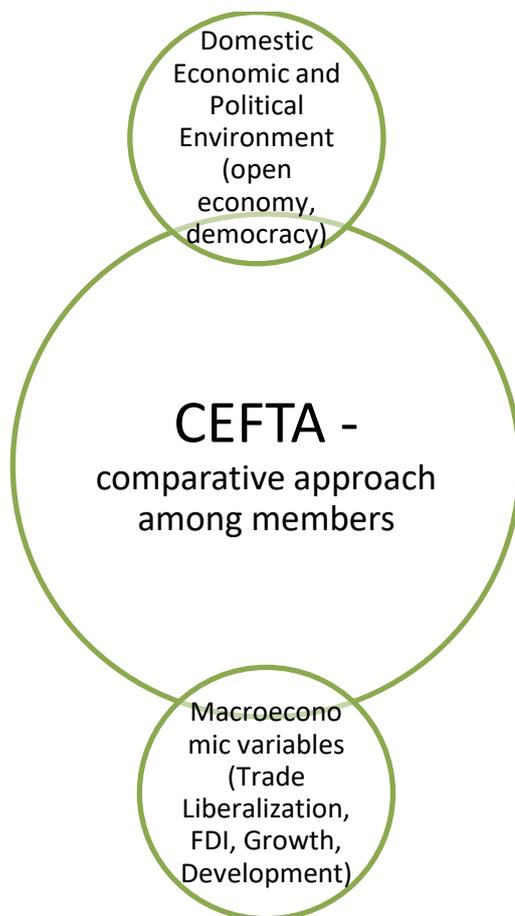


Figure 1. Analytical Framework

#### 4. The Central European Free Trade Agreement – CEFTA

According to the theory, RTAs are formed either for political or economic motives. The political motives of the creation of this FTA rely upon two pillars, that of security and cooperation and that of access to the European Union. Regarding the first pillar, the fall of the Berlin Wall and the end of the Cold War created rearrangements within the Balkan region. Since that time, states of the former USSR were in political and economic transition in order to create market economies and establish democratic governance based on the rule of law. However, this transition was not an easy process, due to conflicts and the raise of nationalistic aspiration, especially in areas of Yugoslavia and Croatia, Bosnia, Slovenia and Kosovo proclaimed their independence and sovereignty.

Under this unstable political environment, CEFTA came into force in 1992 in order to promote cooperation and economic growth among these states which was vital for their accession to the European common market. Given that some of its members, such as Poland, Check Republic, Romania, Bulgaria etc. joint the EU in the last two enlargements in 2004 and 2007, CEFTA form 2006 consists of seven states mainly of Western Balkans, such as Albania, Bosnia and Herzegovina, Moldova, North Macedonia, Montenegro, Serbia and the United Nations Interim Administration Mission in Kosovo on behalf of Kosovo in accordance with United Nations Security Council Resolution 1244 (WTO, 2020).

CEFTA's priorities reflect the challenges that member states need to address in order to achieve the necessary goals and respond to the E.U.'s conditionalities for their accession process. Despite the elimination of tariffs, there are still non-tariff measure among members states, such as "Excessive and redundant trade-related procedures, overlapping compulsory document and data submission requirements for companies, as well as excessive physical inspections at the borders are amongst them" making trade more expensive. Therefore, CEFTA's priorities are summarized as follows:

1. Horizontal support and private sector involvement
2. Harmonization of norms and practices for the elimination of non-tariff barriers
3. Standardization of document and data submission requirements
4. Simplification of customs clearance procedures (CEFTA, 2020(a))

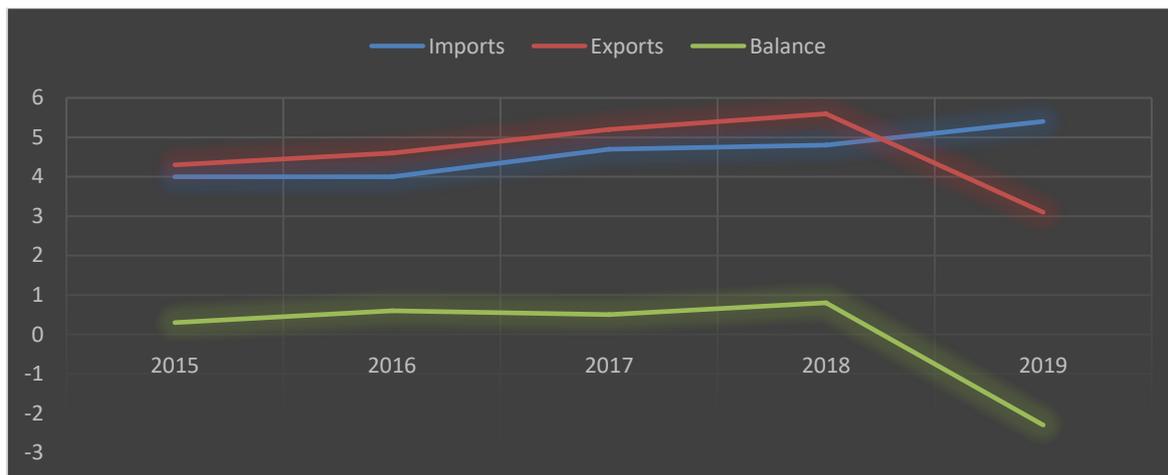
In 2009, CEFTA along with the European Union and German Cooperation (GIZ) created the Open Regional Fund Foreign Trade which focuses on transparency issues in order to help members implement trade reforms and address market access barriers within the region. Statistics show that trade balance is negative either for extra or intra CEFTA trade.



Source: CEFTA, 2020(b)

Figure 2. Extra-CEFTA trade in goods (in billion €)

More specifically, according to Figure 2, from 2013 to 2019 extra-CEFTA trade in goods had negative balance. Although exports increased by 80%, imports also increased by 14% approximately. The trade balance tends to have positive prices only from 2019 onwards. On the other, hand intra-CEFTA trade in goods also had a positive balance, however, from 2018 there was in decline in exports. In particular, according to Figure 3, from 2015 to 2018 imports increased by 20% as well as exports by 30%. However, from 2018 to 2019 imports continued raising in addition to exports which decreased from 5,6 to 3,1 billion €.



Source: CEFTA, 2020(b)

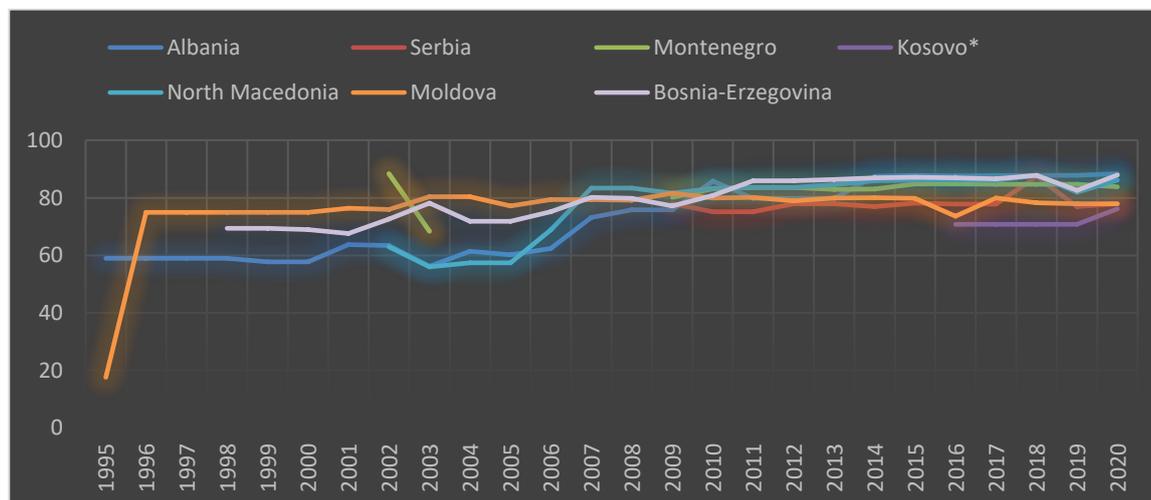
Figure 3. Intra-CEFTA trade in goods (in billion €)

#### 4.1 Macroeconomic variables and Domestic Political and Economic Environment

According to the 2020 Index of Economic Freedom, open markets concern Trade Freedom, Investment Freedom and Financial Freedom. Trade freedom measures the absence of tariffs and non-tariff barriers in imports and exports in goods and services. Non-tariff barriers include quantity restrictions, price restrictions, regulatory restrictions, investment restrictions, customs restrictions as well as direct government intervention. This index takes prices from 0 to 100 and the freedom scale is the following:

- 40-50: repressed
- 50-60: mostly unfree
- 60-70: moderately free
- 70-80: mostly free
- 80+: free

Regarding trade freedom, CEFTA’s members adopted trade liberalization policies in order to foster their production and their economic activity. More specifically, according to Figure 4, from 1995 to 2020 the score CEFTA’s members raised between 78-88, meaning that their trade was considered “mostly free”.

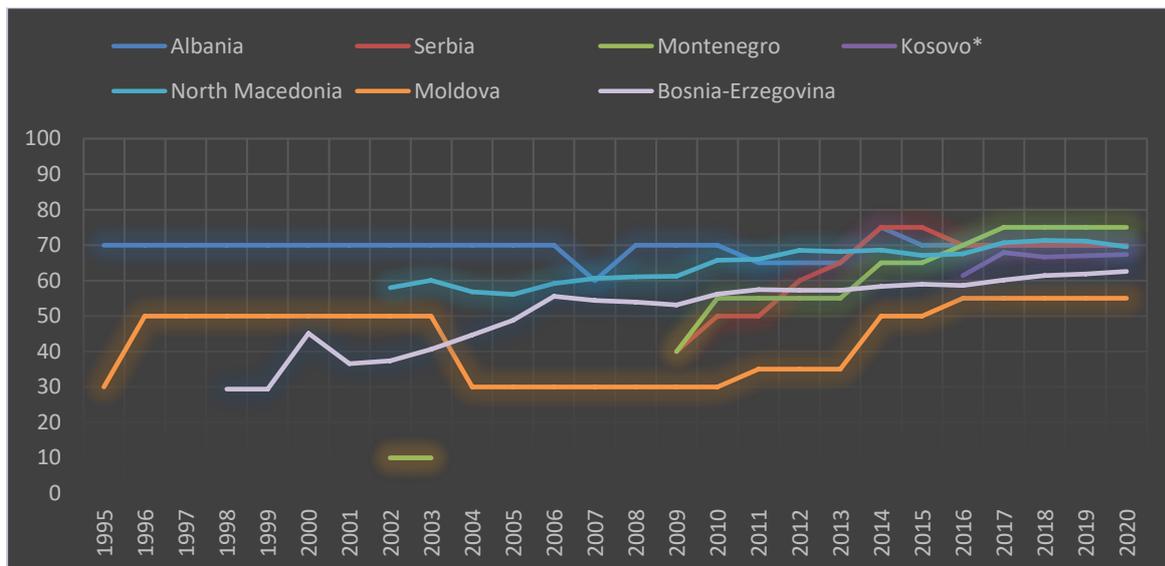


Source: Index of Economic Freedom, 2020

Figure 4. CEFTA’s Trade Freedom

On the contrary, from 1995 to 2009, Moldova, Albania and North Macedonia had the lowest prices, from 20 to 60. Thus, these countries had to overcome challenges caused by protectionist measures and follow policies related to trade liberalization.

Another significant indicator correlated to an open market economy is Investment Freedom, meaning that both individuals and firms can move their resources without restrictions. The current index takes prices from 0 to 100 according to restrictions, meaning that an ideal country without restrictions would receive a score of 100. However, CEFTA’s members impose restrictions even though there are some differences among them.



Source: Index of Economic Freedom, 2020

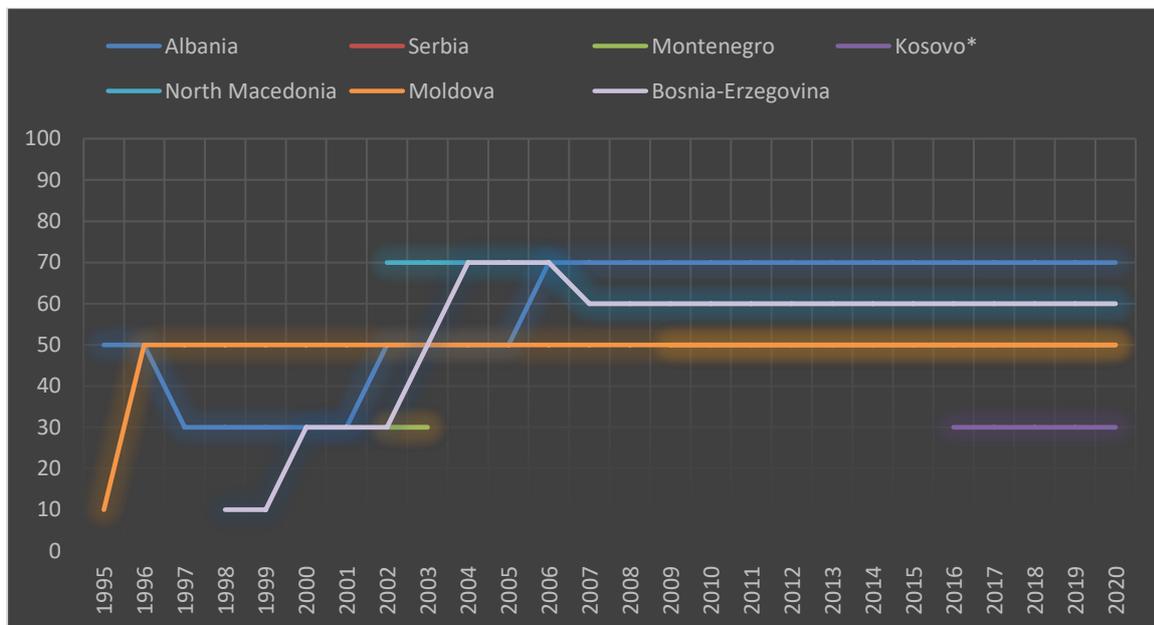
Figure 5. CEFTA's Investment Freedom

More specifically, according to Figure 5, from 1995 to 2020 most of the CEFTA members tried to reduce the restrictions in investments. Albania, Montenegro, North Macedonia and Serbia have the highest prices, from 70 to 75. However, other states such as Moldova remains in the lowest levels, that of 55, especially after a long period, from 2004 to 2010 which received a score of 30.

Financial freedom refers to the government intervention in the financial sector. Given that financial freedom increase competition providing financial services, financial transactions and credits are allocated on market terms without government intervention. The index takes into consideration the extent of government regulation of financial services, the degree of state intervention in banks and other financial firms through direct and indirect ownership, the extent of financial and capital market development, government influence on the allocation of credit, and openness to foreign competition. It takes prices from 0 to 100 where an ideal country without any government intervention would receive a score of 100. The scale of government interference is set as follows:

- 100: negligible
- 90: Minimal
- 80: Nominal (small share of all assets)
- 70: Limited (CB influenced without restrictions)
- 60: Significant (CB not fully independent)
- 50: Considerable (CB significantly influenced by the government)
- 40: Strong (CB subject to government)
- 30: Extensive (extensively influenced)
- 20: Heavy
- 10: Near repressive (control by government)
- 0: Repressive (private financial institutions are prohibited)

More specifically, as it is set out in Figure 6, CEFTA's members are below 70 meaning that government intervention in financial institutions and credit allocation is very high.



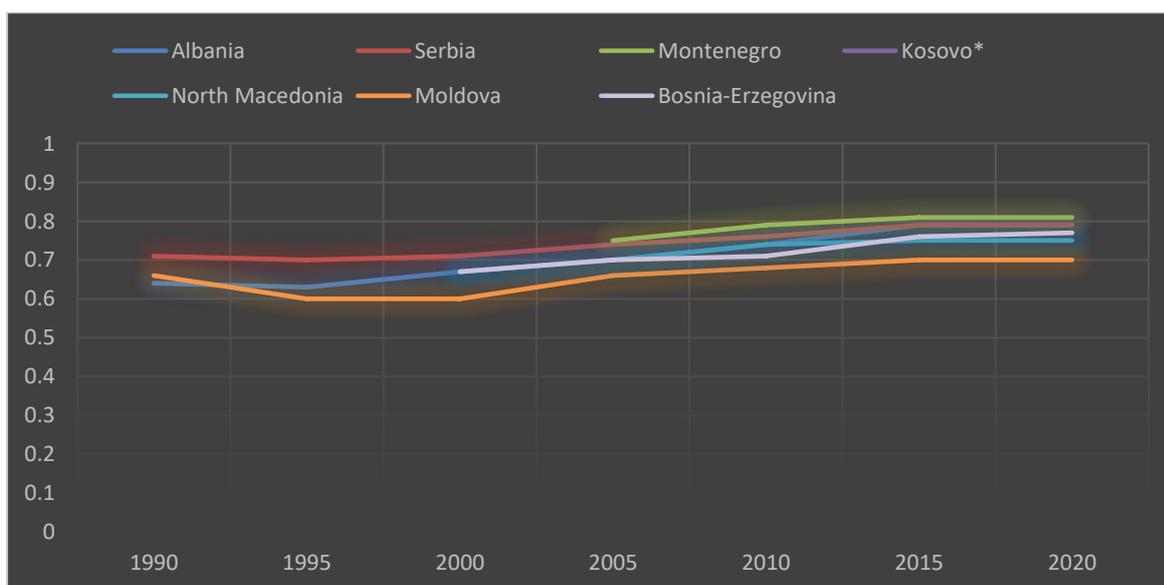
Source: Index of Economic Freedom, 2020

Figure 6. CEFTA's Financial Freedom

In particular, from 2003 to 2020, banking sector is significantly influenced by government in Moldova, Kosovo\*, Montenegro and Serbia in addition to more liberalized members such as Albania, North Macedonia and Bosnia-Herzegovina. Regarding the latter, is also noticeable that from 1998 where the score was 10 reached 70 in 2006 and finally 60 the rest of the years.

Another important element is the human development within CEFTA members. given that GDP per capita measures prosperity based only on quantitative data, the Human Development Index (HDI) takes into account qualitative determinants, such as years of schooling, life expectancy at birth as well as Gross National Income per capita (PPP). HDI aims to assess economic development not only economic growth, which is also affected by trade liberalization, since free trade, due to trade creation, gives people the opportunity to have access to many products responding to their needs and further develop their skills through specialization. HDI takes prices from 0 (low) to 1 (high).

According to Figure 7, HDI in CEFTA's members corresponds to that of developing countries. In particular, Montenegro, Serbia and Bosnia-Herzegovina are among the countries with the highest HDI, where Moldova has the lowest from 1990 to 2020. In addition, all members managed to increase their level during that period, especially Albania, which in 1990 its HDI was 0,64 and in 2020 is 0,79.



Source: HDI, 2020

Figure 7: CEFTA's Human Development Index

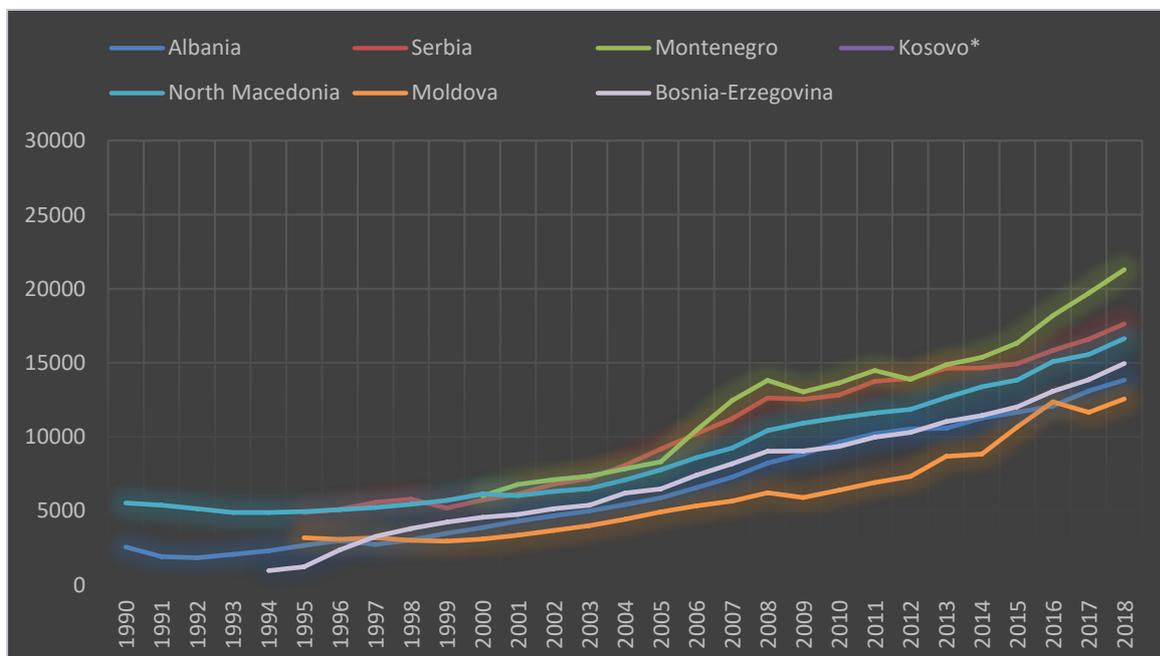
Moreover, according to the literature, it is unclear whether trade is positively correlated with income inequality and alleviation of poverty. The below index, GINI coefficient, is implemented in CEFTA members and measures income inequality and takes prices from 0 (absolute equality) to 100 (absolute inequality). More specifically, according to Figure 8, the period between 2010 and 2017, income inequality was not so intense among CEFTA's members. North Macedonia has the highest price, that is 35,6 and Moldova the lowest, that is 25,9. This means that there are not any big imbalances regarding income distribution and inequalities among these members.



Source: UNDP, 2020

Figure 8: GINI Coefficient (2010-2017)

It is also interesting to assess the previous index (GINI) with GDP per capita among CEFTA's members. As it is set out in Figure 9, GDP per capita has an upward trend for all members. In particular, the increase in the prosperity of Montenegro is remarkable, since it has the highest GDP per capita in 2018, which is 21000USD approximately. Serbia is in second place with 17000 USD and Moldova in last place with 12500 USD the same year.

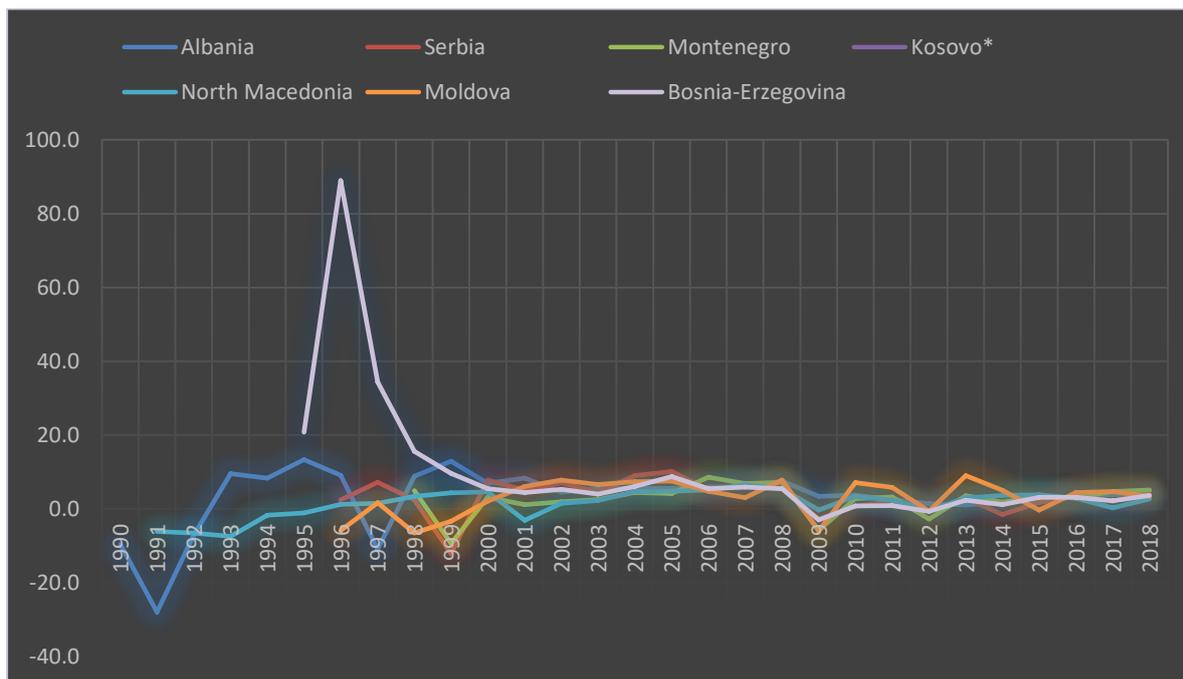


Source: World bank, 2020(b)

Figure 9: GDP per capita (PPP), USD

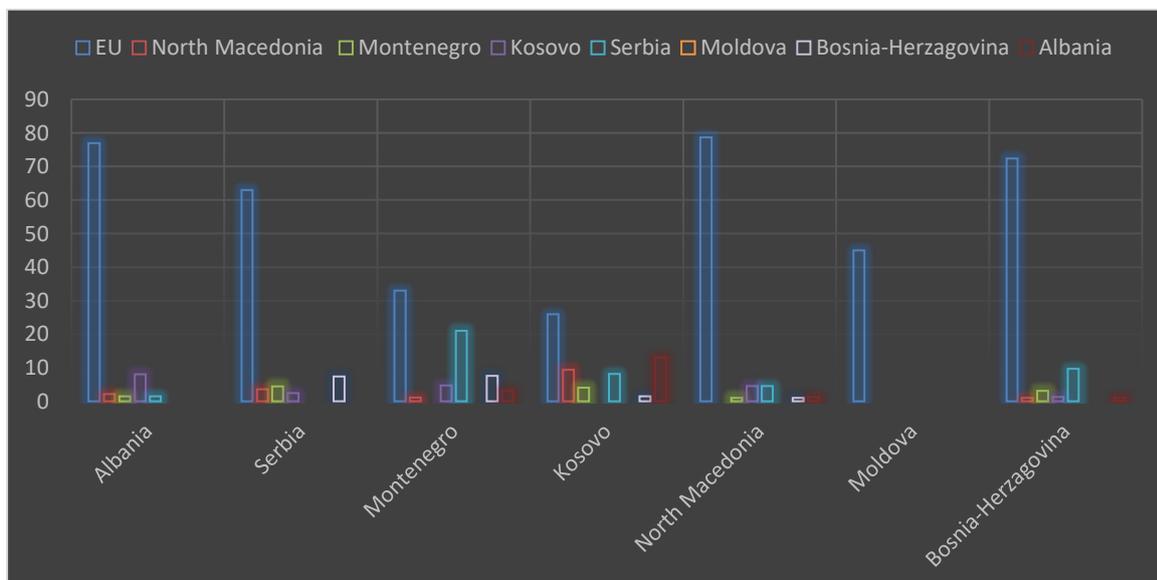
Trade is also positively correlated with GDP growth. According to Figure 10, CEFTA's economies before and after the formation of the FTA did not had significant changes. In particular, from 1990 to 1999 there were the lowest rates for Albania, North Macedonia, Serbia and Moldova, while during the same period, Bosnia and Herzegovina had

the highest growth rate, 89% approximately. In 2009, due to financial crisis, there was also a slight decrease with negative rates apart from Albania and North Macedonia.



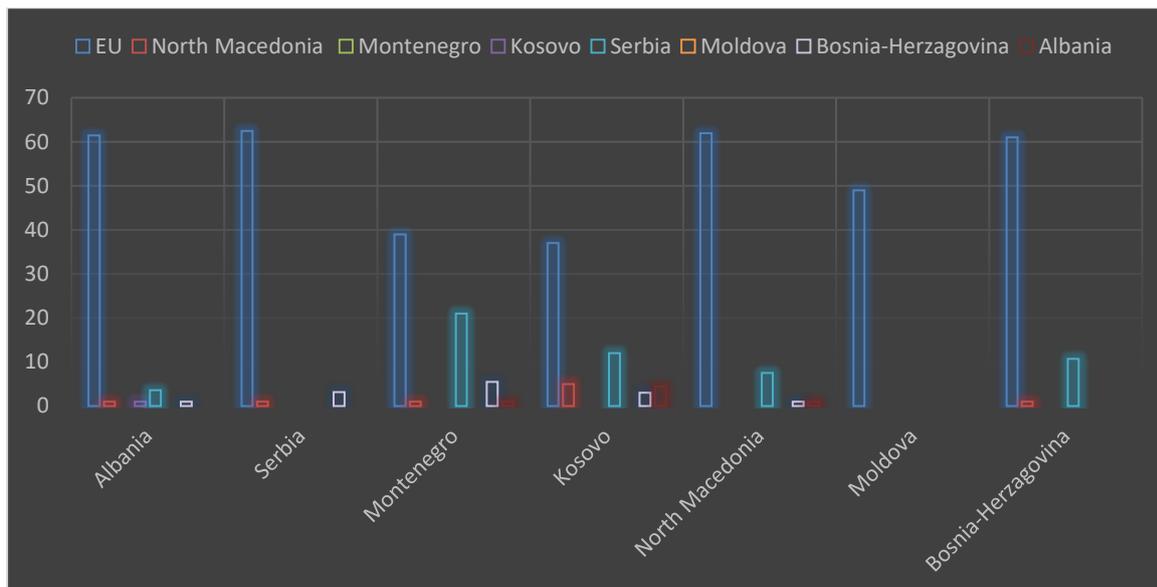
Source: World Bank, 2020(a)  
Figure 10: GDP Growth (%)

In addition, according to the literature, FTAs increase intra-regional trade volume, therefore, it is important to focus on intra-regional trade. The absence of trading partners deriving from CEFTA in the case of Moldova is also noticeable, while North Macedonia and Albania, due to the opening of the accession negotiations, are more committed to the EU. As it is set out in Figure 11, the most significant export partner is the EU however, intra-regional exports are very low as percentage of total exports. In particular, Albania's exports to Kosovo are only 8% of total exports while Bosnia-Herzegovina's exports to Serbia are only 9% of its total exports.



Source: CEFTA, 2020(b)  
Figure 11: Export Partners (average, % of total exports, 2013-2019)

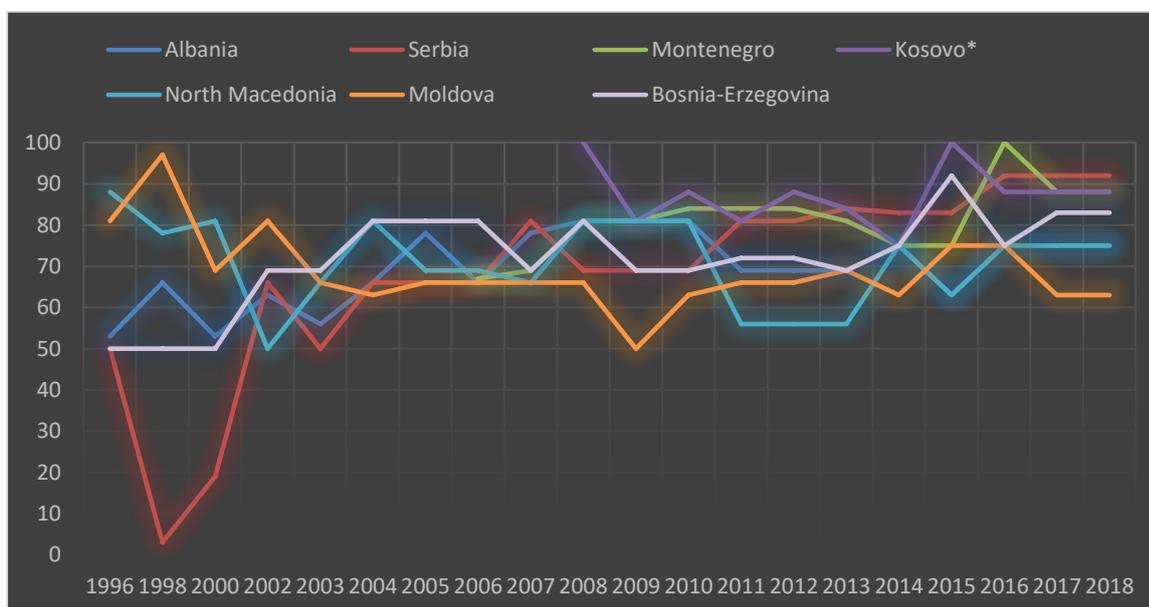
With regard to import partners, there are similar results. According to Figure 12, the EU continue to be the most important import partner for CEFTA members while intra-regional imports correspond to very low rates of total imports. For example, Moldova's imports do not derive from CEFTA members while Serbia and Bosnia-Herzegovina import goods from two intra-regional partners, with these transactions corresponding to 3% and 10% of the total imports, respectively.



Source: CEFTA, 2020(b)

Figure 12: Import Partners (average, % of total imports, 2013-2019)

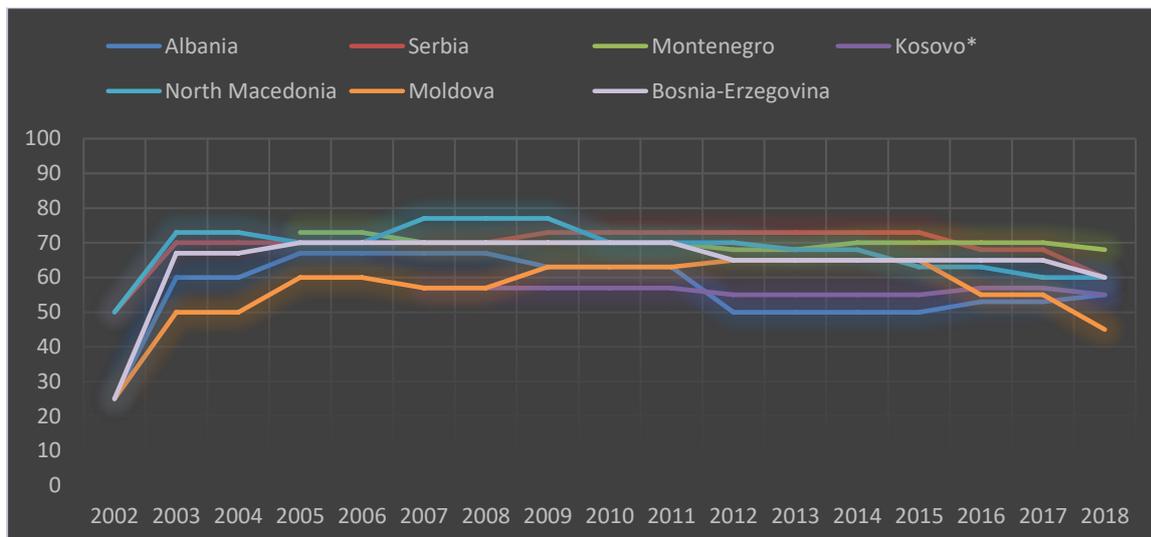
Regarding the domestic political environment, according to the literature, it is critical to be stable and open in order to support an open market economy. Figure 13 shows to political stability and absence of violence for CEFTA members. This index takes prices from 0 to 100, an ideal state would receive the score of 100. However, CEFTA members, are characterized by political instability and violence which also affects the economic aspect. In particular, Serbia, due to war in Kosovo, had the lowest score at 0 in 1998, however, from 2002 onwards managed to overcome the security challenges achieving one of the highest scores within CEFTA's region, that of 92. In addition, other members, such as Moldova, North Macedonia and Albania also had the lowest scores from 2004 to 2014, remaining at the same level of instability, which is not attractive for investments and further economic activity.



Source: WGI, 2020

Figure 13: Political Stability and absence of violence

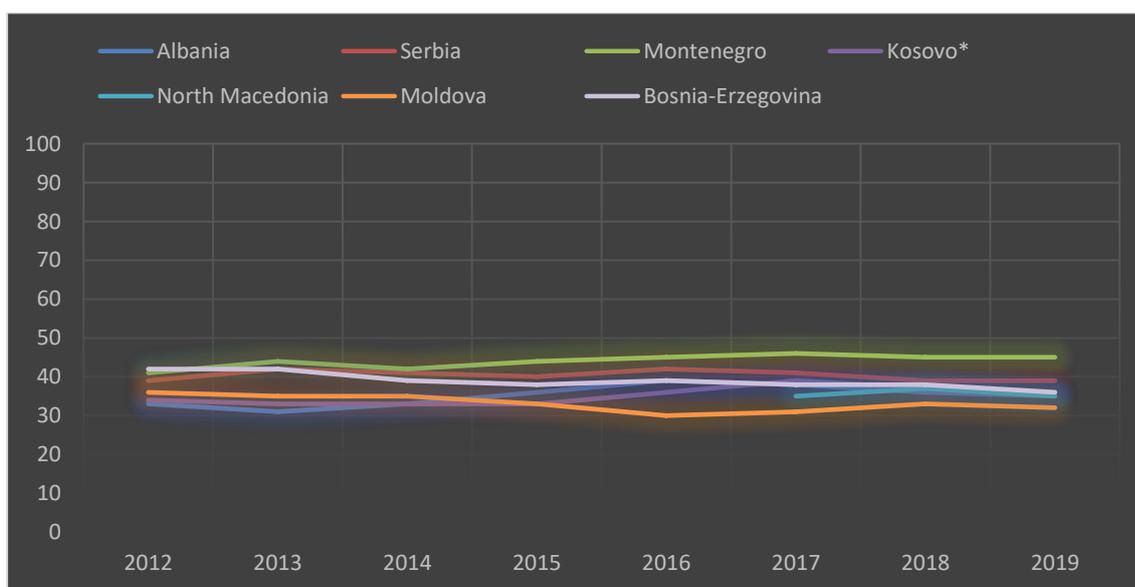
Open political systems, such as Democracies, are also determined by the rule of law. According to this index, "Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence." (WGI, 2020). In particular, according to Figure 14, from 2002 to 2018 most of CEFTA's members raised their rates however they did not manage to score over 80. Albania has the lowest level, approximately 50 followed by Moldova and Kosovo\* with 55. On the contrary, Montenegro and Serbia are in first and second place with 68 and 60 respectively.



Source: WGI, 2020

Figure 14: Rule of Law

Last but not least, corruption plays also a significant role in domestic political environment since, among others, it weakens democracy and harms economic development by increasing inequality and poverty. According to Figure 15, corruption index takes prices from 0 to 100. Highly corrupted are close to 0 while very clean are close to 100.



Source: Corruption Perception Index, 2020

Figure 15: Corruption

Regarding corruption among CEFTA's members, they are all below 50, meaning that they have high levels of corruption. In particular, Montenegro and Serbia are less corrupted than the others while Moldova, North Macedonia, Kosovo and Bosnia-Herzegovina seem to be the most corrupted from 2003 onwards.

## 5. Conclusion

The aim of the paper was to evaluate the impact of CEFTA on exports and economic growth and development of its members. Based on the theoretical context of Regional Trade Agreements, the assessment concerned quantitative analysis of intra-regional macroeconomic variables and development indexes along with domestic economic and political variables. The contradictory arguments in the literature regarding the effects of CEFTA on its members concerned those who argued that CEFTA'S impact on exports and economic growth and development of its members is positive and those who claimed that this impact is either very limited or no existent at all. This study, attempted to make an initial assessment about CEFTA's impact on its members' economic growth and development taking into consideration the wider economic and political environment.

First, according to the literature, most of the scholars found that RTA's are positively correlated with economic growth and income. Since CEFTA's formation, there was not a significant change on growth rates however, GDP per capita increased. In addition, as far as trade is concerned, FTA's have substantial trade creation effects and increase bilateral and intra-regional volume. In the case of CEFTA, intra-regional trade seems to be neglected since all CEFTA members prefer trading with the EU. This does not mean that CEFTA's economies could be more competitive than the EU, however, there is no increase in intra-regional trade volume and when there is, this concerns only few of the partners. In addition, FDI were not examined due to lack of data.

Moreover, trade liberalization reduces income inequality. In the case of CEFTA, further to trade liberalization, indexes show that economic environment remains protected and state centric. Political instability, corruption and rule of law remain in low levels affecting at the same time negatively economic liberalization, as the theory predicts. On the other hand, income inequality is low despite the low levels of trade and economic liberalization while HDI is positively increasing.

Last but not least, there are mixed results that should further be examined. The fact that an FTA such as CEFTA seems that does not have any impact on GDP growth but at the same time GDP per capita and HDI are increasing, might show that there are other variables which affect these indexes. On the other hand, another paradox is that these positive developments happen in highly corrupted, state-centric and protectionist members of a Free Trade Agreement. Also, more attention should be given to the nature of a FTA, if its formation derives from political rather than economic motives, as well as the similarity of the domestic political and economic structures of its members. The latter might be a determinant on further integration within a RTA, if we consider EU's accession prerequisites.

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## Railway Development in Light of Market Needs: A SWOT Analysis of the Rail Transport Markets in the Visegrád Four Countries

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ARTICLE INFO	ABSTRACT
<p>Article History</p> <p>Received 30 July 2020; Accepted 14 December 2020</p> <p><i>JEL Classifications</i> O18, L92, R58</p>	<p><b>Purpose:</b> This paper intends to provide a comparative analysis of the Czech, the Hungarian, the Polish and the Slovak railway development strategies in light of the evolution of transport needs, travel habits, freight volumes, and regional business relations. By offering a general SWOT analysis through real-life examples, the paper shall contribute to the better understanding of railway development trends in the Visegrád states.</p> <p><b>Design/methodology/approach:</b> The research's scope is to identify the real motives and triggers of railway modernization and construction policies in the Visegrád Four countries (the Czech Republic – “Czechia”, Hungary, Poland and the Slovak Republic – “Slovakia”). Through the quantitative research of international, national and corporate transport databases and surveys, as well as the analysis of EU strategies and V4 presidency programs, the paper concludes that the regional rail transport market has clear advantages with constantly growing traffic and every time more actively trading companies.</p> <p><b>Findings:</b> The study found that the V4 railway integration is in major part powered by the EU's development funds and communitarian regulations support the competitiveness of rail services in the region. However, the efficiency of train services ranks below the communitarian medium level in most of the V4 states. Therefore, if Visegrád countries wish to close up with their western neighbors, the frequency, the speed and the quality of train services must improve.</p> <p><b>Research limitations/implications:</b> As this study provides a general insight to Visegrád railway development strategies from a market perspective, future researches might focus on the political motivations of such infrastructure projects. Further papers might also investigate the possible impacts of railway developments on the employment, cultural and business relations, travel habits, tourism, and environmental protection in the Visegrád area.</p> <p><b>Originality/value:</b> By offering a general SWOT analysis through real-life examples (dated from these countries' EU accession), the paper shall contribute to the better understanding of railway development trends in the Visegrád states. The research primarily focuses on the relationship, causal mechanisms, interactions, and dynamics between infrastructure investments and the concrete needs of the transport sectors of these states. The analysis has multiple levels including that of state actors, sub-state regional entities, railway undertakings, and transport corridors. In order to provide a global European view on the evolution of rail transportation, V4 statistical data is compared to European average numbers all through this study.</p>

**Keywords:**

*Transport, railways,  
integration, development,  
statistics, SWOT*

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## 1. Introduction

The research's scope is to identify the real motives and triggers of railway modernization and construction policies in the Visegrád Four countries (the Czech Republic, Hungary, Poland and the Slovak Republic).<sup>1</sup> Through the quantitative research of international, national and corporate transport databases and surveys, as well as the analysis of EU strategies and V4 presidency programs, the paper concludes that the regional rail transport market has clear advantages with growing traffic and actively trading companies. Talking about strategic transformations related to the Eurasian transport integration, Pepe J.M. (2018) argues that the emergence of deeper economic interdependencies among developing countries led to the reconstruction of existing corridors and the exploitation of new trade links on the East-West axis. The European Union's South East Transport Axis project's analysis (SETA, 2012) on transport development plans and the Valdai Discussion Club's report on the North-South transport corridor (Karavayev & Tishehar, 2019) confirmed the potential of railway corridors from Scandinavia to South-East Europe and Central Asia addressing V4 territories. The 2010-2011 annual report of the Community of European Railway and Infrastructure Companies (CER, 2011) also stressed that the V4s' development concepts to boost the position of the railway sector contributes to the creation of an energy efficient, environmentally friendly, and safe transport grid while promoting economic growth and regional cohesion. The same conclusions can be traced in a recent development potential report of the International union of railways (UIC, 2020) on Eurasian corridors.

This paper discusses that ensuring interoperability between railway lines is also essential for the competitiveness of the sector. The technical strategy (EIM, 2008) of European Rail Infrastructure Managers defines the specifications for interoperability to be applied for both the passenger and freight sectors to provide faster and heavier trains, reduced costs, and smarter technologies for operation. This study shows the possibilities and the gaps of the Visegrad countries' railway systems in this field with special regards to future strategies.

However, the lack of sufficient connections, the relatively substandard technical parameters and the concentrated markets are still impeding rail's competitiveness relative to other modes in these countries. Therefore, by offering a SWOT analysis through real-life examples (dated from these countries' EU accession), the paper shall contribute to the better understanding of railway development trends in the Visegrád states. Bouraima *et al.* (2020) employs a SWOT matrix in their study on the railway system's development strategy of the West African Economic and Monetary Union to demonstrate the crucial role of the sector for the economies. The same method was followed by Sun *et al.* (2018) in their analysis on the competitive development strategy of the China railway express.<sup>2</sup>

The research primarily focuses on the relationship, causal mechanisms, interactions, and dynamics between infrastructure investments and the concrete needs of the sector. The analysis has multiple levels including that of state actors, sub-state regional entities, railway undertakings, and transport corridors. In order to provide a European view on the evolution of rail transportation, V4 statistical data is compared to EU average numbers. In order to verify the structural advantages of the V4 countries as far as their ability to get targeted EU funding for railway development is concerned, the paper provides a comparative statistical analysis based on data retrieved from the European Commission's CEF database, showing the ratio between all transport grants and railway-related financial resources from 2014 to 2019. Through targeted research of EUROSTAT databases and statistical yearbooks, this study aims at highlighting the strengths and the weaknesses of the V4 countries' railway systems compared to the rest of the EU. With the aim of having a V4-focused study on the evolution of the railway market, statistical trends are proposed in this paper by data retrieved from the above-noted sources for the evolution of the number of operators, the transport figures of goods and passengers, modal shift, as well as the market shares of domestic incumbent operators and new entrants. Through keyword-searches of ministerial communiqués, annual reports of national railway undertakings, V4 presidency programs, studies of international railway organizations and thematic newspaper articles, this paper identifies common V4 railway development goals.<sup>3</sup>

The enlargement of the European Union in 2004 gave impetus to trading links between Eastern and Western European economies. Consequently, the Czech, the Hungarian, the Polish and the Slovak railway systems began to report promising figures for the intensity of use mostly driven by freight services. This paper also seeks answers on how the funds and regulations of the European Union shape the Visegrád cooperation's transport strategies as railway routes in this region are important parts of the European network. Such endeavor is attended to be reached by proposing a quantitative synthesis of railway investments supported by EU financial mechanisms in the 2014-2019 programming period.

The research completes the Author's previous studies about transport interest articulation in Central Eastern Europe, about the background of high-speed railway constructions in V4 countries, as well as about the role of EU tools enhancing the railways' interconnectivity in the Visegrád countries.

## 2. Strengths: Structural Advantages and EU Funds

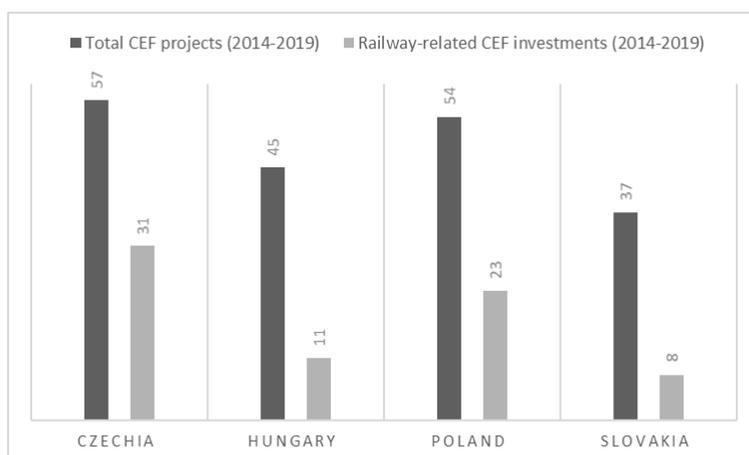
Over the years, the V4 cooperation introduced ministerial conferences and experts group meetings of rail professionals in order to harmonize their positions towards the sectoral policies of the European Union. Being net recipients of EU structural funds, the four states are active players in the informal "Friends of Cohesion Policy" club and managed to get the highest amount of EU funds per capita for the 2014-2020 multiannual financial period. Visegrád states put emphasis on the exchange of experiences in the implementation of railway constructions co-financed by such funds. The EU Cohesion Policy contributes to the improvement of the region's public transport services by the procurement of modern rolling stock, the upgrading of railway infrastructure or the construction of

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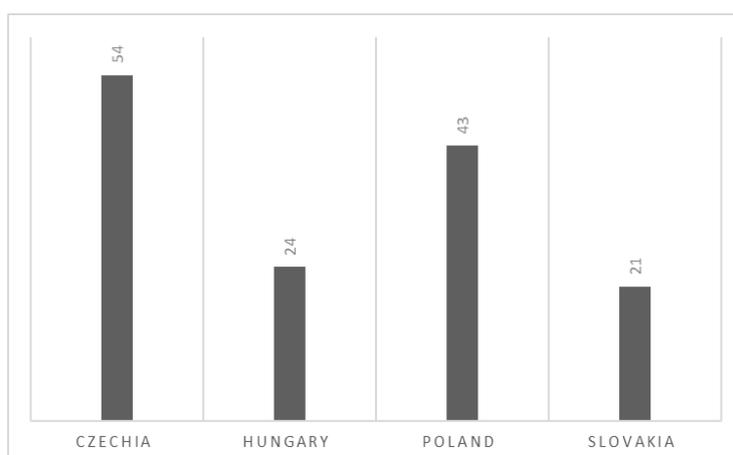
new sections. V4 regional railway integration is in major part powered by EU funds and policies. The deployment with modern train control systems and various line rehabilitation as well as construction projects shape the Visegrád countries' main infrastructure strategies (Tóth, 2018b).

The EU's Multiannual Financial Framework ("MFF") provides the main tools for V4 railway investments amid its distinct pockets for mobility: Connecting Europe Facility ("CEF"), Shift2Rail, Cohesion Fund, etc. The 2021-2027 MFF gives priority to cross-border railway projects. Even the previous (2014-2020) communitarian budget offered 41.6 billion euros as blended (public & private) financing for the realization of transport development projects. Additionally, the Commission allocated 11.3 billion euros from the Cohesion Fund to improve transport infrastructure in 15 less developed EU countries (European Commission, 2018).

Rail has a paramount share in the Czech and Polish transport development activities. During the 2014-2019 programming period, Czech beneficiaries received 1.1 billion euros co-funding from the Cohesion Fund as part of CEF projects. Such grants contributed to investments (works and studies) of a total value of 1.6 billion euros in that timeframe. As much as 54% of such initiatives were directly related to railway development, thus the major part of EU funds (1.062 billion euros) supported the sector. In the same period, Hungarian bidders were granted 1.1 billion euros co-funding (primarily from the Cohesion Fund). Such grants contributed to transport investments of a total value of 1.3 billion euros. About 24% of these projects were linked to railway investments with a budget of 860 million euros altogether. In the given timeframe, Polish beneficiaries were transferred 4.2 billion euros as CEF Transport co-funding (out of which €4.1 billion came from the Cohesion Fund). These grants contributed to investments totaling 6 billion euros. 43% of these initiatives were railway infrastructure development activities, counting for a total budget of more than 3.5 billion euros. In Slovakia, transport projects were granted 712.4 million euros CEF co-funding, out of which more than 704.7 million euros were transferred from the Cohesion envelope. Such grants contributed to investments valued at 927.5 million euros. All things considered, 8% of the Slovakian CEF projects focused on railways and these initiatives received almost one third of the total contribution (Connecting Europe Facility, 2019).



**Figure 1. Selected CEF projects in the 2014-2019 programming period**  
Source: Own representation (Connecting Europe Facility, 2019)



**Figure 2. Proportion of railway investments within CEF-funded projects (2014-2019)**  
Source: Own representation (Connecting Europe Facility, 2019)

The majority of the incumbent V4 railway undertakings have their own financial resources to invest in development projects. With the exceptions of the Czech railway infrastructure manager and the Polish public railway group, all main companies closed the 2018 accounting period with balances in hand.

**Table 1. Annual reports of V4 railway incumbents**

2018	Net profit / loss
Czech Railways	<b>45.96 million euros</b>
SŽDC	<b>-20.52 million euros</b>
MÁV Hungarian State Railways	<b>32.42 million euros</b>
MÁV-Start	<b>28.57 million euros</b>
PKP Polish Railways	<b>-29.53 million euros</b>
ŽSR Slovak Railways	<b>171,846 euros</b>
ŽSSK	<b>37,376 euros</b>

Source: Own representation (Annual reports ČD, 2019: 7; Összevont, 2019; Annual report MÁV-Start, 2019; Annual report PKP, 2019; Annual report SŽDC, 2019; Annual report ŽSR, 2019; and Annual report ŽSSK, 2019)

The Visegrád area is characterized by a relatively dense intertwining of transport networks. At the time of their EU-accession, the Czech Republic, Hungary and Poland had the longest railway network among the new Member States, which altogether constituted the 79% of the new EU Countries' railway system (Kartal, 2007). The Czech Republic has one of the densest railway networks in Europe (122km / 1,000km<sup>2</sup>) and the densest among V4 countries (ECORYS, 2006a).

**Table 2. Electrification level of V4 railway lines, as of 2018**

	Functioning railway lines (length)	Electrified railway lines (%)
Czech Republic	9,567km	<b>34%</b>
Hungary	7,441km	<b>41%</b>
Poland	19,307km	<b>61%</b>
Slovak Republic	3,627km	<b>44%</b>

Source: own representation (Eighth Annual Market Monitoring, 2020)

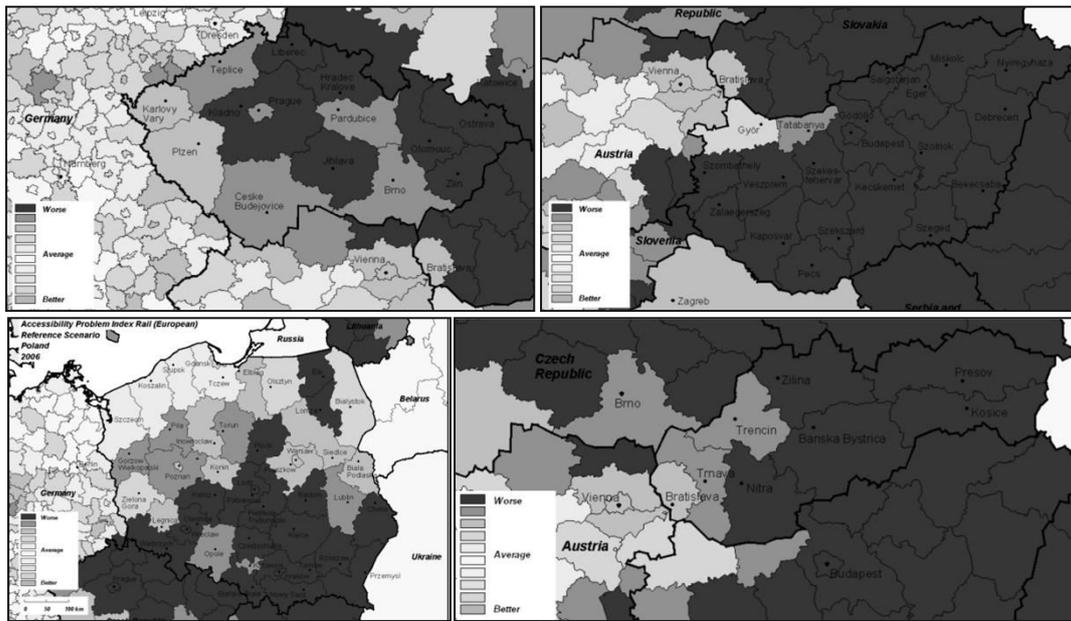
As of 2018, the average electrification level in Europe (EU 28, plus Serbia, Kosovo, and the Republic of North Macedonia)<sup>4</sup> stands at 55%, while such figure is around 44% in the Visegrád States. Poland is the only V4 country in which the length of functioning railway lines had a notable growth over the past years. From 2017 to 2018, altogether 56km of newly built tracks were inaugurated in the biggest V4 country, which meant an 0.3% increase, in contrast to the European average decline of 0.14% (Eighth Annual Market Monitoring, 2020).

### 3. Weaknesses: Room for improvement

In the first years of their EU membership, road accessibility rates in Czechia and Hungary were close to European standards, but the rail accessibility was relatively underdeveloped in all the V4 states with the poorest regions being deprived from fast and reliable train services to the capital cities or the local economic centers. At the time of its EU accession, Poland had to deal with accessibility problems with serious regional disparities. The Baltic region had accessibility above the national average and close to the European levels, whereas the areas bordering Czechia, Slovakia, Ukraine and Belarus were below domestic and European standards. The situation has improved primarily due to cohesion policies. (ECORYS, 2006b).

Transportation modes in V4 countries predominantly developed by the routes of major freight movements between the European Communities and the former Eastern Bloc countries. Consequently, the Visegrád countries' railway network lacks major north-south connections (Tóth, 2018a). The problem of the relatively scarce and underdeveloped north-south rail routes is reflected by the 9-10 hours average journey time between Budapest and Krakow (625km). By comparison, trains run the approximately 611km long east-west Budapest-Prague route in only 6 hours. The presidency programs of the V4 cooperation give special focus to the development of north-south routes, emphasizing Central Europe's need for infrastructure guarantees managed as collective European programs. Additionally, Visegrád countries together with Croatia decided to tackle regional challenges of mutual concern, particularly to develop the north-south axis of the region's road and rail transport network.

Another element that obstacles the creation of smooth crossborder rail connection between V4 countries is that the region is not a homogeneous in terms of a number of certain decisive technical parameters. Hungary predominantly uses alternating current 50 Hz / 25 kV, while the power supply system in Poland is dominated by direct current 3 kV. The Czech Republic and Slovakia operate mixed electrification systems. The proportion of standard and broad-gauge rail lines in use also varies the four CEE countries (Eurostat, 2020c; Statistical yearbook, 2019).



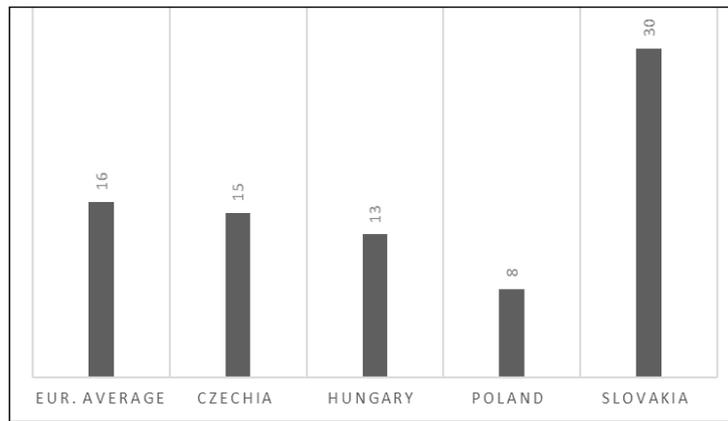
**Map 1. Accessibility of rail services in the Visegrád Four**  
 Source: ECORYS, 2006a; ECORYS, 2006b; ECORYS, 2006c; ECORYS, 2006d

Until their accession to the European Union, V4 governments had not been efficient enough in combining track infrastructure and rolling stock assets to deliver considerable economic outputs. The total capital productivity levels in terms of technical efficiency of the national railway companies were under Western European levels. Rail infrastructure thus needed to be improved to attract passengers, boost cross-border cooperation, and draw trade partners to the region. The relatively poor conditions of the Visegrád states' railways services led to passengers switching from rail to cars. According to a 2018 rating, based on a survey evaluating frequency, punctuality, speed and price of train services, the efficiency of train services ranked below the communitarian medium with only the Czech results being above EU average (EU Transport Scoreboard Country Factsheets, 2020).

The objective of these four governments was to improve the performance of the sector by investing in infrastructure and signalling, safety and traffic control devices, and the modernization of the rolling stock (Tóth, 2019). Their main initial problem was that the railway industries have been very concentrated in the 1990s, and the robust structures of the national railway companies impeded their ability to respond quickly to new challenges and go through extensive structural reforms (Griffin, 2007). By 2017, ratings of the quality of railroad infrastructure in the Czech Republic and Slovakia have grown above European standards, although, in Hungary and Poland such indexes still rank below the EU average (European Commission, 2018a). Ensuring interoperability between railway lines is essential for the competitiveness of this type of transport mode. The main directions of V4 states' railway strategies are in line with the conclusions of the review (C4R, 2015) of existing practices to improve capacity on the railway network elaborated by the EU-funded Capacity for Rail project. In order to increase the modal share of railways, it is indispensable ensuring adequate capacity and punctuality in line with market needs by the promotion of intermodality and interoperability (C4R, 2015). The deployment with the second level of the European Train Control System (ETCS) and various rehabilitation, as well as construction projects on key railway corridors have been at the core of the Visegrád countries' infrastructure development strategies. All V4 countries take part in the cooperation of the European Commission, manufacturers, infrastructure managers as well as undertakings from the rail industries of EU Member States to deploy the European Rail Traffic Management System ("ERTMS"). According to recent deployment plan deadlines, the system on the core network corridors passing through the V4 region will be implemented within a five-six year term (Commission Implementing Regulation, 2017).

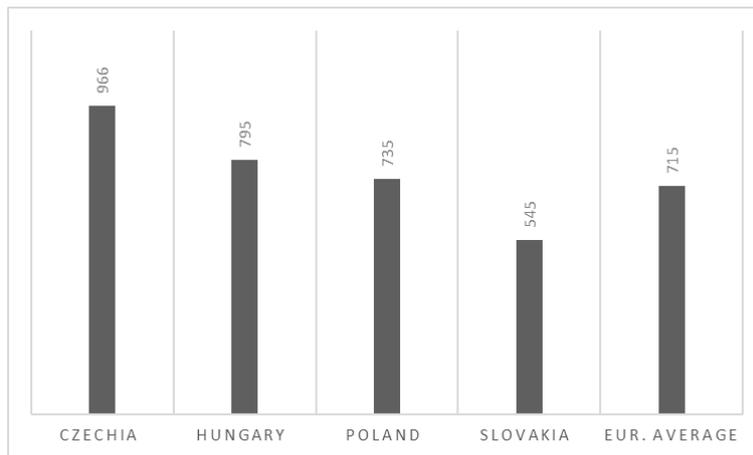
Multilevel V4 meetings normally pay attention to traffic problems caused by bottlenecks. In order to facilitate cross-border rail traffic, a high-level working group on transport connections was launched to coordinate the implementation of the relevant V4 agreements (Programme of the Slovak Presidency, 2014). The V4 Rail Roundtable was formed in 2017-2018 as a platform for railway expert discussions about how to increase competitiveness of rail transport along the north-south freight corridors and exploit railway infrastructure developments by sharing best practices among Central East European terminals and freight companies.

With regard to travel habits, in most of the V4 countries there is room for improvement to reach the European medium level as far as weekly rail usage is concerned among the inhabitants. According to a 2018 representative survey, 16% of the EU's population uses domestic passenger train services (long-distance, regional and suburban – except for metros and trams), at least once a week. The proportion of weekly train users in Slovakia is almost 2 times higher than the EU average, while in the rest of the V4 states, such ratio is below the communitarian medium (European Commission, 2018b).



**Figure 3. The weekly usage of domestic passenger train services (%)**  
Source: Own representation (European Commission, 2018b)

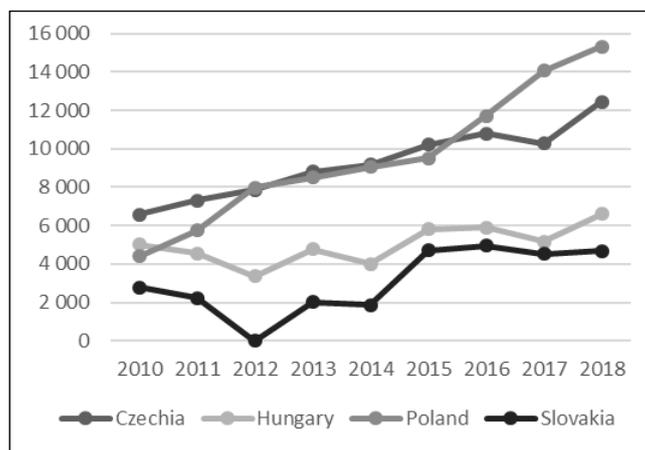
However, calculating the number of kilometers ran by passenger trains per one inhabitant one can have a different picture about V4 travel habits. This indicator shows the average distance travelled by one citizen in a given country. The Czech Republic ranks as the first among Visegrád states with 966 passenger-km per inhabitant in the year 2018, followed by Hungary (795 passenger-km), Slovakia (735 passenger-km), and Poland (545 passenger-km), compared to the European average of 715 passenger-km a year. (Eighth Annual Market Monitoring, 2020). This means that in the V4 region, Czech people are most likely to travel longer distances by train and that at a European level, V4 citizens, in general, are more likely to use this transportation mode to travel between cities.



**Figure 4. Distance travelled by one inhabitant in 2018 (kms)**  
Source: Own representation (Eighth Annual Market Monitoring, 2020)

#### 4. Opportunities: Promising Results

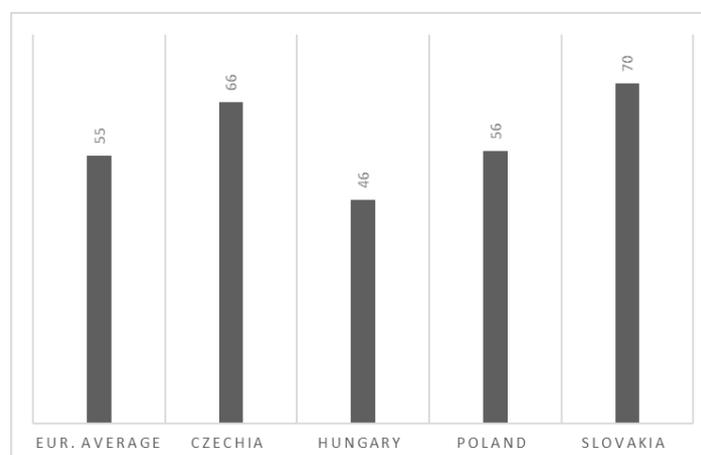
From 2009 to 2018, the number of railway operators has doubled in the Czech Republic, and increased by 40% in Poland. The growth has been less notable in Slovakia (25%), Hungary, in exchange, witnessed a quite notable evolution in this field as the number of railway undertakings has multiplied by 26. In 2018, there were 49 active railway companies registered in Czechia, 52 in Hungary, 78 in Poland and 20 in Slovakia (Eurostat, 2020b). In the Czech Republic, 78% of all train movements is effectuated by passenger trainsets, while in Poland it's "only" 65%. Altogether, 73% of the trains circulating on the Visegrád railway lines are operated by passenger undertakings as opposed to the European average of 81%. In the past years, both freight and passenger rail traffic has increased at the same rate across Europe. (Eighth Annual Market Monitoring, 2020). While through the past 10 years, 17-18% of the total cargo shipments has been handled on rails in the European Union, V4 Countries have reported more favorable ratios for the sector with data around or above 30%. At the time of the country's EU accession, the Czech Republic ranked in the fourth position in Europe with respect to freight railway traffic in terms of millions of tons (ECORYS – CZ, 2006).



**Figure 4. Annual railway transport of goods (containers & swap bodies, thousand tons)**  
Source: Own representation (Eurostat, 2020a)

The Polish rail freight market, which witnessed the sixth highest growth from 2017 to 2018, ranks as the second largest in Europe (between Germany and France). As far as the freight capacities of railway infrastructures are concerned, Poland has the second highest load factor after North Macedonia among the European countries with standard gauge rail tracks (1,435mm) measured by the “ton km per train km” indicator (Eighth Annual Market Monitoring, 2020). Market shares of the domestic incumbent rail freight operators stand around the average European level in the V4 countries, with the Hungarian market being the less concentrated. Only one of the 27 active rail freight undertakings in Hungary can be seen as incumbent, whereas about 80% of the total freight movement on the Hungarian network is international. In the Czech Republic and Poland, the rail freight business is categorized as highly concentrated. Apart from the publicly owned ČD Cargo, there are 78 rail freight companies actively doing business on the Czech network.

There are 72 trading rail freight operators on the Polish market. Besides the state-owned PKP Cargo that controls a market proportion of around 40-45%, 20 other undertakings have market shares over 0.5%. However, all market players are considered to be in competition with each other. In Slovakia, there are 38 rail freight undertakings besides the publically owned ŽSSK Cargo.

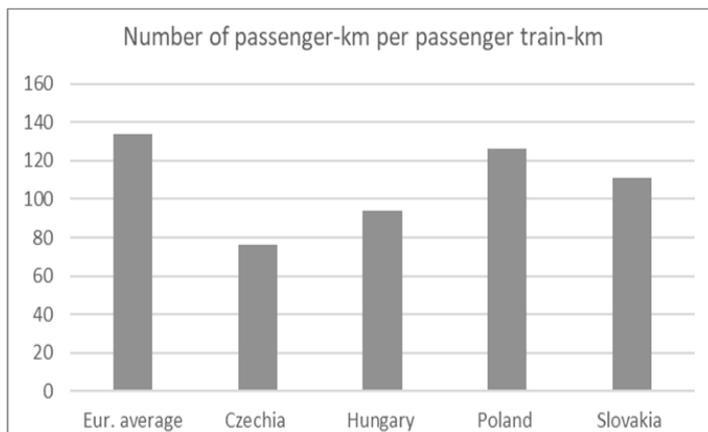


**Figure 5. Market share of the domestic incumbent rail freight operator, as of 2018 (%)**  
Source: own representation (Eighth Annual Market Monitoring, 2020)

Market share discrepancies between leader and less significant business entities indicate the incumbent company’s competitive advantages *vis-à-vis* the rest of the undertakings, thus showing possible barriers to new-joiners on the market. In the four Visegrád states, 59.5% of the rail freight market is covered by the national incumbent operators. Market entrants face the most difficult situation in Slovakia, where the company with a historically dominant national position operates the 70% of all freight trains, whereas in Hungary, only the 46% of such services are managed by the domestic incumbent. By contrast, such portion in the European countries stands at around 55%. In the Slovak Republic, there are no foreign incumbents, in Czechia and Hungary they have a quite modest market representation (1% and 2%, respectively), while in Poland, foreign dominant operators manage as much as the 10% of all freight train services, which number stands quite close to the European average of 13% (Eighth Annual Market Monitoring, 2020).

In the Visegrád region, passenger trains altogether ran 43 billion km in 2018, which is 8.7% of all European passenger train movements. The number of inhabitants living in the Visegrád countries give 12,4% of the total EU population (EU population, 2019). Rail passenger traffic has increased in all V4 countries from 2017 to 2018, with the Czech Republic reporting the most significant (8%) and Hungary registering the less notable (0.5%) increment

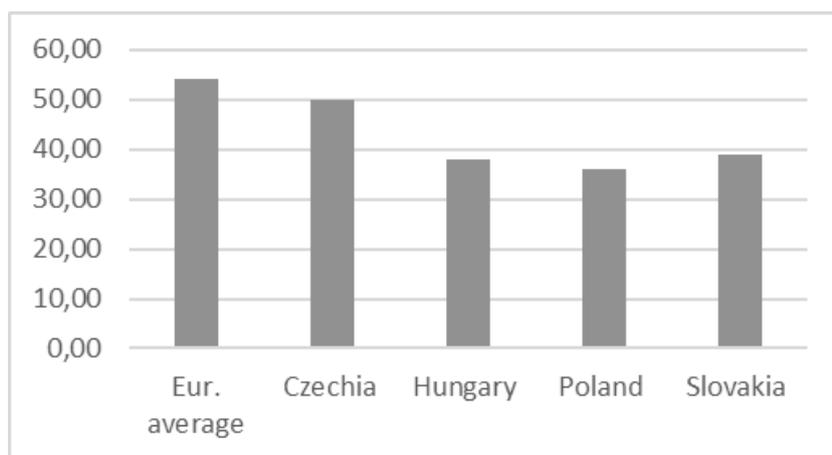
compared to the 4% European average. By dividing total passenger-kms by total train-kms, one can get an indicator that gives a realistic picture about rolling stock capacities. As of 2018, Poland leads the way among the V4 countries in such ranking, followed by Slovakia, Hungary and Czechia. Visegrád states, however, rank below the European standard: the trainsets are shorter and / or have less seats (Eighth Annual Market Monitoring, 2020). However, prior to the 1989 regime changes, both Hungary and Czechoslovakia had quite sophisticated rail manufacturing know-how and industries supplying rolling stock to other Eastern Bloc countries (Griffin, 2007). Such characteristic gives a strong basement for the current rolling stock manufacturing capacities of these states. Rail vehicle production is still an active business in all V4 countries.



**Figure 6. Rolling stock capacities in the V4 countries, as of 2018**  
Source: own representation (Eighth Annual Market Monitoring, 2020)

Across the Visegrád countries, public service obligation services accounted for 94% of passenger train movements, which exceeds the European average by 12 percentage points. In the Czech Republic and Poland, the share of PSO traffic on the supply side is higher than on the demand side. In the V4 region, companies with historically leading market positions have a share of 82% in the passenger rail business, with Hungary reporting the highest proportion (97%) and Poland registering the smallest share (58%) for domestic incumbent undertakings. By contrast, the European average market share of domestic incumbents is 77%. Among V4 states, in terms of train kilometers per year, as of 2018, Poland has the largest market proportion (59%) of non-incumbents, while in the rest of the Visegrád allies such share stands below 8%. The European standard market share for non-leaders is 18%. The presence of foreign-registered incumbent passenger undertakings is traceable only in Poland with a market proportion of around 1% as opposed to the European average of 11%. (Eighth Annual Market Monitoring, 2020).

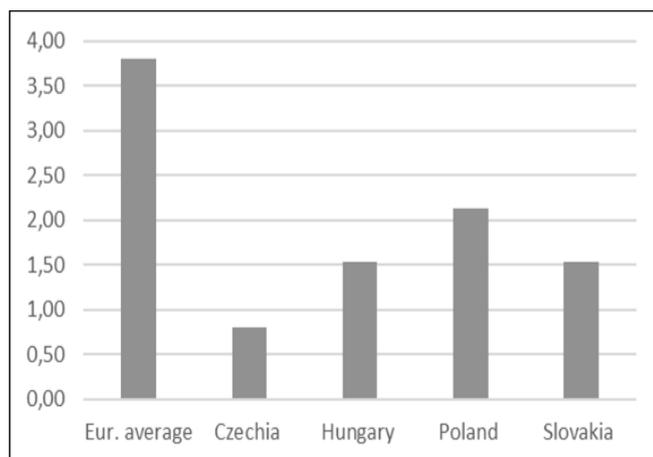
In V4 countries, similarly to most of other European states, the railway tracks are primarily used by passenger rather than by freight services. In 2018, 78% of the network users in Czechia were passenger trains. In Hungary, passenger trains had an 81.6% share, in Poland and Slovakia such proportions were 63.9% and 69.2%, respectively.



**Figure 7. Network usage intensity in V4 states (train km/route-km/day)**  
Source: Own representation (Eighth Annual Market Monitoring, 2020)

As of 2018, Visegrád average price of a minimum track access package is around 1.5 euros, in contrast to the European standard 3.8 euros. In this region, passenger rail undertakings pay the 60.75% of the total track access charges, compared to the European average 88% (Eighth Annual Market Monitoring, 2020). It is essential to mention that passenger train compositions are shorter and lighter than freight trainsets, consequently such services generate less profit per one train, as track access charges are principally calculated based on axle-load and length indicators. The average minimum price of running a passenger trainset in the V4 countries is 1.26 euros per train (as opposed to

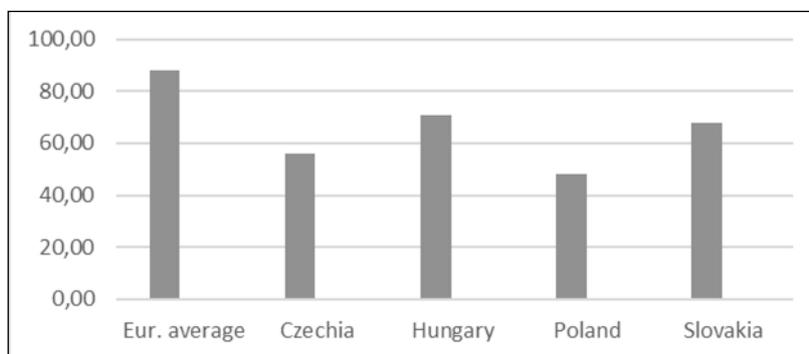
the European average of 4.33 euros per train units). At the same time, the cost of running a freight train is 2.15 euros per unit (that stands quite close to the European average of 2.56 euros). In both cases, the Polish prices are the most expensive and the Czech charges are the most favorable on the regional market (Eighth Annual Market Monitoring, 2020).



**Figure 8. Minimum track access charges paid by railway undertakings (EUR/train-km), as of 2018**

Source: Own representation (Eighth Annual Market Monitoring, 2020)

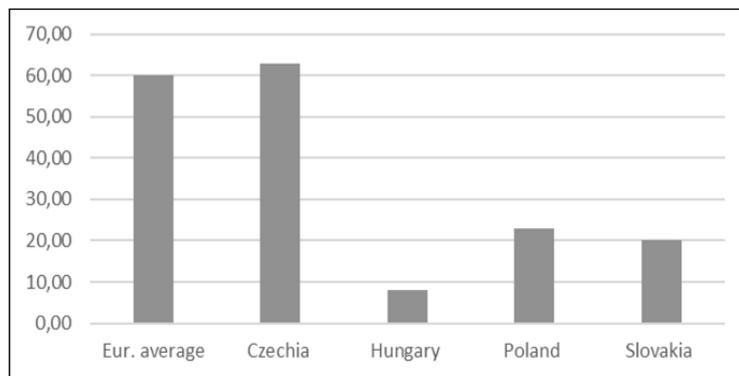
As of 2018, the highest number of active railway undertakings was reported on the Czech market (as much as 102), while the smallest portion of trading railway companies was registered in Hungary (with 28 active undertakings on the market). The 88% of active railway undertakings in the V4 countries provided freight services as opposed to the average European portion of 71.5%. As far as their proportion is concerned, the biggest difference could be traced on the Slovak market, where the number of freight operators is almost 10 times higher than that of passenger undertakings. By contrast, in Czechia, the latter operators are around 4 times more the formers (Eighth Annual Market Monitoring, 2020).<sup>5</sup>



**Figure 9. Breakdown of the total track access charges by passenger services in 2018**

Source: Own representation (Eighth Annual Market Monitoring, 2020)

The EU member states' practical cooperation in the field of railway policies culminates in the creation of the integrated trans-European railway network ("TEN-T"). V4 states support the strengthening of such cooperation as their major routes have become integral parts of priority transport axes. In the past 20 years, rail freight volumes between the EU and Belarus, Moldova, and Ukraine increased constantly. In contrast to TEN-Ts, Rail Freight Corridors ("RFC") are purely freight-focused cross-border governance mechanisms involving ministries, infrastructure managers, railway undertakings and terminals. The RFC network reflects concrete operational and market-driven demands, thus it covers routes outside of the TEN-T system, too.



**Figure 10. Length of the TEN-T Network completed at the end of 2016, compared to the total**  
Source: Own representation (EU Transport Scoreboard Country Factsheets, 2020).

Given their land-locked positions (with the exception of Poland) and the increasing level of Asia-Europe rail traffic, the strengthening of these countries' railway relations towards Eastern Asian countries is definitely advantageous for the region's performance in terms of international trade balances. The presence of Chinese companies, and the "Belt and Road" initiative of Beijing's diplomacy have resulted in the establishment of rail land-bridges via Visegrád Countries towards Western European destinations, significantly shortening the normally 30-40 day long sea routes and avoiding bottlenecks in Northwestern European logistical hubs. Such "Silk Roads" provide economic and geopolitical benefits for the states they cross.<sup>6</sup> Trade links between Europe and the Far East are slowly shifting from road or maritime routes to rail. The roughly 10,000km distance between Chinese and EU ports may be covered in 15 days by train through the Trans-Siberian route, as opposed to an average maritime trip of 30 days (Farkas *et al.*, 2016). Thus, the common V4 goal is to forward more goods on the railways.

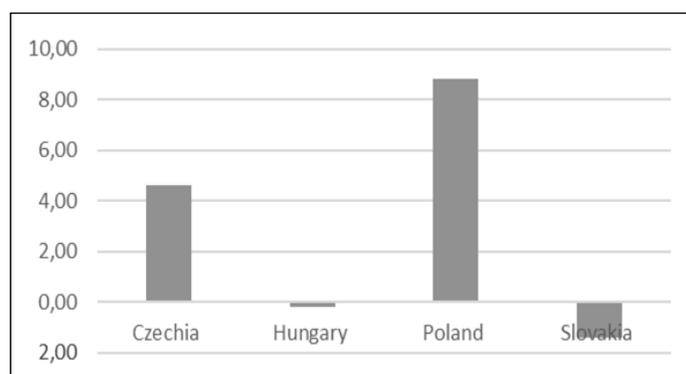
##### 5. Threats: The High-speed challenge and the shift in transportation routes

The modernity of rail services may be measured by the number of operating high-speed lines. Such cutting-edge systems have become symbols of modern transport services while contributing to regional integration amid social and economic development. High-speed trains could encourage people to shift from air to rail for both leisure and business. Industry associations forecast a minimum 10% compound annual growth rate for the passenger rail sector in the medium term as this sector could be the best response from the mobility system to population growth, rising standards of living and increased demand for transport (Burroughs, 2020).

However, if the V4 countries wish to take part in such boom, the frequency, the speed and the quality of passenger train services must improve. In addition, both the frequency and affordability of high-speed services depend on the market liberalization, in which Visegrád countries are lagging behind. V4 presidency programs include general discussions on the construction of future high-speed passenger rail lines in the region. Given the need for a fast north-south train service, during their February 2016 bilateral negotiations, the prime ministers of Hungary and Poland agreed to improve rail connections between their countries (The alliance, 2016). As of 2019, technical and profitability studies are being run related to such new high-speed passenger train service going up to 250-300 km/h.

From the Visegrád region, currently only Poland operates high-speed trains. As of March 2019, the Polish railway network had a 224km long HSR line that partially connects Katowice and Krakow with the capital city. The Polish Government plans to extend the country's HSR network to 598km in future. At the time of writing, the Czech Republic is the only other V4 state with intentions to build high-speed railway infrastructures with a planned extension of 810km (High Speed Lines, 2020). The Czech Republic plans to construct a 810km long HSR network (Velim team, 2018). Czechia considerable made progress in the implementation of a high-speed line that in time would connect Prague with the neighboring capital cities (Libor Lochman speaks, 2019). Hungary plans to build up a Budapest-centered modern and elevated speed railway network in Central Europe. As part of such endeavors, the upgrade of the Belgrade-Budapest rail line is expected to be completed by 2023. There are plans to build a HSR line between Budapest and Cluj (Romania) as well (The Visegrád Group to build, 2018). From 2017 to 2020, the Government intends to spend 4.8 billion euros on rail development projects increasing the country's electrified rail network to 3,300km (Cabinet Office of the Prime Minister/MT, 2017).

Another concern is the shift between Eurasian routes. Trans-Siberian shipments connecting Western European and Chinese destinations tend to prefer the (Kazakhstan)-Russia-Belarus-Poland route as opposed to the (Kazakhstan)-Russia-Ukraine-Hungary/Slovakia corridor resulting in growing freight volumes for the northern V4 countries and a drop for their southern allies. From 2017 to 2018, following European tendencies, rail freight traffic has increased in Czechia and Poland, too. Hungary and Slovakia, in contrast, witnessed a slight decrease primarily due to the East Ukrainian conflict that is still a burden on rail traffic routes passing through the country towards gauge-changing facilities in Slovakia or Hungary. Shipments from Ukraine occupy the leading position in the total commercial freight traffic of the Slovak national rail freight company ŽSSK as Slovakia has become one of the most important countries in transit transportation of commercial cargo from Russia towards Western Europe (Tóth, 2018b).



**Figure 11. Evolution of rail freight traffic in V4 countries from 2017 to 2018**

Source: Own representation (Eighth Annual Market Monitoring, 2020)

## 6. Conclusion

Summing up the strengths and opportunities, one must not forget that the V4 region is characterized by a dense railway network with connections to main international transport corridors. Research of market reports and annual balances of railway companies shows that the regional rail transport market has clear advantages with constantly growing number of enterprises reporting promising financial results. Rail traffic has increased in all V4 countries with operational costs being more affordable than the European medium. Freight services represent a considerable market share in the V4, which is a forward-looking attribute as far as shifting road freight traffic toward environmentally sustainable modes are considered. This study presents promising trends in the V4 countries for both rail freight and passenger services. While over the past 10 years, 17-18% of the total cargo shipments has been handled on rails in the European Union, V4 states reported proportions being twice as much as the EU average. As for passenger services, V4 citizens are more likely to use this transportation mode to travel longer distances than in the rest of the Community.

As part of the V4 cooperation, governments introduced ministerial conferences and working group meetings of professionals to harmonize their positions towards sectoral policies. The intergovernmental policy coordination has strategic relevance as Visegrád countries are net recipients of EU structural and cohesion funds. On one hand, by comparing the relative share of financial recourses provided by the European Union for railway development, this paper concludes that V4 railway integration is in major part powered by the EU's development funds being the main tool for investments amid specialized pockets. On the other hand, the Community's sectoral regulations support the competitiveness of the railways in the V4 region with special regards to the completion of the trans-European railway network of which Visegrád railway lines are becoming integral parts.

Talking about weaknesses and threats, it is essential to note that based on the market trends identified in this study, it can be stated that entering the rail markets of these four states is still more difficult than in Western Europe due to the strong positions of incumbents and the lack of absolute liberalization. V4 railway industries are still relatively concentrated with robust business structures. Compared to Western European levels, Visegrád rail infrastructures still show relatively low accessibility rates and substandard technical parameters leading to longer journey times. The lack of sufficient cross-border transport links and north-south connections is still a burden on competitiveness *vis-à-vis* other transport modes. The introduction of smooth V4 intraregional train services is also impeded by the technical heterogeneity of the four countries' railway infrastructures.

The efficiency of train services still ranks below the Communitarian medium in most of the V4 states. By giving a focused research of market reports and satisfaction surveys this study may help understanding why passengers tend to prefer road services over trains. If V4 countries wish to close up with their western neighbors, the frequency, the speed and the quality of train services must improve. In addition, the affordability of train services depends on the level of market liberalization, a policy field where Visegrád countries are lagging behind.

As this study provides a general insight to Visegrád railway development strategies from a market perspective, future researches might focus on the political motivations of such infrastructure projects. Further papers might also investigate the possible impacts of railway developments on the employment, cultural and business relations, travel habits, tourism, and environmental protection in the Visegrád area.

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## Endnotes

<sup>1</sup> The present study has been presented at the 12th International Conference "Economies of the Balkan and Eastern European Countries", EBEEC 2020, that has been online in Opatija, Croatia from May 29th to 31th 2020 (<http://ebeeec.ihu.gr>).

<sup>2</sup> A convincing SWOT analysis appears in a master degree thesis (Petracchini, 2017) at the Faculty of Civil and Industrial Engineering of the Sapienza University of Rome as a scientific technique used to prove (or disaffirm) the competitiveness of the rail transport sector of the Sultanate of Oman.

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<sup>3</sup> In order to narrow down the high number of hits and identify the relevant information, contextual ‘intext’ searches have been run on the following terms (and their variations): “high-speed”, “railway development”, “railway investment”, “railway policy”, “railway construction”, “modal share”, “modal shift”, “shift to rail”, “rail transport market”, “boost rail”, “enhance rail”, “develop rail”, “promote rail”, “railway connections”, “railway lines”, “railway transportation”, “rail transport”, “railway network”, “railway infrastructure”, and “rolling stock”.

<sup>4</sup> The Independent Regulators Group’s 2020 market report gathered data from the then 28 Member States of the European Union, plus Switzerland, Serbia, Kosovo, and the Republic of North Macedonia, therefore, in the paper the terms “Europe” and “European” consequently are used for the above-noted geographic region.

<sup>5</sup> The First Railway Package (2001) gave operators the right to enter the trans-European network on a non-discriminatory basis. The Second Railway Package (2004) proposed safety regulations and certification procedures. The Package contained a directive on the allocation of infrastructure capacity and the levying of charges for its use. The Third Railway Package (2007) introduced open access rights for the provision of international rail passenger services. It also gave birth to a special European licensing for locomotive drivers, enabling them to circulate on the entire European rail network. The 2012 Single European Railway Directive laid down rules regulating the use of railway infrastructure for domestic and international rail services. The Fourth Railway Package (2016) completed the single market for rail services: the Single European Railway Area. By significantly reducing costs and administrative burdens for railway undertakings, the legal package’s technical pillar was intended to support the competitiveness of the railway sector vis-à-vis other transport modes. The Fourth Railway Package’s market pillar meant the final legal step towards market opening.

<sup>6</sup> The roughly 10,000km distance between Beijing and the German port city of Hamburg may be covered in 15 days by train through Mongolia (or Kazakhstan), Russia, Belarus and Poland, as opposed to an average maritime trip of 30 days (Farkas *et al.*, 2016).

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## Appendix

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- A1. Figure 1. Selected CEF projects in the 2014–2019 programming period
- A2. Figure 2. Proportion of railway investments within CEF-funded projects (2014–2019)
- A3. Figure 3. The weekly usage of domestic passenger train services (%)
- A4. Figure 4. Distance travelled by one inhabitant in 2018 (kms)
- A5. Figure 5. Market share of the domestic incumbent rail freight operator, as of 2018 (%)
- A6. Figure 6. Rolling stock capacities in the V4 countries, as of 2018
- A7. Figure 7. Network usage intensity in V4 states (train km/route-km/day)
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- A9. Figure 9. Breakdown of the total track access charges by passenger services in 2018
- A10. Figure 10. Length of the TEN-T Network completed at the end of 2016, compared to the total
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- A13. Table 1. Annual reports of V4 railway incumbents
- A14. Table 2. Electrification level of V4 railway lines, as of 2018

## Current State and Perspectives of Securitization Processes in the Russian Federation

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ARTICLE INFO	ABSTRACT
<p>Article History</p> <p>Received 25 July 2020; Accepted 26 September 2020</p> <hr/> <p><i>JEL Classifications</i></p> <p>G18, G21, G23</p> <p>Keywords: Securitized assets; Mortgage; Mortgage bonds; Mortgage loan; Commercial bank; Securitization</p>	<p><b>Purpose:</b> The study is aimed not only at determining the current state of the bank asset securitization market but also at developing methods and ways to improve the processes of bank asset securitization in Russia.</p> <p><b>Design/methodology/approach:</b> The article presents the results of a survey of Russian market securitization over the last 10 years, where the author separately considers mortgage and non-mortgage securitization, conducts a discrete analysis of regulatory changes in securitization, and identifies the main problems in the development of this important economic process and the issues that have remained unresolved during the decade. The main methods of study chosen by the author are systematization, generalization and econometric analysis.</p> <p><b>Finding:</b> The author has demonstrated that there is a strong inverse relationship between the mortgage lending volume and the interest rate, and has built a linear function of the estimated mortgage lending volume. The excess in the real mortgage lending volume over the estimates confirms that the current state policy, including state support and reduction of the Central Bank key rate, in the sphere of mortgage lending is indeed stimulating.</p> <p><b>Research limitations/implications:</b> The development of securitization in Russia has been constrained not only by sanctions and bureaucratic inconsistencies in the requirements set for securitized assets, but also by delay in the access of the official bodies such as the Federal Service for State Registration, the Cadastre, and Cartography (“Rosreestre”) to modern technologies, as well as by the insecurity and distrust of digital financial service technologies. Quite different conclusions follow from the analysis of non-mortgage securitization, where the author supports and develops critical remarks expressed by other researchers in previous years.</p> <p><b>Originality/value:</b> The survey results not only show the achievements of mortgage lending in Russia in recent years, but also provide valuable recommendations to help support the positive dynamics of mortgage lending and securitization development in the Russian Federation.</p>

### 1. Introduction

The growing demand for credit resources in the real sector of the Russian economy encourages the national banking system to seek long-term financing and look for effective instruments for refinancing loans. In the late 1980s, a new way of attracting long-term financing, based on attracting any assets that create a stable cash flow, was introduced into the global financial system (Burkova, 2014). World practice in recent decades shows that securitization is widely used in financial markets to attract additional financing, meet capital adequacy standards, maintain liquidity, diversify assets and minimize risks.

Securitization is an evolving complex innovative process which has good prospects for implementation and development in the practice of Russian banks. This is an effective way of raising funds as it provides access to almost unlimited resources both in Russia and abroad, bypassing sanction barriers. Securitization allows the credit institution to obtain liquid funds without losing the efficiency of active operations. It all makes the study of the current conditions and prospects of the bank asset securitization market in Russia especially relevant.

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The subject of the study is bank asset securitization in Russia and the relations that arise between the parties in the course of this process. The study is aimed not only at determining the current state of the bank asset securitization market but also at developing methods and ways to improve the processes of bank asset securitization in Russia. To achieve these goals, the author has 1) analyzed and evaluated the Russian securitization market; 2) highlighted problems and prospects of securitization development in Russia; 3) proposed a number of measures to solve the current problems in the process of bank securitization in Russia.

## **2. Literature Review**

Quite a number of works in the economic literature are devoted to the problems of securitization. The theoretical basis of this research consists of works of Russian and foreign scientists on securitization, financial management, investment operations and regulation of operations with derivatives. It is necessary to mention the works of E.R. Yescombe (Yescombe, 2013), T. Belikov (Belikov, 2009), H.P. Baer (Baer, 2007), T.S. Kolmykova (Kolmykova, 2013) and some other authors. Detailed theoretical and methodological provisions on securitization are presented in the works of N.V. Aleksandrov (Alexandrov, 2007), I.I. Guliyev (Guliyev, 2014), L.N. Drobyshevskaya and T.V. Koneva (Drobyshevskaya, Koneva, 2013), L.P. Harchenko (Harchenko, 2017).

This research also takes into consideration the works devoted to the general issues of securitization in Russia: V.S. Aksenov and P.S. Golikov (Aksenov, etc., 2013), M.A. Denisov (Denisov, 2016), V.E. Krolivetskaya (Krolivetskaya, 2019), O.V. Khmyz (Khmyz, Alekseeva, 2018), I.M. Golaido and Tsyrko, A.A. (Golaido, etc., 2019). As mortgage loans constitute the largest share of securitization in Russia, it is most interesting to provide a retrospective comparison of the results and conclusions presented in the publications of E. Davidson (Davidson, etc., 2007) and Y.A. Burkova (Burkova, 2014). The author also resorts to the results of the study on housing and communal services (Vasilyeva, 2018), systematized expertise and forecasts in the field of non-mortgage securitization (Suslov, 2015), as well as asset securitization in commercial organizations in general (Kovaleva, Khvostenko, Glukhova, Mozharovsky, 2018).

Works, reviewing foreign securitization experience, have helped to come up with the interim and final results of the study: B. Dave and Y. Kobayashi (Dave, Kobayashi, 2018), I. Krekoten (Krekoten, Svistun, Khudolii, 2018), C.Y.-P. Lo (Lo, 2018).

The study relies on the data from the analytical materials published on the official website of the Central Bank of the Russian Federation, on the website of the Federal Service of State Statistics of the Russian Federation, on the information portal Rusipoteka, rating agency Expert RA, and other materials.

The study applied a number of general scientific methods: a logical and retrospective analysis, synthesis, generalization, and system approach, expert evaluation method, visualization and correlation analysis involving the use of MS Excel.

The present study has been presented at the 12th International Conference “Economies of the Balkan and Eastern European Countries”, EBEEC 2020, that has been online in Opatija, Croatia from May 29th to 31st 2020 (<http://ebeec.ihu.gr>).

## **3. Data, Methodology and Empirical Results**

### **3.1 Mortgage loans market in Russia**

The development of securitization in Russia began long before the introduction of legislation regulating the procedure of these transactions. Past this stage of development, the securitization market is starting to move towards growth and competition. Amendments to the current legislation in the field of non-mortgage securitization, a new procedure for assessing credit risk, together with the state support in the form of the Agency for Housing Mortgage Lending (AHML), which was transformed later into a financial housing development institution DOM.RF, and the State Development Corporation VEB.RF (former Vnesheconombank), have led to the increase in securitization in Russia. However, all these achievements do not guarantee the readiness of existing infrastructure. Under current conditions, the majority of securitization transactions are related to securitization of mortgage assets.

DOM.RF (until 2018 known as the Agency for Housing Mortgage Lending (AHML)) provides a mechanism for refinancing mortgage loans by issuing single-tranche mortgage bonds. It is expected that in 2019 the issuing volume will exceed 150 billion rubles. In 2018, the issuing volume of mortgage bonds amounted to more than 100 billion rubles and the transactions involved public and private banks: Sberbank, VTB, Raiffeisen bank, Housing Finance Bank. At the end of December 2017, a deal securitized the mortgage portfolio of VTB 24 by issuing mortgage bonds worth 48.2 billion rubles. Besides that, VTB accepted applications for the purchase of securities from institutional investors.

In 2018 the volume of deals reached 146 billion rubles. VTB planned to implement more transactions involving mortgage, consumer and auto loans in 2018, expecting a significant interest of local investors in auto loan securitization. This exactly what happened in November 2018. VTB together with DOM.RF (AHML) issued mortgage bonds worth 74.3 billion rubles.

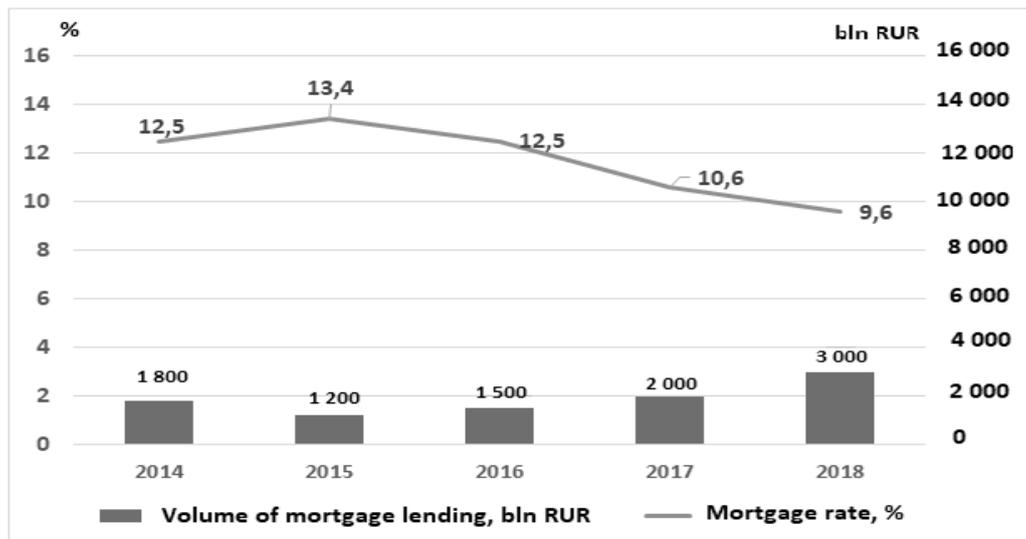
In view of 2019, VTB signed a memorandum with DOM.RF to issue mortgage bonds of up to 500 billion rubles in 2019 – 2021. Bonds will be secured by the pools of mortgages issued by the VTB Group and guaranteed by DOM.RF.

The first bond issuing within Vnesheconombank's Project Finance Factory was planned for the beginning of 2018. However, as of March 2018, the planned issuance was never carried out.

The proposed mechanism involves risk distribution: at the first stage, the borrower receives a syndicated loan from several tranches, while the VEB assumes the role of a lending agent and pledge manager; at the second stage, bonds for the amount from 10 to 30 billion rubles, guaranteed by the government and secured by the tranche portfolio, are issued. The long-term tranche is initially financed by the VEB and then assigned to the bond issuer, a special purpose vehicle (SPV). Assets are accrued to bondholders of all issuances, with the nominal value of bonds issued at any time not exceeding the asset value. Experts plan that in three years' time the portfolio of SPV will increase to 300 billion rubles.

Mortgaging remains the most dynamic segment and one of the drivers of the Russian banking system. In 2016, when the volume of issued mortgages exceeded 1.5 trillion rubles, lending rates were at a historic low. In 2018, mortgaging levels broke all records and exceeded the volume of 2016 by 2 times. As of December 31, 2018 mortgage lending volumes reached 3 billion rubles (fig.1).

These factors contribute to the development of mortgage securitization in Russia. However, the increase in the key rate led to the increase in the mortgage rate, which influenced the forecasts in mortgage lending volumes in 2019.



**Figure 1: Dynamics of mortgaging in the Russian Federation**

Note : Compiled by the author on the basis of data provided by the Central Bank of the Russian Federation. [Electronic resource]. URL: <http://cbr.ru/analytics/bnksyst/> (accessed: 03.10.2019).

The Russian mortgage market is stable and has big prospects for further development: the share of mortgaging to GDP in Russia is only 5% compared to the average 35% in other countries. Based on the projections of the researchers, more than 8 million families might be granted mortgages in the next 5 years, which is more than ever in the history of the mortgage market since 2004. At the same time, the events of 2020 allow us to judge that the forecasts are more than modest. With the outbreak of the COVID-19 pandemic, the government of the Russian Federation took a number of measures to support the economy during the period of self-isolation, one of which was aimed at supporting mortgage lending. In addition to the simplified scheme for obtaining these loans and the complete digitalization of procedures, interest rates on housing mortgage loans were reduced: according to preliminary estimates, the average market decline was 1.5%. In addition, the so-called "mortgage holidays" and the opportunity to restructure loans were provided to families in difficult life situations due to the pandemic. All this gave a significant incentive to increase the volume of housing mortgage lending, which, according to the Bank of Russia, in January-July 2020 exceeded the volume of the same period in 2019 by 34.3%. At present, mortgages issued by universal commercial banks are playing an increasing role. The Russian mortgage market consists of a large number of banks with mortgages in their balance sheets.

Based on the results of 2018, it is possible to identify 10 banks as leaders in the Russian mortgage market (Table 1).

**Table 1: Performance of leading mortgage banks in Russia in 2018**

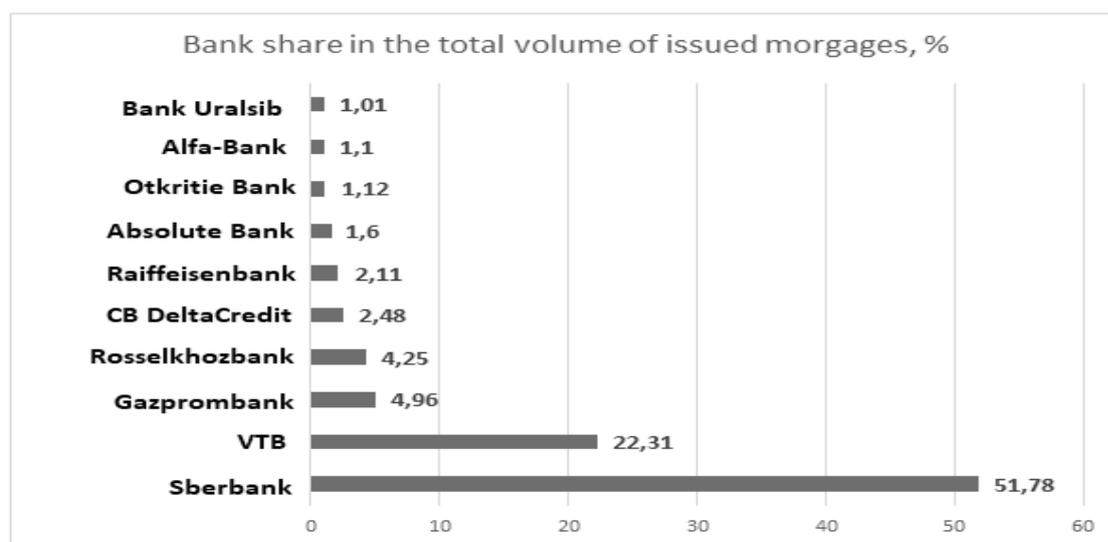
N	Bank	The volume of issued mortgage loans, mln rub.	Number of issued mortgages, pieces	Increase in the volume of issued loans compared to 2017, %
A	1	2	3	4
1	Sberbank	1 560 204	827 928	44
2	VTB	672 292	289 898	55
3	Gazprombank	149 408	64 283	87
4	Russian Agricultural Bank (Rosselkhozbank)	128 004	68 138	75
5	CB DeltaCredit	74 643	28 858	28
6	Raiffeisen bank	63 441	22 761	7,6
7	Absolute Bank	48 096	19 807	78
8	Otkritie Bank	33 743	13 323	171
9	Alfa-Bank	33 049	9 091	no data
10	Bank Uralsib	30 531	14 168	13

Note : Compiled by the author on the basis of the analytical material of LLC "Rusipoteka" – an overview of the competitive environment in the mortgage market in 2018. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry/826/> (accessed: 14.09.2019)

Sberbank of Russia headed the list of leading mortgage banks in 2018. The volume of home equity loans issued by Sberbank is 2.32 times higher than by VTB, which comes second in the list. If compared by the number of mortgages issued in the specified period, Sberbank exceeded VTB by 2.85 times. Other banks in the rating list showed lower volumes and the number of mortgages issued.

However, if we compare the same banks in 2017, almost all banks demonstrated a positive increase (from 7.6% to 171%), which fact indicates the development of mortgaging and the emerging positive dynamics.

In order to understand the conditions of the mortgage market better, it is necessary to consider the share of banks, included in the list of TOP-10 mortgage institutions, in the total volume of mortgages issued in 2018 (fig. 2).

**Figure 2: Share of leading banks in the total volume of mortgages issued in 2018**

Note : Compiled by the author on the basis of the analytical material of LLC "Rusipoteka" – an overview of the competitive environment in the mortgage market in 2018. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry/826/> (accessed: 14.09.2019)

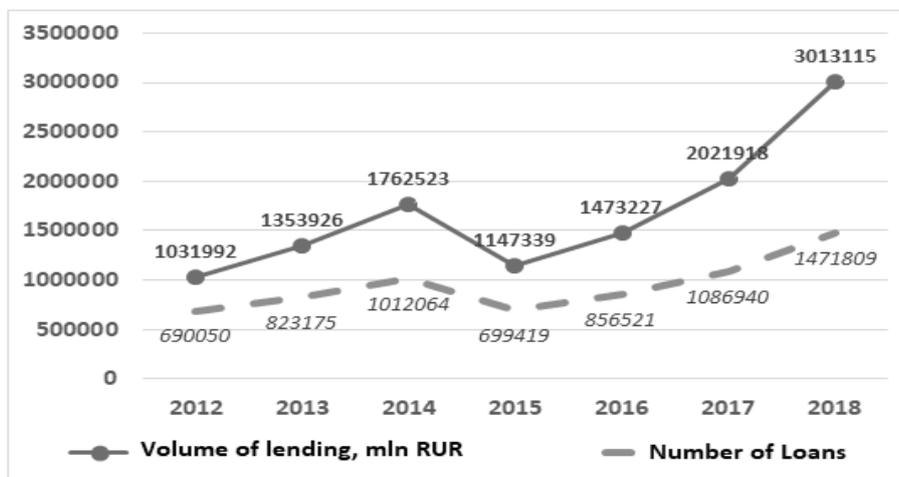
PJSC Sberbank (51.78%) and VTB (22.31%) became the absolute leaders in issuing mortgages with a total share of 74.09%. They are followed by Gazprombank (4.96%), Russian Agricultural Bank (4.25%), CB DeltaCredit (2.48%), and others.

A graph showing the volume of loans granted to residents in rubles in 2013 – 2018 (fig. 3) has been built in order to assess growth or decline trends in mortgage demand. At the end of 2018, mortgage loans increased significantly in volume and number compared to the same period in 2015.

Over the period of 2012-2018, the volume of issued mortgages increased by 1,981,123 million rubles, or 192% at the end of 2018 compared to 2013, which certainly confirms the positive forecast for mortgage lending. Such an active growth indicates that the demand for mortgage loans in Russia today is far from saturation: every year more families are granted mortgage loans. In 2018, their number almost reached 1.5 million, which is not so much for Russia. In addition, real estate is often viewed by Russians as a good investment. Therefore, people prefer this form of investment than others.

The dynamics of the volume of mortgage lending is affected by the devaluation of the Russian ruble, the rise in real estate prices, and some other factors. The growth rates of lending volumes are gradually decreasing. For

example, the growth rate of the mortgage portfolio of the leader in terms of lending, Sberbank of Russia, is lower than that of its closest competitor VTB. This indicates a gradual cooling of the demand for mortgage loans, which in turn is taken into account in securitization. Not all mortgage loans are securitized, but only a share of the portfolio determined by the banks' policy. The slowdown in securitization is due to expectations of saturation of the mortgage market. And the first to feel such saturation is the market leader, Sberbank, which predetermines a decrease in the growth rate of the portfolio in comparison with VTB Bank.

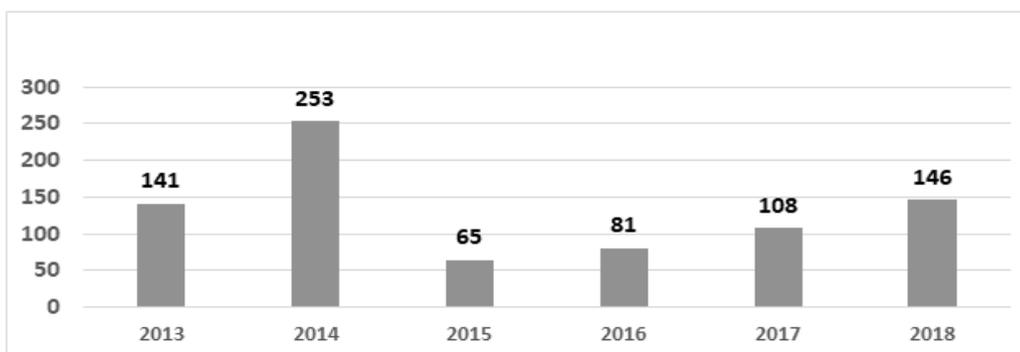


**Figure 3: Volume and number of mortgages issued to individuals during the period of 2012 – 2018.**

Note : Compiled by the author on the basis of the analytical material of LLC “Rusipoteka” – the market overview of the mortgage market in 2012-2018. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry> (accessed: 24.09.2019)

### 3.2 Development of mortgage securitization in Russia

The growth in the Russian mortgage market could not but influence the development of the mortgage securitization market, with a growing number of transactions during the period of 2016 – 2018 (fig. 4).



**Figure 4: Mortgage securitization volumes in the Russian Federation, bln. rub.**

Note : Compiled by the author on the basis of the analytical material of LLC “Rusipoteka” – the market overview of the mortgage market in 2013-2018. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry> (accessed: 24.09.2019)

The crisis of 2014 led to a sharp 74% drop in mortgage securities. However, with the growth in the volume and amount of mortgage lending, there has been an increase in the securitization of mortgage assets. The development of this type of financing has also been pushed by the restrictions in foreign capital borrowing. Mortgage lending growth rates have become the main driver for the increase in mortgage securitization.

Public policies and government support have had a positive impact on the development of the mortgage market. Government programs aimed at increasing housing construction volumes and improving mortgage lending conditions include the program for housing renovation, the Federal Target Program "Housing" for 2015-2020, the priority project “Mortgage and rental housing” and provide data used to forecast trends in mortgage securitization.

In order to identify the nature and level of correlation, an elementary correlation analysis of the impact of the interest rate on the volumes of issued mortgages, presented in figures 5 (a) and (b), respectively, was carried out. The charts show a monthly change in indicators over a 10-year period.

Using a set of observations of the monthly dynamics of the weighted average interest rate on mortgage loans and monthly volumes of issued mortgages from the beginning of 2009 to the end of 2018, the correlation coefficient was calculated using the CORREL function in MS Excel. The program calculates the coefficient according to Formula 1:

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x}) * (y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} * \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}} \quad (1)$$

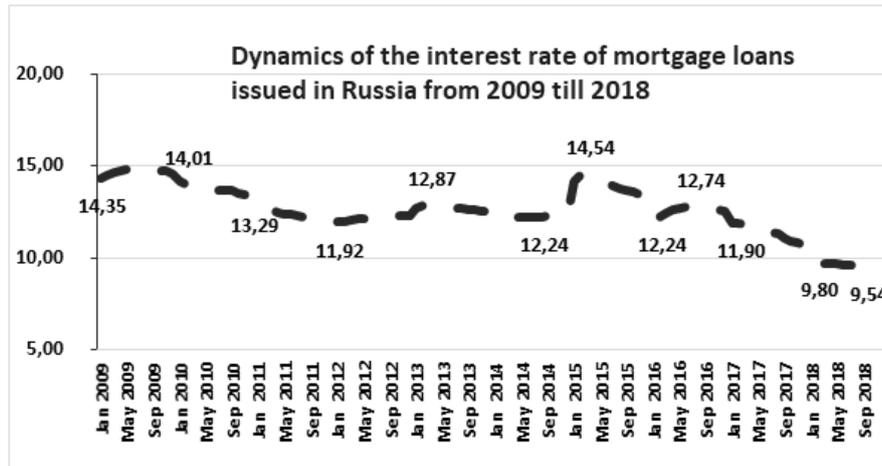
where n – number of periods

$x_i$  – amount of mortgage loans issued in period i;

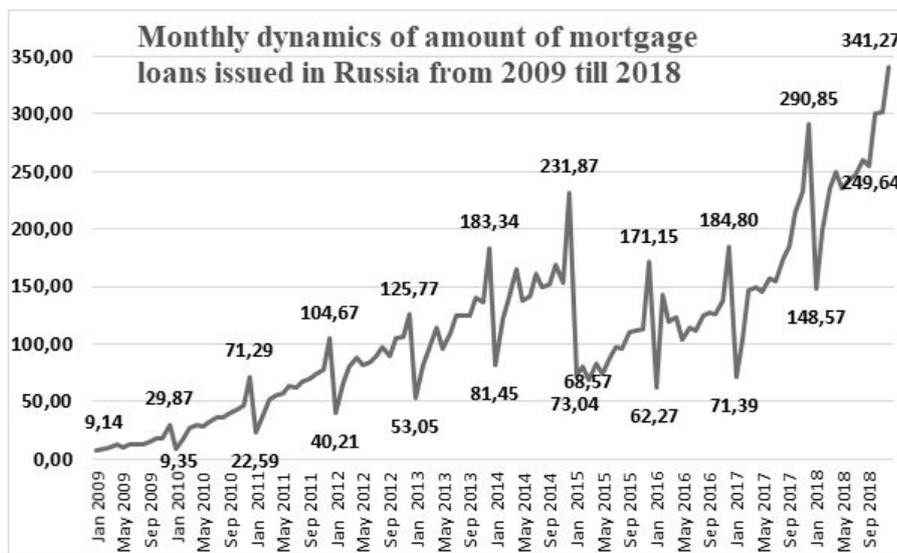
$\bar{x}$  – average value of issued mortgages over the entire period of observation;

$y_i$  – value of average weighted interest rate on mortgage loans in period i;

$\bar{y}$  – average value of average weighted interest rate on mortgage loans over the entire period of observation.



(a)



(b)

**Figure 5: Monthly dynamics of interest rate and amount of mortgage loans issued in Russia from 1.01.2009 till 31.12.2018**

Note : Compiled by the author on the basis of the analytical material of LLC "Rusipoteka" – the market overview of the mortgage market in 2009-2018. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry> (accessed: 24.09.2019)

According to calculations, the correlation coefficient  $r$  amounted to  $-0.829658207$ , which indicates that there is a strong inverse dependence between the interest rate on loans and the amount of mortgages granted. That is, the reduction of mortgage loan rates results in the increases in the volume of their issuance and vice versa.

The assessment of the statistical significance of the correlation coefficient due to the small sample size was performed using the Student's  $t$ -test. The observed (actual) value of this criterion ( $4.6995$ ) exceeds the critical values from the tables and is considered significant. Consequently, there is a close statistical relationship between the studied variables.

Coefficients of the linear function (Formula 2) are determined with the help of LINEST function in MS Excel:

$$Y = ax + b \quad (2)$$

where  $y$  – amount of issued mortgage loans;

$x$  – value of the average interest rate on a mortgage;

$a, b$  – linear function coefficients.

Calculations result in the following equation (Formula 3):

$$Y = -44223.2 * X + 665700.1 \quad (3)$$

Linear function (Formula 3) makes it possible to determine the estimated value of all mortgage loans issued in 2018 and compare it with the real value of the same year (table 2).

**Table 2: Difference between real and estimated mortgage values in 2018**

Date	Real value of mortgage loans over the period, mln. rub.	Estimated value of mortgage loans over the period, mln. rub.	Difference between real and estimated values, mln. rub.
January 2018	148 573	230101.1	-81 528
February 2018	199 261	232312.3	-33 051
March 2018	235 307	234965.7	341
April 2018	249 641	237176.9	12 464
May 2018	235 846	238503.6	-2 658
June 2018	243 060	239830.2	3 230
July 2018	246 801	240272.5	6 529
August 2018	260 302	241599.2	18 703
September 2018	255 354	242483.6	12 870
October 2018	300 572	243368.1	57 204
November 2018	302 174	243810.3	58 364
December 2018	341 265	242925.9	98 339
Total in 2018	3018156	2867349	150807

Note : Compiled by the author on the basis of the analytical material of LLC "Rusipoteka" – the market overview of the mortgage market in 2013-2018. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry> (accessed: 24.09.2019)

Estimated volume of mortgage loans exceeded the real volume in January, February and May, which could have been connected with a decrease in the activity of buyers during long holidays. The difference between the calculated indicator and the real one had been increasing in the period from June to December 2018, which could be explained by the cumulative or "snowball" effect. On the whole, in 2018, the estimated volume of mortgage lending was 150.8 billion rubles less than the real one. This fact is the evidence of the correct economic policy in the field of mortgage lending, government support and regulation of the key rate of the Central Bank. These measures proved to be quite efficient in attracting new borrowers and increasing the mortgage portfolio in excess of the estimated figures. The figure of 150.8 billion rubles are those extra resources that banks did not expect.

Since mortgage securitization is recognized as the most developed in the Russian Federation, it is necessary to estimate the impact of these additional financial resources on the securitized mortgage portfolio. For this purpose, it is necessary to calculate the securitized mortgage portfolio ratio in the total amount of issued mortgage. The securitization coefficient shall be calculated in accordance with the following formula (Formula 4):

$$\frac{\sum_{i=1}^n x_i / n}{\sum_{i=1}^n y_i / n} * 100\% \quad (4)$$

where n – number of observation periods,

$x_i$  – volume of securitized mortgage portfolio in period n;

$y_i$  – volume of all mortgage portfolio in period n.

The calculation is based on annual data for 2013-2018. After summing it up, the securitization coefficient equals to 8.9606%. In other words, only 8.96% of the entire mortgage loan portfolio is securitized. On the one hand, the value is not high, but on the other hand, the share of the securitized portfolio has the potential to grow as a result of the competent financial policy.

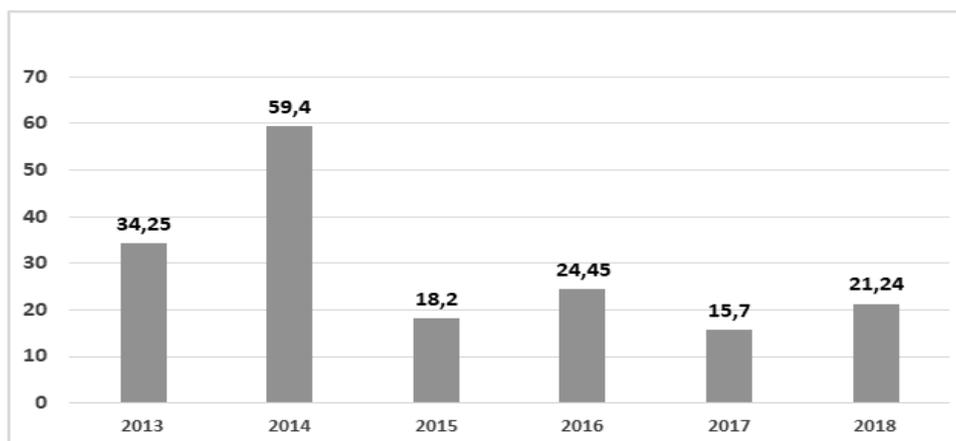
The amount of "additional securitization", the part of the securitized portfolio, which formed as a result of the difference between the volume of issued mortgage loans and the estimated one, is of particular interest. In order to assess it, it is necessary to multiply the difference between the actual amount of the mortgage portfolio and the estimated one by the securitization coefficient. Thus, the increase in securitization due to the government's quality mortgage lending policy in 2018 amounted to 13.513 million rubles. This is 9.26% of the total securitization (146 billion rubles) in 2018. Therefore, the state, by introducing changes in the socially important sector of the economy, indirectly increased the volume of securitized securities, which has a positive impact on the growth of the industry as a whole.

### 3.3 Development of non-mortgage securitization in Russia

Exploring the issues of non-mortgage securitization, those authors (Kharchenko, 2017), whose studies concern its international aspects, note that asset-backed securities (ABS) occupy a significant share of the international debt market, with the main instruments including bonds for auto loans, credit cards and student loans.

Today, bonds secured by auto loans may become another instrument of the securitization market in Russia, in addition to mortgage lending. However, there are certain difficulties, including duration assessment and low liquidity, which may limit the interest of investors. In addition, in 2014 some legal restrictions were imposed on the Russian non-mortgage securitization market. All transactions prior to the adoption of amendments to the legislation introduced by the Federal Law No. 379-FZ were carried out in accordance with the legislation of the country where the SPV was established, among which were Cyprus, Great Britain, Spain, Portugal and Italy.

The first transaction under Russian law included placement of bonds secured by the auto loan portfolio in June 2015 for the amount of more than 12.5 billion rubles. The originator of the transaction, i.e. the entity that has the right to assign receivables during the securitization of assets, was Credit Europe Bank. It was the first securitization transaction to settle open accounts between several banks, to check the complex procedure of the guarantee pool replenishment ("revolver"), to develop a mechanism for accelerated depreciation of bonds to meet specific conditions in tender documents and a unified system to control compliance with the main parameters of the transaction. The dynamics of non-mortgage securitization in Russia is unstable (fig. 6), and the data are still insufficient for relevant forecasting.



**Figure 6 – Dynamics of non-mortgage securitization in Russia, bln rub.**

Note : Compiled by the author on the basis of the analytical material of LLC “Rusipoteka” – the bank financial data. [Electronic source]. URL: <http://www.ludipoteki.ru/shop/researches/entry/975/> (accessed: 1.10.2019)

The most successful year for non-mortgage lending and securitization was 2014. After the crisis in December 2014, ABS securitization decreased by 69%. In this case, correlation analysis will prove inaccurate due to the heterogeneity of assets underlying the non-mortgage securitization, as well as due to the lack of statistical data for the reliable calculation of indicators.

One of the reasons for the low securitization of non-mortgage assets compared to mortgage-backed securities (MBS) is undeveloped legislation. Another reason is the lack of understanding of the duration of this instrument: it is hard to predict how the underlying loans will be depreciated. Therefore, while in the West such instruments are of increasing interest to insurance companies and other institutionalized investors, in Russia there are no tools to hedge the risks. It can be concluded that the Russian Federation as a whole does not have an established market of such investors who are ready to invest in these instruments. Low liquidity on such securities also inhibits the development of non-mortgage securitization.

The high cost of the securitization process also hinders the development of the market. Securitization becomes profitable with a portfolio of 3.000 million rubles or more. According to various estimates, the cost of preparing the transaction ranges from 30 to 45 million rubles, and most of the costs are accounted for by consulting. At the same time, it is obvious that the costs of the initial issuance may be much higher due to the lack of experience. Thus, only large organizations seem to have access to this method of financing.

Thus, the growth of the securitization market undoubtedly has a direct correlation with the growth of the bank's loan portfolios. After a bad year in 2015, the mortgage and other lending markets are returning to pre-crisis indicators. On the one hand, it contributes to the development of securitization and financial market of the country as a whole. However, not all segments of loan portfolios are equally attractive to investors or have similar prospects for securitization.

### 3.4 Current problems of asset-backed securitization in Russia and their solutions

The mechanism of attracting funds through asset securitization is widely used in the global financial market. Recently, this method of financing has reached emerging markets. Securitization allows a company to get a higher rating than the borrower's company, separating securitized assets from other assets of the organization and thereby reducing the cost of borrowed funds. This method of financing has other advantages (Aksenov and Golikov, 2013).

The current attractiveness of securitization operations for Russian banks might be explained by the following:

Russian banks face a long-term liquidity deficit. Securitization makes it possible to attract long-term and relatively inexpensive capital, in particular, from pension funds.

The ability of commercial banks to diversify their funding sources is important in managing liquidity and interest rate risks.

Securitization is a convenient way to control liquidity risks on the balance sheet as securities are more liquid than long-term loans.

State corporations and institutions contribute to the development of the securitization market.

There is a demand for securities from investors.

The main problem for the development of securitization in our country before 2014 was the absence of laws regulating the process of asset securitization. The only statutory instrument was the law on the securitization of mortgage loans (Federal Law No. 152-FZ of 11 November 2003 "On mortgage-backed securities"). Securitization of other non-mortgage assets under Russian law is currently regulated by Federal Law No. 379-FZ of July 1, 2014, as amended on July 3, 2016. However, insufficient regulatory provisions still affect the volume of non-mortgage securitization transactions (Kharchenko, 2017).

At the moment, one of the main problems of securitization in Russia is the lack of and inability to attract long-term resources in the international market. In this regard, the state needs to take measures to transform legislation in the field of securitization. The new law should reflect the statements, put forward by major market players, and stimulate investments in securitized assets by institutional investors. It is also necessary to make provisions for the measures designed, on the one hand, to encourage banks to resort to securitization and, on the other hand, to take into account the foreign experience of securitization, which restrains the so-called "bubbles" in the derivatives markets.

Another way to increase securitization in Russia is to standardize assets. Standardization greatly simplifies securitization. Standardized assets are easier to pool, which significantly reduces costs. On the other hand, standardized assets make it easier to conduct the analysis and assessment of collateral securities and risks for such assets, which facilitates decision-making by investors and, therefore, increases the attractiveness of securitized securities (Kolmykova, 2013).

DOM.RF is involved in the buyout and standardization of mortgage loans. However, its limited functionality also hinders the development of securitization. It is necessary to extend the mandate of the company and broaden its functions. For example, in order to reduce systemic risks of the mortgage market, DOM.RF shall provide information on the default of groups of borrowers. Since the mortgage portfolio of DOM.RF is the largest in the market and well-diversified at the regional level, this information will allow major lenders to improve the quality of borrower assessment and risk forecasting for the developing portfolio.

Mortgage loans should rightly be the pioneers of securitization. In order to consolidate this position, the professional community, for example, in the form of domestic banking associations, should develop general principles for the organization of a pool of standardized assets and create standard rules for the issue of securities and their placement. At the same time, it is necessary to avoid totalitarian actions. All processes should be regulated by market conditions, without the interference of the government and the regulator in pricing at any stage, i.e. at the stage of formation of the pool of assets, and at the stage of securitization.

Difficulties also lie in the absence of coordination of actions and lack of trust in new developments. Many banks, together with financial companies and some public authorities, make attempts at developing the mortgage market in the digital environment. Information technology has been helping to improve various aspects of life for 40 years and has been in use in banks for more than 15 years. The development of banking applications and technologies facilitates the lives of clients, as well as bank employees. For instance, in the middle of 2018, the legislators passed amendments, making provisions for the electronic mortgage deed, which significantly simplified its storage. Following these amendments, there have been introduced various services to provide mortgage loans via the Internet. As a result of these measures, the speed of the transactions is expected to increase from 2 weeks to 3-4 days. This is only the first stage in the process and, obviously, the incompetence of people, abuse of powers or even criminal actions might pose obstacles and impede the development of new products. Besides, not all clients are ready to conduct online transactions. Hopefully, there will be improvements in cybersecurity, investigation of crimes related to the use of electronic signatures, protection of the rights of customers of banks involved in online banking, and customers will be given time to adapt to new technologies.

The development of new financial products and technologies often runs ahead of the expectations of society, which is not always prepared to accept them. Moreover, even financial service providers might not be ready. One example is the project of a "decentralized depository system" based on the MasterChain platform that was developed by banks and financial companies. It is a very convenient and progressive tool to accelerate the processes of registration, storage, and transfer of the title to real estate. However, at present, the platform operates only with mortgages and, thus, promotes only mortgage lending. In order to develop securitization, it is necessary for the platform to be able to transfer and register titles, which is not yet in the power of the banks and financial companies. In order to meet the real needs of the securitization market, the involvement of the Federal Service for State Registration, the Cadastre, and Cartography (Rosreestr) is necessary. As soon as the agency starts registering titles and transferring mortgages using blockchain technology, the process of transferring mortgages will be accelerated and the process of creating mortgage pools will also gain speed. It will reduce the time of the securitization process and, consequently, the costs of issuing securitization securities, which may facilitate the entry of small and medium-sized banks into the market. This will not only promote long-term liquidity and asset portfolio expansion, but also the development of interbank competition.

The next problem is bureaucratic inconsistencies. According to the Bank of Russia's Information of 15 July 2018 "On setting the long-term creditworthiness rating to invest pension savings and savings for housing provision for servicemen", the minimum rating level for investing pension savings is set at BB+ as (RU) in the classification of

Analytical Credit Rating Agency (ACRA JSC). However, in accordance with the guidelines of the Basel Committee on Banking Supervision on structured finance instruments, including mortgage-backed securities, the agency assigned the suffix “.SF” (i.e. it should read not just RU, but RU.SF). Contrary to expectations, that was not a formality and it would now require a separate decision of the regulator to determine the minimum rating level for mortgage-backed securities to invest pension savings (RUSIPOTECA, 2019)<sup>1</sup>.

Many authors (Aksenov, Golikov, 2013; Denisov, 2016) believe that for the development of securitization it is important to abolish the 10% limit in the portfolio for investing pension savings of non-governmental pension funds (NPFs) in mortgage-backed securities, which fall under this restriction due to the specifics of depreciation. The reasoning is usually based on the fact that the credit quality of such securities meets the requirements of NPF investments. In addition, the NPF managers have sufficient expertise and resources to evaluate such securities. However, the 10-15% limit seems to be fair and corresponds to the moderate investment policy that a socially significant institutional investor should follow. Other institutional investors, including investment funds and insurance companies, might adopt more aggressive investment strategies to expand their investor base.

Solving the above problems will undoubtedly contribute to the development of the domestic asset securitization market. Changes in the regulatory framework and standardization of transactions will promote further growth of the Russian mortgage market and create additional incentives for housing construction, as well as reduce the degree of monopolization in the mortgage segment of the Russian economy. The proposed measures will also enhance investor protection in the Russian real estate market and securitize transactions.

#### 4. Conclusion

Based on the analysis of the current state of the securitization market in Russia, mortgage securitization obviously prevails. This is due to the fact that mortgage loans are long-term and mostly standardized, which facilitates the securitization process. The government policy in the sphere of mortgage lending also contributes to this process. The state, while managing the change in the socially important sector of the economy, indirectly increased the volume of securitized securities, which had a positive impact on the whole industry. In the article, it was proved that housing mortgage lending is showing steady growth, which is supported by successful government policies. Other types of mortgage lending are not developing yet.

The non-mortgage securitization has a much smaller share in the total volume of securitization. This can be accounted for by the lack of experience in conducting transactions and standardization of assets, as well as by insufficient attention of the government to this type of securitization. Undoubtedly, direct and indirect government support is fully aimed at mortgage securitization.

The securitization process, in general, is not devoid of the problems hindering its development. For example, there are inconsistencies in the legislation. Besides, the sanctions imposed by the USA and European countries do not allow foreign investors to invest funds in the securities of leading Russian issuers. Particular attention should be paid to bureaucratic inconsistencies that require a separate decision of the regulator to determine the minimum rating level of mortgage-backed securities for the investment of pension savings.

National financial technologies in the field of mortgage securitization might have become the most advanced in the world by the present time. However, in order to satisfy all the requirements set for transactions and to meet the real demands of the securitization market, it is necessary to involve the Federal Service for State Registration, the Cadastre, and Cartography (“Rosreestre”). The agency shall include the blockchain technology in the arsenal of tools to speed up the registration of rights and transfer of mortgages, which in its turn will facilitate the formation of mortgage pools, making securitization cheaper and more accessible for smaller banks.

To encourage customers to use digital technology, banks and public service providers need to pay attention to cybersecurity. Law enforcement agencies should consolidate their efforts to investigate electronic signature-related crimes, protect the rights of online banking customers, and promote and raise public awareness.

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## The British Stock Market under the Structure of Market Capitalization Value: New Evidence on its Predictive Content

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ARTICLE INFO	ABSTRACT
<p>Article History</p> <p>Received 13 September 2020; Accepted 4 January 2020</p> <hr/> <p><i>JEL Classifications</i> G11, G12, G17, E44</p>	<p><b>Purpose:</b> The aim of our paper is twofold. First, we examine the predictive ability of log book-market, dividend-price, earnings-price and dividend-earnings ratios on the most recent data set of the strongest securities in the UK economy; unlike the majority of the studies in this data set, our analysis is not limited on returns but further investigates dividend and earnings growth predictability under the presence of the most recent global financial recession. Second, we exploit the long-run equilibrium relationship in two systems, <math>[p_t, d_t, e_t]</math> and <math>[p_t, b_t, e_t]</math> and examine the predictive ability of our newly formed variables, namely <math>pde_t</math> and <math>pbe_t</math>.</p> <p><b>Design/methodology/approach:</b> In this study, we examine the most recent data set of Financial Times Stock Exchange 100 (FTSE 100) and analyze it based on the formation of size portfolios. The main focus is placed on the index's returns, dividend and earnings growth rates and the predictive ability of the four financial ratios we have selected following their reputation as strong predictors. We also formulate two extra ratios based on their long-run equilibrium relationship.</p> <p><b>Finding:</b> Our study's main findings can be summarized as following. First, we retrieve evidence that in-sample return predictability is evident in the medium and large-sized portfolios and is better captured by <math>pde_t</math> at 35% and 47% equivalently. Second, forecasts on dividend growth are even more linked to the size criterion we employ. Third, in-sample regressions of continuously compounded earnings growth rate show that most predictive benefits are obtained by <math>dp_t</math> in the medium portfolio with an <math>R^2</math> of 45%.</p> <p><b>Research limitations/implications:</b> A first constraint is the forecasters we employ; we have used the most indicative ones due to their popularity in similar data sets but there are other macroeconomic variables such as spreads and interest rates that could be tested in future research. Also, we could examine the sensitivity of our results on whether we use nominal, excess or real returns and then, attempt to alter our data's frequency so as to address the seasonality effect observed mainly in dividends and earnings.</p> <p><b>Originality/value:</b> We believe that our paper contributes to the ongoing debate of the traits that make return predictable and the information included in either dividends or earnings to explain that predictability. Finally, the novelty of this paper lies in the links it tries to retrieve among market capitalization value and predictability in a market whose predictive components have not been entirely explored. Our paper may prove informative to investors focused on short-term forecasting and interested in the effects of size in portfolio formation.</p>
<p><b>Keywords:</b> Return predictability, dividend growth, earnings growth, size portfolios, FTSE 100</p>	

### 1. Introduction

There have been intensive efforts on examining the predictive ability of certain macroeconomic variables so as to produce valid forecasts. Employing a number of data sets and methodologies, the empirical literature has covered in great depth the issues of financial ratios' ability to explain variations in stock returns and shed light on other predictable components such as dividend and earnings (see for example, Cochrane, 2009; Lettau and Ludvigson, 2005; Campbell and Shiller, 2001). A significant limitation of the literature though is that it has primarily focused on US

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data (see, e.g. Campbell and Shiller, 2001; Cochrane, 2009; Lettau and Ludvigson, 2001; Welch and Goyal, 2008; Ang and Bekaert, 2007). Fewer studies can be retrieved with regards to European data, and in particular UK data sets (e.g. Fletcher, 2010; Clare et al., 1997; Michou et al., 2012) with the notable exception of a rather small number of studies which have focused on the ability of several forecasters to predict UK stock returns (see Strong et al., 1997; Morelli, 2007).

Under the light of this event, our paper tries not only to retrieve evidence of returns forecasting in the British market, but it also associates the findings with market capitalization value by fixing size portfolios of the market's strongest index. We therefore focus on the Financial Times Stock Exchange 100 (FTSE 100) and group its securities into size portfolios of returns, dividend and earnings growth. The included securities are grouped in such a way that the small portfolio consists of one third of the index's securities with the smallest market capitalization value, while the large portfolio includes the last third of FTSE 100 with the highest market cap value. Consequently, we construct three (small, medium and large) return portfolios, and extend our analysis by also fixing three dividend and three earnings growth portfolios. There are three main reasons why the UK market is chosen as a case study in this research; first, the data availability and second, the quality of the data are far more superior compared to other markets. Third, since the research efforts on US datasets are so extensive, it is perhaps more efficient in terms of comparison to isolate the Anglo-Saxon economies and study similarities, if any, in forecasting patterns.

We examine the predictive power of book-price ( $bp_t$ ), dividend-price ( $dp_t$ ), earnings-price ( $ep_t$ ) and dividend-earnings' ( $de_t$ ). Unlike the majority of the studies in this field, our forecasts are only in-sample, since due to data availability, we are unable to provide out-of-sample forecasts. However, we leave this puzzle for future research. The selection of the ratios is primarily based on these ratios' predictive capacity in return forecasting as they are all well-renowned for their predictive benefits (Lamont, 1998; Cochrane, 1999b; Torous et al., 2004). Specifically, Pontiff and Schall (1998) argue that  $bp_t$  acts a good predictor because book value proxies for expected future cash flows, while in  $dp_t$ 's case, there has been a vigorous discussion over dividend's ability to measure the permanent components of stock prices, and thus explain the managerial behavior behind dividend policies setting (Cochrane, 2009). Regarding  $ep_t$ 's predictive ability, it is linked to its potential to be a good measure of current business conditions (Lamont, 1998), while the classical  $de_t$  ratio has provoked fruitful discussion and empirical research since it associates the level of future earnings to dividend payment schemes (Gill et al., 2010).

In this context the aim of our paper is twofold. First, we examine the predictive ability of  $\log bp_t$ ,  $dp_t$ ,  $ep_t$  and  $de_t$  ratios on the most recent data set of the strongest securities in the UK economy; unlike the majority of the studies in this data set, our analysis is not limited on returns but further investigates dividend and earnings growth predictive patterns under the presence of the most recent global financial recession. Previous research on this specific dataset indicates rather mild evidence of returns predictability by ratios such as the dividend and earnings yields (see Morelli, 2007), while classical performance models such as the CAPM and Fama and French factor models are unable to interpret observed variations in the British stock market (see Fletcher, 2001; Georgiou et al., 2019). We also exploit the long-run equilibrium relationship in two systems,  $[p_t, d_t, e_t]$  and  $[p_t, b_t, e_t]$  and examine the predictive ability of our newly formed variables, namely  $pde_t$  and  $pbe_t$ . Similar efforts may have been employed before primarily on US data, however the degree at which cointegrated series can forecast the UK returns remains unexplored.

We believe that our paper contributes to the ongoing debate of the traits that make return predictable and the information included in either dividends or earnings to explain that predictability. Finally, the novelty of this paper lies in the links it tries to retrieve among market capitalization value and predictability in a market whose predictive components have not been entirely explored. This study presents new evidence with regards to the strongest index of the UK economy during a severe economic recession worldwide. To the best of our knowledge such an analysis with this specific data set has not been reported elsewhere.

The remainder of the paper is organized as follows: Section 2 presents some key references of the literature review on time series predictability, while Section 3 sets our research framework. Section 4 formally examines the ability of our selected financial ratios to forecast the UK returns, dividend and earnings growth rates in-sample. Concluding remarks follow in Section 5.

## 2. Literature Review

### 2.1 Evidence of ratios that predict returns

The literature that examines return predictability has extensively referred to several variables that potentially explain the observed variations in returns. With regards to the ratios employed in this study, there have been vigorous theoretical and empirical discussions stressing that both  $dp_t$  (see the discussion in Campbell and Viceira, 2002; Lewellen, 2004; Campbell and Yogo, 2006) and  $ep_t$  (e.g. Campbell and Shiller, 1998; Lamont, 1998; Shen, 2000) are highly persistent, and that is the reason why predictability as measured by  $R^2$ , tends to rise in longer horizons. For instance, Lewellen (2004) reports that both  $dp_t$  and  $ep_t$ 's persistence is strong, leading to a coefficient of 0.99 on a monthly basis during the period 1946-2000. Campbell and Yogo (2006) show that  $ep_t$ 's predictive benefits are stronger in US data, while  $dp_t$  can predict returns but only on an annual basis. On the other hand, by examining similar ratios' forecasting ability on a variety of data sets, Campbell and Shiller (2001) conclude that  $dp_t$  and  $ep_t$  are weak forecasters of dividend and earnings growth, but they do forecast changes in future stock prices. Shen (2000) reports that high pe ratios today mean low stock prices tomorrow.

Supplementary studies on the selected forecasters include Lamont (1998) who examines dividends and earnings ability to predict returns during 1947-1994 and argues that financial ratios are rather weak in long-term predictions but do a fine job on the short-term. He argues that the reason why  $de_t$  provides evidence of predictability is either because dividends can predict future returns and/or earnings do. More specifically, he supports that dividends measure the managerial behavior in dividends setting schemes, thus dividends is a good measure of the permanent component in prices. On the other hand, earnings vary according to the economic conditions; in times of recession, investors demand high expected returns, while in times of booms, they do not worry on lower expected returns. In other words, earnings is a good measure of the current business conditions. Finally, when examining the ability of  $bp_t$  to similarly explain variations in the stock market, Pontiff and Schall (1998) associate its predictive ability to size portfolios and argue that it is a far stronger predictor compared to other examined variables such as dividend yields and interest rate spreads; in fact, it manages to predict both future market returns and excess returns of DJIA and S&P stocks in small portfolios for the period 1920-1993. Cochrane (1999) also supports that low price-book values today signal high average returns tomorrow; it is the value of prices rather than the book values that determines future returns in either individual or grouped into size-portfolios securities and thus, book values alone hold almost minor predictive power (Berk, 1995; Cochrane, 1999).

More specifically about the UK market, variables that have been identified for their strong predictive benefits are the  $dp_t$  ratio, the January effect<sup>1</sup>, money supply, inflation rate and the company size effect. Li (2009) argues that out of these variables, the January effect is the most powerful predictor. Also, Bowen et al. (2010) report predictability evidence on the UK market, identifying certain periods that are highly predictable. By employing the Lo and MacKinlay Variance Ratio and the Chow and Denning Multiple Variance Ratio, they form size portfolios similar to the ones of this study for the period 1963-2007. They argue that in certain sub-periods, namely 1965-1974 and 1975-1985, all size portfolios are predictable, while during 1986-1996 only the large size portfolios have some predictive benefits. Their paper also examines the 1997-2007 period, during which predictability is revived for the majority of the included stocks in their sample.

## 2.2 Dividend growth predictive evidence

A separate strand of empirical literature is also focused on the dividend growth predictability (Ang and Bekaert, 2007; Welch and Goyal, 2008; Lettau and Van Nieuwerburgh, 2008; Cochrane, 2009) and mainly stresses on  $dp_t$ 's forecasting ability. Cochrane (2009) argues that  $dp_t$  is unable to predict dividend growth on US data, and  $dp_t$ 's variations can only explain expected returns' variations. A similar result is also retrieved for the UK data set by Wetherilt and Wells (2004), who run the same regression as Cochrane on non-overlapping data for the period 1925-2002 and receive an  $R^2$  equal to 0.02 compared to Cochrane's result at 0.06. Nonetheless, they do find evidence of UK predictability on quarterly excess returns, confirming that both  $dp_t$  and  $ep_t$  have some predictive power.

A more recent study of Garrett and Priestley (2012) on a similar data set, presents evidence that dividend growth is indeed highly predictable when the predictor variable is estimated from the cointegration relationship between dividends, prices and earnings. Retrieving evidence on cointegrated time series and testing whether these long-run equilibrium relationships can explain variations in different stock markets has been employed before. For example, Lettau and Ludvigson (2001) fix their consumption-wealth ratio (cay) in US data sets and further elaborate on the reasons why the traditional  $dp_t$  ratio is a weak forecaster of dividend growth and why their cay interprets business cycle variations in expected excess returns.

## 2.3 Earnings growth predictability

Finally, references on earnings growth predictability are rather limited, particularly in the British data. In fact, earnings growth has been associated with return predictability either in cross-sectional or time series studies (see for example, Teets and Wasley, 1996; Kothari et al., 2006). Campbell (1991) argues that there are two scenarios for earning changes at time  $t$ ; either they are positively correlated with news of expected returns at time  $t$ , or/and they are negatively correlated with expected returns at time  $t-1$ . An indicative study on monthly and annual US returns for instance, for the period 1965-2005, report that the  $dp_t$  ratio is able to predict earnings growth and returns but in opposite directions (that is, high  $dp_t$  values predict higher returns and lower earnings growth rates), indicating that both expected returns and expected earnings are negatively correlated (Sadka and Sadka, 2009). A supplementary reason why researchers are rather reluctant on employing earnings data in financial forecasting may also be the very nature of the data sets; the variety of accounting definitions and the changing measurement traits of earnings produce earnings related ratios that may seriously tackle with their forecastability. An indicative example is Siegel's recent paper (2016) who fixes Campbell and Shiller's cyclically-adjusted price-earnings ratio (cape) with either NIPA profits and S&P's reported earnings; he shows that cape constructed by NIPA data is a stronger forecaster.

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<sup>1</sup> A seasonal effect, suggesting that January average returns are much higher compared to other months (see the discussion in Clare et al., 1995).

### 3. Research Methodology

#### 3.1 Data description

Our data set consists of monthly observations on prices,  $ep_t$ ,  $bp_t$  and  $de_t$  of each stock included in the Financial Times Stock Exchange 100 (FTSE 100), covering the period 1996:01-2016:12. We construct three size portfolios, based on stocks' market capitalization value. Therefore, the "small" portfolio consists of one third of the securities with the lowest market capitalization value of the index, while the "large" portfolio includes the last third of the securities with the highest market cap value. There are two primary arguments in favor of sorting stocks in portfolios; first, it reduces the idiosyncratic volatility, and second, factor loadings and thus, risk premia are more precisely estimated. This is an approach which originates in Blume (1970) who argues that the estimation errors in betas can be scattered away when stocks are aggregated in portfolios. The main rationale is that the more precision we receive when estimating factor loadings, the more precise we can be overall and have lower standard errors of factor risk premia (see the discussion in Black, Jensen and Scholes, 1972; Fama and MacBeth, 1973; Fama and French, 1993).

With regards to our dependent variables, we construct returns ( $r_t$ ), dividend growth ( $\Delta d_t$ ) and earnings growth ( $\Delta e_t$ ) of all size portfolios on a monthly basis. We denote  $r_t$  as the log nominal returns of each portfolio,  $P_t$ ,  $D_t$ ,  $B_t$  and  $E_t$  the values of price, dividends, book and earnings at month t, respectively. When lowercase numbers are used, they stand for the log values of their capital equivalents (that is,  $p_t = \log P_t$ ,  $d_t = \log D_t$ ,  $b_t = \log B_t$  and  $e_t = \log E_t$ ). The monthly returns are estimated following the formula:

$$r_t = \log\left(\frac{P_t + D_t}{P_{t-1}}\right) \quad (3.1)$$

This estimation is similar to the rationale of Ang and Bekaert (2007) and Chen (2009).

By keeping size as our selection criterion of grouping the total 100 stocks included in the index, we additionally form three dividend and three earnings growth portfolios. Overall, nine portfolios (three return portfolios, three dividend and three earnings growth portfolios) are constructed in this study.

The monthly dividend growth rate is estimated as,

$$\Delta d_t = \log\left(\frac{D_{t+1}}{D_t}\right) = \log\left(\frac{\left(\frac{D_{t+1}}{P_{t+1}}\right) P_{t+1}}{\left(\frac{D_t}{P_t}\right) P_t}\right) = \log\left(\frac{D_{t+1}}{P_{t+1}} \frac{P_t}{D_t} \frac{P_{t+1}}{P_t}\right), \quad (3.2)$$

where,  $\frac{P_{t+1}}{P_t}$  is the monthly returns without dividends. The monthly earnings growth rate is respectively,

$$\Delta e_t = \log\left(\frac{E_{t+1}}{E_t}\right) = \log\left(\frac{\left(\frac{E_{t+1}}{P_{t+1}}\right) P_{t+1}}{\left(\frac{E_t}{P_t}\right) P_t}\right) = \log\left(\frac{E_{t+1}}{P_{t+1}} \frac{P_t}{E_t} \frac{P_{t+1}}{P_t}\right) \quad (3.3)$$

These variables are constructed under the rationale of Cochrane (2009).

The synthesis of our independent variables includes  $bp_t$  estimated as the ratio of book value to price for each security, as calculated by Bloomberg database. We consider dividends as the 12-month moving sums of dividends paid on the FTSE 100. Therefore,  $dp_t$  is the difference between log dividends and log prices. Earnings are also considered as the 12-month moving sums of the index's earnings, thus our  $ep_t$  is the difference of log earnings to log prices. Finally, we construct  $de_t$  as the difference of log dividends to log earnings (see the discussion in Campbell and Shiller, 1998; Lamont, 1998; Welch and Goyal, 2007; Ang and Bekaert, 2007).

Our efforts focus on retrieving the predictive ability of  $bp_t$ ,  $dp_t$ ,  $ep_t$ , and  $de_t$  on returns, earnings and dividend growth of the entire index. We also examine the trends among individual components of these forecasters, and find two cointegration relationships; one among prices (p), dividends (d) and earnings (e), and another in prices, book values (b) and earnings. We consequently form  $pde_t$  and  $pbe_t$  and examine their performance in our portfolios. Our analysis exploits the size criterion and seeks linkages between the market capitalization value of stocks and the predictability of the selected variables. The entire data set is provided by Bloomberg database.

#### 3.2 Estimating the co-integration among the series

In this paper we follow the multivariate Johansen methodology (1995a) which tests for the presence of multiple cointegration relations. The implementation of the technique itself can be divided into several steps, in the first of which we need to test the order of integration of each variable entering the multivariate model. Second, we need to set the suitable lag length of the VAR and third, test and determine the reduced rank of the matrix  $\Pi = \alpha\beta'$ . In the fourth step, we need to decide whether trends exist in the data, and thus, deterministic variables should enter the cointegration space. Finally, we examine the case of weak exogeneity and test for unique cointegration vectors by setting restrictions on  $\alpha$  and  $\beta$ .

More specifically, in our study we are interested in examining the presence and number of cointegration relations in two systems of variables:  $w'_t = [p_t, d_t, e_t]'$  and  $z'_t = [p_t, b_t, e_t]'$  on the index's monthly data based on the assumption that all variables included in both systems are I(1) as verified by unit root tests. The Johansen approach essentially estimates a Vector Error Correction (VEC) model and concludes its rank by the size of the eigenvalues of an impact matrix  $\Pi = \alpha\beta'$ , where  $\alpha$  is the speed of adjustment to disequilibrium while  $\beta$  is the matrix of long-run coefficients such that the term  $\beta'w_{t-1}$  embedded in the VECM of eq. (3.7) below stands for up to (n-1) cointegration relationships in the multivariate model.

We firstly assume that there are two separate three-dimension vectors  $w'_t = [p_t \ d_t \ e_t]$  and  $z'_t = [p_t \ b_t \ e_t]$  and two cointegration vectors  $b$  and  $c$  exist respectively. Then the errors in the data set are represented by  $b'w_{t-1}$  and  $c'z_{t-1}$ . Our  $pde_t$  and  $pbe_t$  variables refer to the trend deviations from the long-run equilibrium between prices, dividends and earnings on the one hand, and prices, book values and earnings on the other.

$$pde_t = p_t - \gamma_1 d_t - \gamma_2 e_t \quad (3.4)$$

$$pbe_t = p_t - \delta_1 b_t - \delta_2 e_t \quad (3.5)$$

We proceed by normalizing each vector and setting the coefficient on price equal to one, therefore each cointegration relation is denoted as  $g'=(1, -\gamma_1, -\gamma_2)$  for the vector  $w'_t$  and  $p'=(1, -\delta_1, -\delta_2)$  for the vector  $z'_t$ . In order to estimate the parameters  $\gamma_1, \gamma_2$  and  $\delta_1, \delta_2$  we examine both systems in separate VAR models in levels. Based on the aforementioned steps of the technique, we commence with two unrestricted VAR models involving up to  $k$  lags of the form:

$$w_t = A_1 w_{t-1} + \dots + A_k w_{t-k} + u_t \quad U_t \sim IN(0, \Sigma) \quad (3.6)$$

where,  $w_t = [p_t \ d_t \ e_t]'$  and each  $A_i$  is an  $(3 \times 1)$  matrix of parameters. A similar VAR is formed for  $z_t = [p_t \ b_t \ e_t]'$ . We then test for lag length criteria by assuming a high initial number of auto-regressive lags (that is 12 since we are dealing with monthly data). Based on Hannan-Quinn criterion (HQ)<sup>2</sup>, we condition down to a more harmonious representation of using 2 lags for VAR, and thus 1 lag for VECM in both vectors. Eq. (3.6) is then formulated in a VECM following the form of:

$$\Delta w_t = v + \beta \hat{g}' w_{t-1} + \Gamma(L) \Delta w_{t-1} + e_t \quad (3.7)$$

where,  $\Delta w_t$  is the  $(3 \times 1)$  vector of log first differences for  $(\Delta p_t, \Delta d_t, \Delta e_t)'$ ,  $v$  and  $\beta$  are  $(3 \times 1)$  vectors,  $\Gamma(L)$  is a finite order distributed lag operator, and  $\hat{g}$  is the  $(3 \times 1)$  vector of previously estimated cointegration coefficients. A similar set of equation holds for  $(\Delta p_t, \Delta b_t, \Delta e_t)'$  where we replace  $\hat{g}$  with  $\hat{p}$ .

We consider the Trace statistic values as our identification criterion of cointegration, under the null hypothesis ( $H_0$ ) that there are exactly  $r$  cointegrating relations against the alternative ( $H_1$ ) that there are  $p$  cointegration relations (where  $p$  is the number of the series included in each vector)<sup>3</sup>. Regarding the determination of critical values, we consider that our log series have linear trends but the cointegration relation consists of only a constant (see the discussion in Johansen, 1995 about these assumptions).

**Table 1:** Cointegration table and the null hypothesis  $[1 \ -1 \ 0]$  for  $pde_t$ . The table presents the results of the Johansen test on the pair  $[p \ d \ e]$ , to retrieve evidence of cointegration relationships among prices (p), 12-month summed dividends (d) and 12-month summed earnings (e). Panel B tests the restriction that  $[1 \ -1 \ 0]$  spans the cointegration space among (p, d, e). 5% and 1% significance are denoted by \*\* and \*\*\* respectively. Data is monthly, covering the period 1996:01-2016:12

Panel A	Coint. Vector	Trace test stat.	5% crit. value
	0	38.48**	29.80
	$\leq 1$	9.12	15.49
	$\leq 2$	0.64	3.84
<b>Panel B</b>	<b><math>H_0: [1 \ -1 \ 0]</math></b>	<b><math>\chi^2</math>-stat.</b>	
		28.44***	

Source: Bloomberg database

**Table 2:** Cointegration table and the null hypothesis  $[1 \ -1 \ 0]$  for  $pbe_t$ . The table presents the results of the Johansen test on the pair  $[p \ b \ e]$ , to retrieve evidence of cointegration relationships among prices (p), book values (b) and 12-month summed earnings (e). Panel B tests the restriction that  $[1 \ -1 \ 0]$  spans the cointegration space among (p, b, e). 5% and 1% significance are denoted by \*\* and \*\*\* respectively. Data is monthly, covering the period 1996:01-2016:12

Panel A	Coint. Vector	Trace test stat.	5% crit. value
	0	40.87**	29.80
	$\leq 1$	11.77	15.49
	$\leq 2$	3.73	3.84
<b>Panel B</b>	<b><math>H_0: [1 \ -1 \ 0]</math></b>	<b><math>\chi^2</math>-stat.</b>	
		11.65***	

Source: Bloomberg database

The evidence in Tables 1 and 2 strongly suggest that there is a single cointegration relationship in each system following the forms:

$$pde_t = p_t + 0.0485d_t - 2.7270e_t \quad (3.8)$$

<sup>2</sup> See the discussion in Johansen et al. (2000) for the reason why this specific criterion is utilized against the alternatives, even though results are similar if one prefers to use the Akaike Information Criterion (AIC).

<sup>3</sup> We have also considered L-max statistic to identify cointegration with no significant changes in the outcomes.

$$pbe_t = p_t - 0.6161b_t - 0.3967e_t \quad (3.9)$$

Also, Panel B of both Tables examines the restriction that  $\begin{bmatrix} 1 & -1 & 0 \end{bmatrix}$  spans the cointegration space of the Johansen methodology on  $\begin{bmatrix} p_t & d_t & e_t \end{bmatrix}$  and  $\begin{bmatrix} p_t & b_t & e_t \end{bmatrix}$  and confirms that it does not. This consists an even stronger indication that our series are indeed I(1) processes.

#### 4. Results

This section presents the empirical findings and proceeds on interpreting the outcomes.

##### 4.1 Descriptive statistics

Table 3 reports the descriptive statistics of the FTSE 100 after the construction of the size portfolios of returns (Panel A), of the dividends growth rate (Panel B), earnings growth rate (Panel C) and the selected predictive variables (Panel D) for the period 1996:01-2016:12. Certain patterns that are related to the rest of this paper are boldfaced and discussed below.

**Table 3:** Data summary of the FTSE 100 returns ( $r_t$ ), dividend growth ( $\Delta d_t$ ) and earnings growth ( $\Delta e_t$ ), covering the period 1996:01-2016:12 as provided by Bloomberg database. The mean, standard deviation and autocorrelation coefficient based on an AR(1) model of returns, dividends and earnings growth are reported. Panel A consists of the returns of the size portfolios based on the market capitalization criterion, while Panels B and C report the portfolios' dividend and earnings growth rates respectively. Panel D includes the selected financial ratios employed. The discussed numbers in the text are boldfaced.

Size portfolios	Mean	Std	AR(1)
<i>Panel A: Returns</i>			
Small	<b>2.16</b>	<b>0.54</b>	0.89
Medium	<b>2.20</b>	<b>0.53</b>	0.94
Large	<b>2.25</b>	<b>0.39</b>	0.84
<i>Panel B: Dividend growth</i>			
Small	0.74	<b>0.39</b>	0.01
Medium	0.74	<b>0.16</b>	-0.11
Large	<b>0.95</b>	<b>0.39</b>	0.08
<i>Panel C: Earnings growth</i>			
Small	<b>0.89</b>	<b>0.42</b>	0.95
Medium	0.71	0.06	-0.05
Large	0.71	0.12	-0.03
<i>Panel D: Predictive variables</i>			
$bp_t$	-0.87	<b>0.48</b>	0.95
$dp_t$	3.69	0.22	<b>1.01</b>
$ep_t$	-0.59	<b>0.45</b>	0.98
$de_t$	4.29	0.38	0.99
$pde_t$	8.62	<b>0.61</b>	<b>1.00</b>
$pbe_t$	8.22	0.24	0.94

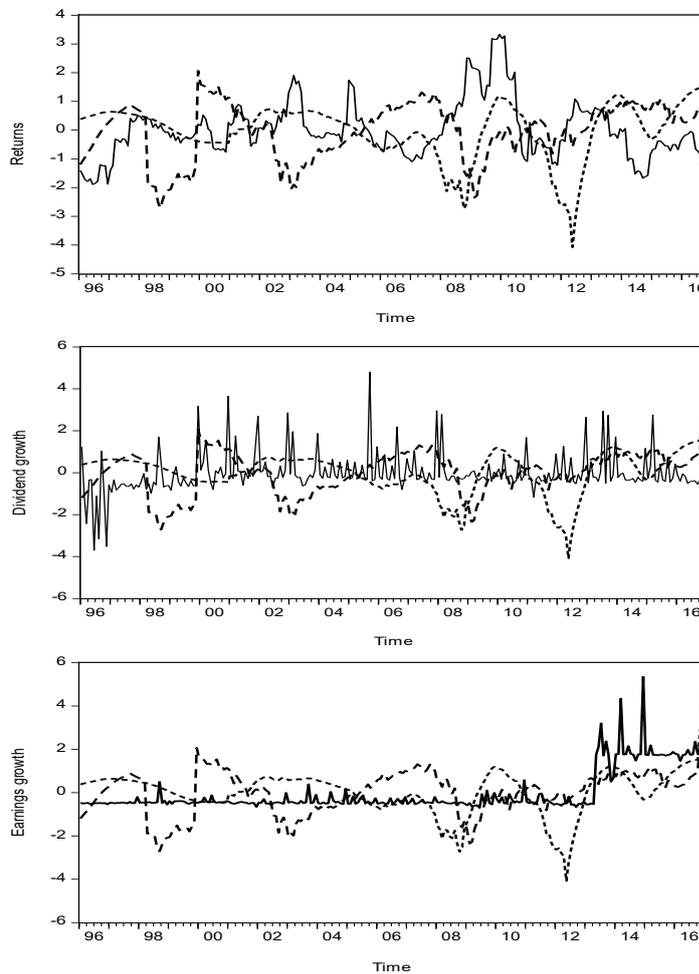
Three points are highlighted. First, the mean values of the returns portfolios are much higher compared to both earnings and dividend growth portfolios. Specifically, we receive greater mean values of 2.16 to 2.25 in the return portfolios, while in Panels B and C the highest mean value is noticed in the large portfolio of dividend growth at 0.95 and in the small portfolio of earnings growth at 0.89.

Second, Table 3 shows that small and medium portfolios' returns are considerably more volatile at 0.54 and 0.53 respectively, compared to 0.39 for the large portfolio. However, in Panel B an interesting indication is that both the small and the large portfolio are equally volatile at 0.39, while the medium one provides almost half the respective value of standard deviation. In the case of earnings growth portfolios, the highest volatility is observed in the small portfolio at 0.42.

Third, our constructed variable  $pde_t$  depicts the highest volatility at 0.61, with  $bp_t$  and  $ep_t$  follow at 0.48 and 0.45 equivalently. All of our predictors seem to be highly persistent, particularly  $dp_t$  with an AR(1) value of 1.01 and  $pde_t$  at 1.00. The fact that persistent variables are well claimed to provide increased values of slope coefficients in longer horizons is clearly discussed and identified several times in the finance literature, starting early on from Miller and Modigliani (1961), Fama and French (1988) and later by Cochrane (1991), Lettau and Ludvigson (2001) and many others.

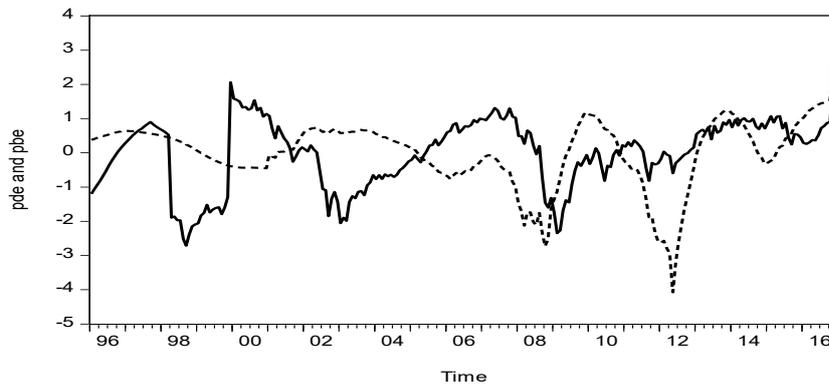
To illustrate extra patterns that are evident among returns, dividend and earnings growth and our newly constructed variables,  $pde_t$  and  $pbe_t$ , we plot all series on separate graphs. Figure 1 shows that there are several time periods that returns move to the exact opposite direction with  $pbe_t$ , namely 1998-2001 and 2002-2010. Also, large negative spikes of  $pde_t$ , in the periods 2008-2009 and 2011-2013 co-exist with sudden increases in returns, indicating that huge decreases in either prices or earnings were accompanied by even greater increases in dividends which kept

returns positive during a time period of severe economic turbulences worldwide. Dividend growth on the other hand, provides several positive spikes that co-exist with either much lower values of  $pde_t$  or  $pbe_t$ , except the period 2012-2015 that all series follow a positive uprising trend. Finally, the plot on earnings growth reveals that after 2013 sudden increases are clearly more evident that overcome in magnitude the respective fluctuations of both  $pde_t$  and  $pbe_t$ . From the beginning of our sample till 2013 though, minor fluctuations in earnings growth do not exhibit any interpretable behavior in conjunction with sudden drops and increases derived by either  $pde_t$  or  $pbe_t$ . Overall, if the center of our focus is the recent financial crisis' period (2008-2010), the index's returns do depict significant fluctuations since prices drop significantly while both dividend and earnings growth are not as severely affected.



**Figure 1:** Returns, dividend growth and earnings growth, covering the period 1996:01-2016:12 as provided by Bloomberg database. The figure compares returns, dividend and earnings growth (solid line in each graph) to  $pde_t$  (dashed line) and  $pbe_t$  (double dashed line)

Finally, in Figure 2 we isolate our two constructed variables  $pde_t$  and  $pbe_t$  and examine their behavior in the sample. We notice that these trend relations tend to move together after 2005, except the late 2012 when there is a huge negative spike in  $pbe_t$  although they both show a declining pattern. Overall, declining values in  $pbe_t$  seem to lead to increasing upcoming values of  $pde_t$  and vice versa.



**Figure 2:** Long-run equilibrium relationships among  $[p_t, d_t, e_t]$  (solid line) and  $[p_t, b_t, e_t]$  (dashed line), covering the period 1996:01-2016:12 as estimated by authors' calculations.

#### 4.2 Monthly long-horizon regressions

In this sub-section, we report the results of the forecasting regressions of the returns and the growth rates of dividend and earnings for the three size portfolios on the FTSE 100 stock market index at horizons ranging from 1 to 24-months. Our regressions follow the spirit of Cochrane (2009) on our selected financial ratios, namely  $bp_t, dp_t, ep_t, de_t$  and our constructed variables from the cointegration relationships (see section 3.2 in this paper),  $pde_t$  and  $pbe_t$ . We firstly construct continuously compounded returns, dividend and earnings growth for all horizons and then we consider the following regression on monthly data:

$$y_{t+h} = \alpha_h + \beta_h \chi_t + \varepsilon_{t+h} \quad (4.1)$$

where  $y_{t+h}$  is either return, dividend or earnings growth at month  $t$ , and  $\chi_t$  is either  $bp_t, dp_t, ep_t, de_t, pde_t$  or  $pbe_t$ . Tables 4, 5 and 6 report the regression coefficient in the first row, the t-statistics in parenthesis in the second row (following a GMM correction for heteroscedasticity and serial correlation) and  $R^2$  in the third row. Consequently, our discussion focuses on three dimensions, the slope size (regressions' coefficients values), significance (t-statistics) and explanatory power ( $R^2$ )<sup>4</sup>.

**Table 4:** In-sample predictability of continuously compounded returns ( $r_t$ ) of the size portfolios on the selected financial ratios and the long-run equilibrium relationship of  $[p_t, d_t, e_t]$  and  $[p_t, b_t, e_t]$ , covering the period 1996:01-2016:12. The first row reports the regression coefficient, t-statistics is reported in parenthesis in the second row and the third row reports  $R^2$ . Standard errors are GMM corrected. Boldfaced numbers are discussed in the text

$h$	1	6	12	18	24
Panel A: Small					
$bp_t$	0.19 (2.45)	7.66 (2.39)	6.81 (3.26)	21.57 (3.56)	31.52 (3.93)
$dp_t$	0.02 (3.81)	0.01 (2.20)	0.05 (1.62)	0.09 (1.57)	0.07 (1.59)
$ep_t$	0.03 (-1.47)	0.02 (-1.15)	0.06 (2.42)	0.14 (3.65)	0.10 (4.45)
$de_t$	0.01 (-0.77)	0.00 (1.62)	0.02 (0.08)	0.13 (-2.99)	0.17 (-3.86)
$pde_t$	0.00 (-1.36)	0.01 (1.30)	0.00 (-0.09)	0.02 (-2.86)	0.06 (-3.71)
$pbe_t$	0.01 (-3.00)	0.00 (-3.84)	0.00 (-3.58)	0.08 (-3.31)	0.20 (-2.16)
	0.02	0.02	0.06	0.11	0.02
Panel B: Medium					
$bp_t$	0.28 (2.66)	2.15 (5.40)	13.82 (4.81)	5.97 (3.47)	10.95 (3.25)
$dp_t$	0.04 (0.22)	0.10 (1.65)	0.11 (1.45)	0.05 (7.64)	0.01 (16.35)

<sup>4</sup> Due to their size and in order to avoid confusion, our analysis in this sub-section is mainly focused on the most significant in-sample outcomes of Tables 4, 5 and 6.

	(1.41)	(1.60)	(1.61)	(1.54)	(1.56)
	0.01	0.05	0.10	0.08	0.03
$ep_t$	-0.11	3.08	9.11	6.57	20.47
	(-1.09)	(0.69)	(3.27)	(3.66)	(3.56)
	0.01	0.00	0.10	0.14	<b>0.27</b>
$de_t$	0.35	7.62	-3.92	-4.90	-20.55
	(3.55)	(1.88)	(-1.74)	(-3.29)	(-3.42)
	0.06	0.02	0.01	0.05	0.07
$pde_t$	-0.09	-6.46	-8.03	-6.35	-20.03
	(-1.29)	(-1.81)	(-3.26)	(-3.45)	(-3.28)
	0.01	0.03	0.12	0.22	<b>0.35</b>
$pbe_t$	-1.02	-2.98	-14.02	-31.10	13.96
	(-7.71)	(-5.43)	(-3.43)	(-1.50)	(2.63)
	0.21	0.12	0.07	0.02	0.01
Panel C: Large					
$bp_t$	0.17	9.78	4.36	14.89	37.71
	(1.98)	(5.15)	(5.43)	(4.62)	(4.06)
	0.03	0.09	0.10	0.10	0.08
$dp_t$	0.28	8.12	25.84	7.32	14.12
	(1.61)	(1.75)	(1.77)	(1.72)	(1.70)
	0.04	0.05	0.03	0.02	0.01
$ep_t$	<b>0.22</b>	<b>7.62</b>	<b>3.57</b>	<b>12.33</b>	<b>29.34</b>
	<b>(4.69)</b>	<b>(5.61)</b>	<b>(5.24)</b>	<b>(5.78)</b>	<b>(6.05)</b>
	0.06	0.11	0.15	0.16	<b>0.20</b>
$de_t$	-0.09	-5.12	-3.89	-13.29	-34.61
	(-1.49)	(-3.37)	(-4.72)	(-4.42)	(-3.77)
	0.01	0.03	0.08	0.11	0.09
$pde_t$	-0.06	-4.13	-3.25	-15.93	-40.56
	<b>(-1.22)</b>	<b>(-2.94)</b>	<b>(-5.10)</b>	<b>(-5.57)</b>	<b>(-4.47)</b>
	0.01	0.05	0.20	0.40	<b>0.47</b>
$pbe_t$	0.09	3.44	1.40	12.38	21.42
	(0.98)	(1.70)	(2.19)	(0.86)	(0.58)

Table 4 shows that evidence of return predictability is primarily focused on the medium and large-size portfolios; in fact,  $ep_t$  and  $pde_t$  manage to explain 27% and 35% of returns variations in the medium portfolio at  $h=24$ . The forecasting power of  $pde_t$  is even more impressive in the large portfolio, reaching a  $R^2$  of 47% at our longest horizon, and providing significant but negative coefficients in all horizons. Also, another forecaster with large and positive values of coefficients and rising  $R^2$ s till 20% at  $h=24$  is  $ep_t$ . However, our second constructed variable based on the long-run equilibrium of  $[p_t, d_t, e_t]$  is rather weak in explaining return variations regardless of size. Overall,  $pde_t$  and  $ep_t$ 's forecasting power is mostly distinguishable in the returns portfolios and is mainly evident in the medium and large-size securities. Also, unlike the strong forecasting ability of  $dp_t$  in US data sets reported in similar studies (see for example, Campbell and Shiller, 2001; Campbell and Yogo, 2006), here in the British data, and in particular when sorted in portfolios, it seems unable to provide any significant results.

**Table 5:** In-sample predictability of continuously compounded dividend growth ( $\Delta d_t$ ) of the size portfolios on the selected financial ratios and the long-run equilibrium relationships of  $[p_t, d_t, e_t]$  and  $[p_t, b_t, e_t]$ , covering the period 1996:01-2016:12. The first row reports the regression coefficient, t-statistics is reported in parenthesis in the second row and the third row reports  $R^2$ . Standard errors are GMM corrected. Boldfaced numbers are discussed in the text

$h$	1	6	12	18	24
Panel A: Small					
$bp_t$	-0.11	-4.76	-3.66	-15.36	-67.45
	(-1.09)	(-1.12)	(-3.01)	(-4.01)	(-4.63)
	0.01	0.01	0.07	0.10	0.13
$dp_t$	0.17	6.02	14.94	42.92	-39.86
	(1.99)	(3.18)	(2.22)	(2.06)	(-0.24)
	0.02	0.02	0.01	0.01	0.00
$ep_t$	0.03	0.65	85.01	47.56	89.33
	(0.56)	(0.39)	(2.05)	(3.42)	(1.59)
	0.00	0.00	0.01	0.02	0.00
$de_t$	-0.08	-5.84	-25.39	-92.71	-26.67
	(-1.02)	(-2.23)	(-3.89)	(-4.46)	(-3.39)
	0.01	0.02	0.04	0.05	0.03

$pde_t$	-0.02 (-0.53)	-2.31 (-2.26)	-85.65 (-2.53)	-35.89 (-2.60)	-88.50 (-1.79)
	0.00	0.01	0.01	0.02	0.01
$pbe_t$	0.05 (0.41)	-6.69 (-1.60)	-32.78 (-2.48)	-14.16 (-2.89)	-26.76 (-1.48)
	0.00	0.01	0.03	0.05	0.01
Panel B: Medium					
$bp_t$	-0.01 (-0.17)	4.70 <b>(5.75)</b>	27.08 <b>(6.17)</b>	12.06 <b>(6.75)</b>	45.24 <b>(7.73)</b>
	0.00	0.07	0.12	0.18	0.23
$dp_t$	0.06 (1.43)	<b>3.70</b> <b>(1.90)</b>	<b>18.83</b> <b>(1.94)</b>	<b>73.95</b> <b>(1.99)</b>	<b>23.55</b> <b>(2.12)</b>
	0.01	0.04	0.05	0.06	0.06
$ep_t$	0.03 (1.86)	2.66 <b>(4.07)</b>	16.51 <b>(4.28)</b>	77.06 <b>(5.05)</b>	27.79 <b>(5.82)</b>
	0.01	0.05	0.09	0.16	0.19
$de_t$	-0.01 (-0.69)	<b>-2.19</b> <b>(-3.75)</b>	<b>-16.13</b> <b>(-4.33)</b>	<b>-79.95</b> <b>(-4.94)</b>	<b>-30.97</b> <b>(-5.72)</b>
	0.00	0.02	0.06	0.11	<b>0.15</b>
$pde_t$	<b>0.01</b> (0.46)	<b>-0.05</b> (-0.10)	<b>-86.24</b> (-2.61)	<b>-69.27</b> (-4.52)	<b>-25.76</b> (-5.66)
	0.00	0.00	0.04	0.20	<b>0.26</b>
$pbe_t$	<b>0.06</b> <b>(1.97)</b>	<b>4.71</b> <b>(4.19)</b>	<b>20.90</b> <b>(5.90)</b>	<b>53.95</b> <b>(4.61)</b>	<b>16.13</b> <b>(3.70)</b>
	0.01	0.04	0.04	0.05	0.06
Panel C: Large					
$bp_t$	-0.01 (-0.05)	27.26 (5.27)	13.89 (2.41)	41.16 (0.92)	-11.62 (-0.31)
	0.00	0.07	0.03	0.00	0.00
$dp_t$	0.13 (1.46)	5.27 (1.15)	13.26 (0.25)	15.95 (0.45)	-25.74 (-0.01)
	0.01	0.00	0.00	0.00	0.00
$ep_t$	0.03 (0.59)	-2.60 (-0.70)	-93.78 (-3.06)	-10.40 (-3.91)	-9.85 (-4.41)
	0.00	0.00	0.03	0.06	0.04
$de_t$	-0.09 (-1.25)	-17.86 (-3.58)	-15.19 (-4.31)	-11.23 (-3.61)	-7.26 (-3.52)
	0.01	0.04	0.05	0.04	0.04
$pde_t$	-0.01 (-0.22)	-4.89 (-1.99)	-29.20 (-1.61)	-35.80 (-2.07)	-23.36 (-2.07)
	0.00	0.01	0.01	0.01	0.04
$pbe_t$	0.42 (4.34)	48.00 (6.49)	47.25 (8.75)	29.33 (5.10)	22.06 (4.89)
	0.07	0.13	0.23	0.25	<b>0.29</b>

Turning to long-horizon forecasts of dividend growth in Table 5, again most predictive components of our selected ratios are found in our medium portfolio. More specifically, the t-statistics from the forecasting regressions on  $bp_t$  and  $ep_t$  are all above four from 6 to 24-month horizon; simultaneously,  $R^2$  keeps augmenting, reaching the highest values at  $h=24$  of 23% from  $bp_t$  and 19% from  $ep_t$ .

Furthermore,  $pde_t$  proves rather explicable, the more we extend the horizon, with an  $R^2$  value of 26% at  $h=24$ , and rising values of regressions coefficients in absolute values. Further predictive evidence is noticed by  $dp_t$ ,  $de_t$ , and  $pbe_t$  with a more impressive performance derived by  $de_t$  with large significant t-statistics and  $R^2$  of 15% at its highest. Focusing on the discussion of the coefficients' sign, we also observe that  $dp_t$  forecasts dividend growth but with the wrong sign; when prices are higher compared to dividends, higher dividend growth should be forecasted (see the discussion in Cochrane, 1991; Campbell, 2003; Lettau and Ludvigson, 2005). Such empirical evidence is no news in the forecasting literature, but the fact that the same applies even when the size criterion is taken into consideration is new. Finally, the results of  $pde_t$  and  $pbe_t$  suggest that the latter is a stronger forecaster in the large portfolio, explaining 29% of the dividend growth variation. The fact that all classical ratios apart from our tri-variate predictors, provide some degree of explicability for the variations in the British dividend growth is impressive enough since they do not manage to perform seemingly in US data (see for example, Cochrane, 2009; Chen, 2009).

**Table 6:** In-sample predictability of continuously compounded earnings growth ( $\Delta e_t$ ) of the size portfolios on the selected financial ratios and the long-run equilibrium relationships of  $[\mathbf{p}_t, \mathbf{d}_t, \mathbf{e}_t]$  and  $[\mathbf{p}_t, \mathbf{b}_t, \mathbf{e}_t]$ , covering the period 1996:01-2016:12. The first row reports the regression coefficient, t-statistics is reported in parenthesis in the second row and the third row reports  $R^2$ . Standard errors are GMM corrected. Boldfaced numbers are discussed in the text

$h$	$1$	$6$	$12$	$18$	$24$
Panel A: Small					
$bp_t$	0.08 (0.48)	14.84 (6.53)	60.38 (6.04)	22.39 (5.50)	8.30 (4.90)
	0.01	0.08	0.07	0.07	0.05
$dp_t$	0.19 (1.69)	62.78 (1.74)	25.45 (1.64)	10.87 (1.56)	7.12 (1.64)
	0.02	0.01	0.01	0.01	0.01
$ep_t$	0.03 (0.77)	32.94 (2.51)	21.39 (3.97)	9.46 (3.52)	3.84 (2.87)
	0.00	0.01	0.02	0.02	0.02
$de_t$	0.11 (1.62)	4.25 (0.20)	-10.48 (-1.40)	-5.32 (-1.72)	-5.92 (-0.51)
	0.01	0.00	0.00	0.00	0.00
$pde_t$	<b>0.29</b> <b>(6.62)</b>	<b>97.08</b> <b>(6.85)</b>	<b>37.37</b> <b>(7.13)</b>	<b>13.84</b> <b>(4.50)</b>	<b>5.88</b> <b>(4.28)</b>
	0.17	0.20	<b>0.21</b>	0.08	0.08
$pbe_t$	<b>0.70</b> <b>(6.48)</b>	<b>25.43</b> <b>(6.57)</b>	<b>11.19</b> <b>(6.88)</b>	<b>4.93</b> <b>(5.76)</b>	<b>1.63</b> <b>(4.98)</b>
	0.15	0.17	<b>0.17</b>	0.14	0.11
Panel B: Medium					
$bp_t$	0.01 (1.01)	1.67 (4.89)	99.58 (8.11)	40.71 (11.10)	14.29 (15.90)
	0.00	0.06	0.18	0.29	<b>0.45</b>
$dp_t$	0.01 (0.90)	0.44 (1.21)	26.35 (1.91)	97.54 (2.22)	33.21 (2.63)
	0.00	0.00	0.01	0.01	0.02
$ep_t$	-0.00 (-0.44)	-0.53 (-1.72)	-25.15 (-2.04)	-59.83 (-1.48)	48.04 (3.56)
	0.00	0.01	0.02	0.03	0.07
$de_t$	0.01 (1.12)	<b>1.16</b> <b>(3.40)</b>	<b>65.39</b> <b>(4.89)</b>	<b>20.25</b> <b>(4.44)</b>	-50.20 (-0.43)
	0.00	0.04	0.10	<b>0.10</b>	0.00
$pde_t$	0.01 (1.01)	0.83 (3.93)	30.38 (3.21)	34.56 (0.83)	-16.10 (-0.16)
	0.00	0.06	0.06	0.01	0.00
$pbe_t$	0.01 (0.53)	0.16 (0.31)	-40.35 (-2.33)	-20.23 (-3.69)	-77.50 (-4.56)
	0.00	0.00	0.02	0.04	0.08
Panel C: Large					
$bp_t$	-0.09 (-1.49)	1.27 (2.40)	58.73 (3.45)	23.82 (4.80)	84.56 (6.21)
	0.09	0.01	0.02	0.06	0.11
$dp_t$	0.03 (0.68)	-0.23 (-0.49)	38.06 (1.70)	19.49 (1.79)	63.16 (1.85)
	0.01	0.00	0.01	0.03	0.05
$ep_t$	0.01 (0.78)	-0.11 (-0.35)	-5.76 (-0.61)	-23.78 (-0.85)	68.87 (0.78)
	0.00	0.00	0.00	0.00	0.00
$de_t$	0.01 (0.32)	-0.18 (-0.37)	27.56 (2.19)	16.04 (4.08)	34.09 (3.19)
	0.00	0.00	0.01	0.03	0.02
$pde_t$	0.02 (1.15)	1.01 (4.04)	70.12 (5.95)	26.64 (7.70)	66.39 <b>(8.62)</b>
	0.01	0.03	0.11	0.23	<b>0.25</b>
$pbe_t$	0.08 (1.60)	2.82 (3.00)	10.61 (3.41)	28.40 (3.59)	73.07 (3.60)
	0.02	0.03	0.04	0.05	0.05

Table 6 summarizes the results of the long-horizon forecasting regressions on earnings growth. In this case, our forecasters do capture some components of the small-sized securities and their time-varying earnings growth rate. In particular,  $pde_t$  and  $pbe_t$  are able to provide highly significant coefficients with t-statistics exceeding the value of six in our longer horizons and high  $R^2$ s of 21% and 17% at  $h=12$ , respectively. In the medium portfolio, forecasting evidence is again richer and is derived by all forecasters, especially  $bp_t$  which manages to explain 45% of total variations in this portfolio. The conventional ratios that include information on the index's earnings (that is,  $ep_t$  and  $de_t$ ) as well as  $dp_t$  show limited performance with  $de_t$  being more capable with big values of t-statistics, even though  $R^2$  is kept at 10% till  $h=18$ . Finally,  $pbe_t$  proves superior to  $pde_t$ , even though the performance here is not as impressive as in the case of dividend growth of the medium portfolio.

Additional evidence on the large portfolio though reflect on  $pde_t$ 's superiority on capturing variations of large-sized securities against a rather milder performance of  $bp_t$ ,  $dp_t$  and  $pbe_t$ . More specifically, t-statistics reaches the value of 8.62 at  $h=24$ , while  $R^2$  becomes 25%. All in all, earnings growth predictability is better explained by  $pbe_t$  and  $pde_t$  in the small portfolio,  $bp_t$  in the medium and  $pde_t$  in the large portfolio. Traditional ratios such as  $ep_t$  and  $bm_t$  have been tested for their earnings growth' forecastability (see for instance Lamont, 1998; Pontiff and Schall, 1998) and provided poor outcome for both the DJIA and S&P's earnings data.

Overall, there are three key findings in this section of the paper. First, return predictability is mainly concentrated in our medium and large portfolios and is better retrieved by  $pde_t$  in both cases with  $R^2$  reaching the values of 35% and 47% equivalently. Unlike other studies on this specific data (see for instance, Li, 2009; Bowen et al., 2010), we introduce that our fixed  $pde_t$  is a capable explanatory variable of UK return variations. Second, evidence of dividend growth predictability is again observed mostly in the medium and large portfolios. Both  $bp_t$  and  $ep_t$  provide highly significant coefficients early on from  $h=6$  with rising t-statistics as we increase horizon, similarly to the findings of Wetherilt and Wells (2004) as far as  $ep_t$ 's forecastability is concerned. Also,  $pde_t$ 's explanatory power surpasses the other forecasters in the medium portfolio, while  $pbe_t$  performs better in the large-sized securities. Third, earnings growth predictability provides more mixed outcomes as we observe predictability evidence in the small portfolio as well, with significant coefficients provided by  $pde_t$ ,  $pbe_t$  and  $bp_t$ . In terms of explanatory power,  $bp_t$  gives an  $R^2$  of 45% in the medium portfolio, while variations in the large portfolio are better explained by  $pde_t$  with t-statistics exceeding the value of eight. Consequently, some of our findings confirm previous research, but we also provide new indications of the forecastability of certain predictors. Finally, the link with the size criterion that we base our analysis may prove informative to investors interested not only in forecasting but also, in asset pricing and business augmentation.

## 5. Conclusion

In this paper, we have examined the most recent data set of FTSE 100 and analyzed it based on the formation of size portfolios. We have focused on the index's returns, dividend and earnings growth rates and chose four financial ratios, namely  $bp_t$ ,  $dp_t$ ,  $ep_t$  and  $de_t$  as our predictive variables based on their reputation as strong predictors. We also formulate two extra ratios based on the long-run equilibrium relationship of  $[p_t, d_t, e_t]$  and  $[p_t, b_t, e_t]$ , namely  $pde_t$  and  $pbe_t$ . By allocating all stocks of FTSE 100 into size portfolios according to their market capitalization value, we have not only examined our selected ratios' ability to explain the observed variations in returns and growth rates, but also stress on the presence of any links between size and predictability in-sample.

Our study's main findings can be summarized as following. First, we retrieve evidence that in-sample return predictability is evident in the medium and large-sized portfolios and is better captured by  $pde_t$  at 35% and 47% equivalently. Second, dividend growth portfolios present strong links with size; particularly, highly significant coefficients are provided by  $bp_t$  and  $ep_t$  with rising t-statistic values as we extend the horizon. Similarly, our constructed ratios based on the cointegration relationships act as strong performers too; more specifically,  $pde_t$  explains 26% of the medium portfolio, while  $pbe_t$  explains 29% of the large portfolio. Third, in-sample regressions of continuously compounded earnings growth rate show that most predictive benefits are obtained by  $dp_t$  in the medium portfolio with a  $R^2$  of 45%. Also,  $pde_t$  provides high values of t-statistics both in the small and large portfolios, while  $pbe_t$  and  $bp_t$  perform better in the small portfolio.

The encouraging findings of this study suggest that the implementation of further methodologies could lead to even more fruitful evidence. Examining for instance, other macroeconomic variables such as spreads and interest rates and testing the sensitivity of our results on whether we use nominal, excess or real returns are left for future research. We could also attempt to alter our data's frequency into annual so as to address the seasonality effect observed mainly in dividends and earnings (see the discussion in Lamont, 1998; Lettau and Ludvigson, 2005). Additionally, if permitted by data availability, we could extend the time horizon and produce out-of-sample forecasts as well.

An alternative approach would be to study the forecasters' ability before and after Brexit. At present, data is not enough to satisfy such a project but it would be interesting to test the predictive capacity of the examined ratios against an event of this scale. More time may be required to reflect on the true economic effects of the Brexit path, yet still it certainly did not cause an immediate recession as originally speculated, despite the slow turn of the UK's economic growth compared to other major economies (see for instance Born et al., 2017). Perhaps, it is crucial to consider that the majority of the FTSE 100 companies have global presence, thus they generate earnings internationally. Consequently, the value of their assets may rise in different currencies against a weakening pound. This argument is better reflected at the early days of the Brexit Referendum results, that the pound may have fallen

greatly but overall, the value of the FTSE 100 increased impressively. Also, these companies do diversify and belong to a wide group of sectors. Therefore, some may be severely affected, while others may benefit from these circumstances. Finally, the fact that Brexit has created certain uncertainty in the country's overall outlook is undeniable, however, this may also leave room for investment speculation, particularly for long-term investing plans. We leave this puzzle for future endeavor.

All in all, the relationship between market capitalization value and several forecasters has interesting implications. There are few strings in literature that connect those two traits and could potentially work as a significant parameter to consider in investment decision-making. Our paper may prove informative to investors focused on short-term forecasting and interested in the effects of size in portfolio formation. Further in-depth analysis of this pattern, primarily empirical, can be very beneficial to link the dots between business augmentation and financial forecasting, and provide more entail of the imprint of asset pricing to the real economy.

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## Dynamics of Corporate Dividend Policy under Hyperinflation and Dollarization: A Quantile Regression Approach

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ARTICLE INFO	ABSTRACT
<p>Article History</p> <p>Received 26 October 2020; Accepted 21 November 2020</p> <p><i>JEL Classifications</i> G320 G350 G390</p>	<p><b>Purpose:</b> Zimbabwe experienced hyperinflation (2000–2008) followed by dollarization from 2009 onwards which had implications on dividend policy. In this context, this study isolates the main determinants and examines their behaviour across the distribution of dividend policy.</p> <p><b>Design/methodology/approach:</b> The study employs quantile regression analysis and a sample of 30 firms listed on the Zimbabwe Stock Exchange (ZSE), covering the period 2000 to 2016. The fixed effects (FE) analysis is applied as a base model.</p> <p><b>Finding(s):</b> The most robust determinants are ownership structure, earnings per share (EPS) and taxation. In our context, results are more informative, than those based on FE analysis by showing the change in the impact of each explanatory variable across the distribution. EPS has a positive and significant impact on dividend policy throughout the distribution in both sample periods. Its effect increases in magnitude as firms move from low to high quantiles. The other variables are useful in explaining dividend policy at selected points of the distribution. Thus, there is clear heterogeneity in the determinants of dividend policy.</p> <p><b>Research limitations/implications:</b> The study shows the importance of developing dividend policy by focusing on the position of the firm on the distribution. Dividend policy should be developed in view of the earnings potential of the firm, ownership concentration and perceived changes in fiscal policy. A well-designed policy should have a differentiated approach to influencing corporate dividends.</p> <p><b>Originality/value:</b> This study enhances our understanding of dividend policy in unique markets. It confirms the applicability of dividend relevance theories. Furthermore, It shows that quantile analysis provides more reliable estimates than those obtained using standard panel data models.</p>
<p><b>Keywords:</b> Dividend Policy, Hyperinflation, Dollarization, Quantile Regression, Zimbabwe</p>	

### 1. Introduction

Zimbabwe's economy experiences structural changes between 1997 and 2019. This is triggered by both political and economic factors. In 1998, the government embarks on a reform to compulsorily acquire land from the white minority and give it to the landless black majority (Mandizha, 2014). Unbudgeted gratuities are paid to war veterans and the government supports the war in the Democratic Republic of Congo. The international community does not support such decisions and multilateral institutions like the International Monetary Fund (IMF), Africa Development Bank and the World Bank (WB) withdraw financial support. In response, the government prints money to finance its activities resulting in hyperinflation from 2000 to 2008. The effects include: the worsening of the exchange rate, loss of import cover, fall in export revenue, negative gross domestic product (GDP) growth, deterioration in the balance of payments position and fall in production levels and a rise in unemployment. By the end of 2008 the official inflation rate reaches 231 million percent (Makochekanwa, 2007, Mandizha, 2014, Kararach Kadenge and Guvheya, 2010). During this period of high inflation, some firms pay dividends to retain investors. More so, the stock market provides a hedge against inflation and trading activities remain high (Jagongo and Mutswenje, 2014). The money market instruments perform badly due to high inflation and investors shift their portfolios to stock market related securities (Njanike, Katsuro, and Mudzura, 2009).

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However, inflation falls to single digits in February 2009 following the adoption of a multicurrency regime (Kanyenze, Chitambara and Tyson, 2017, Zhou and Zvoushe, 2012). The economy is partially dollarized, and the United States Dollar, South African Rand and Botswana Pula become legal tender. The speculative activities cease, and firms shift their focus to generating production profits (Sikwila, 2013, Njanike et al, 2009). The Reserve Bank of Zimbabwe (RBZ) loses its lender of last resort function which limits the availability of liquidity in the market. The market is still unstable which affects the level of dividends distributed by firms to shareholders as well. Hence formulating corporate dividend policy is still important for firm managers under dollarization period.

Previous studies (Edwards and Magendzo, 2001, Nor, 2012) on hyperinflation and dollarization fail to discuss these structural changes in view of corporate dividend policy. Understanding the determinants and dynamics of dividend policy in these periods adds to the current debate in corporate finance. Literature lacks studies that directly examine dividend dynamics in this context. This is despite the possibility that the predictive power of main dividend theories may be lost under these circumstances. Previous discussions are mainly based on standard panel data models which provide conclusions based on mean values of explanatory variables. They fail to fully exploit the critical information at different points of the distribution of dividend policy. In view of this, this study extends the current literature by employing quantile regression techniques to obtain useful information due to the presence of heterogeneity in the firms' dividend policy. The effect of each explanatory variable is sensitive to the position of the firm on the distribution of dividend policy. This is tested and confirmed using data for Zimbabwe firms.

The study offers some new insights by showing that there is clear heterogeneity in the determinants of dividend policy. The most robust determinants are ownership structure, earnings per share and taxation. In our context, results are more informative, than those based on fixed effects analysis by showing the change in the impact of each explanatory variable across the distribution. Earnings per share has a positive and significant impact on dividend policy throughout the distribution in both sample periods. Its effect increases in magnitude as firms move from low to high quantiles. The other variables are useful in explaining dividend policy at selected points of the distribution. Thus, quantile analysis provides more reliable estimates than those provided by standard panel data models. This study enhances our understanding of dividend policy in unique markets. It confirms the applicability of dividend relevance theories.

The rest of the study is organized as follows: section two summarizes the key theories underpinning this study and the main determinants of dividend policy, section three discusses the methodology applied in this study, section four discusses main results and section five concludes and provides policy implications.

## **2. Literature Review**

This study is done under imperfect market conditions as such dividend policy affect firm value (Gordon, 1963, Lintner, 1962). It is underpinned by dividend relevance theories which are summarized as follows: the bird in hand theory, by Lintner and Gordon, shows that investors prefer current dividends which have low risk. They tend to discount future cashflows with a lower rate which increases the value of the firm. A firm that does not pay dividends experiences low firm value (Gordon, 1963, Lintner, 1962); the agency costs theory shows that the payment of dividends reduce the agency problem by removing excess cash which might be misused by managers (Easterbrook, 1984) and the clientele theory (Allen et al, 2000, Seida, 2002) shows that the payment of dividend attracts institutional investors due to low taxation. Investors' preference of dividend payments is determined by the level of taxation. Those in higher tax brackets prefer shares with low or no dividends while those in low tax brackets prefer cash dividends.

### **Determinants of Dividend Policy**

#### **Past Dividends**

Thus far, literature is clear on the impact of previous dividend payouts on current dividend policy. Studies (Edmund, 2018, Mirbagherijam, 2014, Tran and Nguyen, 2014) have shown that past dividend payments are a good predictor of future dividend policies. Investors can use the payment of dividend as a signal for the future prospects of the firm. Firm managers are reluctant to reduce dividends payments even during inflationary periods. They continue to make disbursements to mimic good prospects for current and potential investors.

#### **Financial Leverage**

Highly leveraged firms (LEV) pay less dividends due to high debt service costs (Hosain, 2016, Edmund, 2018, Fliers, 2017). Such firms are exposed to the risk of bankruptcy. More dividends can be paid where a firm relies on other sources of cash flows (Nguyen et al, 2013, Ahmad and Javid, 2009). Payment of dividends may differ according to debt composition. Firms may be willing to acquire more debt to finance dividend payouts which acts as a signaling device to shareholders. However, some studies (Rizqia and Sumiati, 2013, Alzomaia and Al-Khadhiri, 2013) argue that financial leverage has no effect on dividend policy.

#### **Investment Outlays**

Previous studies (Al-Najjar and Belghitar, 2011, Ahmed and Javid, 2009) show that high investment expenditure (INV) reduces the likelihood of paying dividends. Firms with more investment opportunities may source external funding where access to financial markets is easy and they can still maintain high dividend payouts. Bildik, Fatemi, and Fooladi (2015) argue that large firms can still pay dividends in the absence of credible growth opportunities.

Their study confirms the positive relationship between investment decisions and dividend policy. This is consistent with theoretical propositions (Adediran and Alade, 2013, Lahiri and Chakraborty, 2014) that firms can make investment and dividend decisions concurrently.

### **Earnings per Share**

Literature confirms the linkages between earnings per share and dividend policy. For previous studies (Basse and Reddeman, 2011, Adediran and Alade, 2013, Bassey, Asinya, and Elizabeth, 2014, King'wara, 2015) show that high earnings per share (EPS) guarantee the payment of more dividends. Again, firms may not necessarily make huge dividend disbursements as they seek to retain funds for future use. Ahmed and Javid (2009) argue that though dividend policy is dependent on earnings per share (EPS) and past year's dividends, it is more sensitive to the former than the latter.

### **Managerial Ownership**

The agency theory shows that managerial ownership is related to dividend policy. Studies (Björn and Lantz, 2016, Ahmed and Javid, 2009) show that more dividends are paid where managers seek to reward themselves using free cash flows. On the other hand, high managerial ownership (OWN1) may cause managers to postpone the payment of dividends and invest so as to increase the firm's future income generating capacity (Kania and Bacon, 2005, Mirza and Azfa, 2010, Bushra and Mirza, 2015). Low dividends in firms with high inside ownership are explained by the desire by management to increase the expected value of their stock options which they receive as compensation. However, studies like Arshad et al (2013) and Hosain (2016) show that in the case of Pakistan firms inside ownership and dividend policy have no relationship

### **Institutional Ownership**

The presence of institutional shareholders brings discipline among managers who are deterred from overinvesting a firm's excess funds. Past studies (Bozec et al, 2010, Björn and Lantz, 2016) show that institutional ownership (OWN5) promotes the payment of dividends where a firm is at the high quantile of its growth opportunities. In this case the firm may be having more excess cashflows which are useful for rewarding owners. On the other hand, institutional shareholders may restrict payment of dividends and advocate for more money to be spent on growth opportunities (Kania and Bacon, 2005, Bushra and Mirza, 2015). However, Mossadak, Fontaine, and Khemakhem (2016) argue that institutional ownership has no effect on dividend policy.

### **Taxation**

The taxation policy of the firm affects investor choices. Institutional investors and the elderly prefer dividend paying stocks since tax on dividends is low. Taxation (TP) reduces funds available for payment of dividends (Berzins, Bohren and Stacescu, 2017, Morck and Yeung, 2005). On the other hand, previous studies (Atia, 2017, Amidu and Abor, 2010) show that taxation has a positive relationship with dividend payout where firm managers have chosen a certain dividend policy, desire to use dividends as an investor retention strategy or have access to other financing alternatives. Chetty and Saez (2010) argue that corporate taxation does not distort the ability of a firm to pay more dividends in contrast to the agency cost theory. It has an insignificant effect on dividends (Gul et al, 2012, Khan, Jehan and Shah, 2017).

### **Firm Size**

Large sized firms (SIZE2) pay more dividends as they are likely to be financially stable (Arshad et al, 2013, Michaely and Roberts, 2012). Similarly, Bildik et al (2015) show that large firms can still pay dividends in the absence of credible growth opportunities, but they have to be profitable (Kowalewski, Stetsyuk and Talavera, 2007). On the other hand, King'wara (2015) argues that large firms could have taken more debt to finance their current levels of growth. This reduces the ability to make dividend payments in the short term.

### **Inflation and Money Supply**

Inflation (INFN) and money supply (MSP) are useful in controlling for hyperinflation and dollarization respectively as firms design their dividend policy. Basse and Reddeman (2011) argue that firms pay more dividends even when they are faced with high inflation. They can still rely on high nominal earnings. Firms are expected to have reduced dividends payout under hyperinflation (Elly and Hellen, 2013, Edmund, 2018) and more payouts during dollarization period. On the contrary, Mirbagherijam (2014) argues that dividends signal bad future prospects. Chronic high inflation results in a fall in the earnings as well as dividends. Pandey and Bhat (2004) show that money supply has a positive effect on dividend policy. On the contrary, Akyildirim et al (2013) supports the proposition that high money supply reduces the payment of dividends. Furthermore, Mambo (2012) argues that monetary policy activities have no effect on dividend policy.

### 3. Data, Methodology and Empirical Results

#### 3.1 Model Specification

Dividend policy (PR) is measured using dividend per share. The choice is determined by its usage in literature, diagnostic tests and giving of better results consistent with Zimbabwean context. The dependent variable, PR, is specified as function of the firm and macroeconomic variables and their expected signs are guided by literature. The generalized model is stated as:

$$Quant_{\theta}(y_{it}|x_{it}) = \beta_0 + \beta_{\theta f}firm_{it} + \beta_{\theta m}macro_{it} + \varepsilon_{it} \quad (1)$$

Where,  $Quant_{\theta}(y_{it}|x_{it})$  is the  $\theta$ th conditional quantile of  $y_{it}$ , the dependent variable capturing corporate dividend policy, conditional on the vector of regressors  $x_{it}$  as represented by the *firm and macro* variables.

Quantile regression model (Koenker and Basset, 1978) is used to analyse the effects of each explanatory variable on corporate dividend policy in different quantiles. It helps in exploring, accurately, the determinants of dividend policy. This approach helps in understanding the effects of each variable by looking at the sign of the coefficient, size and level of significance across the distribution. It gives better results than those given by OLS models (Fattouh, Harris and Scaramozzino, 2008). The design matrix bootstrap method is used to estimate standard errors for coefficients (Buchinsky, 1998). Confidence intervals are constructed using the percentile method (Koenker and Hallock, 2001). Estimations are done using nine quantiles: 0.10, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80 and 0.90. The model estimated is specified as follows:

$$Quant_{\theta}(y_{it}|x_{it}) = \beta_0 + \beta_1FG_{it} + \beta_2FLEV6_{it} + \beta_3OWN5_{it} + \beta_4INFLN_t + \beta_5OWN1_{it} + \beta_6MSP_t + \beta_7EPS_{it} + \beta_8TP_{it} + \beta_9INV1_{it} + \beta_{10}SIZE2_{it} + \varepsilon_{it} \quad (2)$$

The study also employs the fixed effects model to provide base results for comparison with quantile regression. Robust standard errors are employed. Potential endogeneity is tested by checking the robustness of estimates. This is done by removing or adding explanatory variables to see if results remain unchanged (See results in Tables 5 and 6 in the appendix). A sample of 30 non-financial firms, is used, that are listed on the ZSE, giving a total of 510 firm years. Annual data on firm characteristics and macroeconomic variables is extracted from financial statements of firms and WB (2017) respectively. All variables, used in this study, are defined in Table 1.

**\*Table 1: Variables Definitions: Dividend Decisions**

Variable	Definition	References
Dividend policy (PR1)	Dividend paid/Total Shares	Huda and Abdullah, 2013, Adediran and Alade, 2013, Björn and Lantz, 2016
Firm growth (FG)	% Change in total sales ((Current year Sales-Previous year Sales)/Previous Year Sales)	Chen and Dhiensiri, 2009, Kania and Bacon, 2005, Al-Kuwari 2009, Edmund, 2018
Leverage (Flev 6)	Total debt/equity	Ahmad and Javid, 2009 ; Huda and Abdullah, 2013, Al-Kuwari 2009; Rizqia and Sumiati, 2013, Mutenheri, 2003, Arshad et al, 2013, Edmund, 2018
Investment decisions (INV1)	Net Fixed Assets (Total Fixed Assets-Total Liabilities-Depreciation)/Total Assets	Mutenheri, 2003
Inflation (INFLN)	Annual Inflation Rate divided by 100	Elly and Hellen, 2013, Edmund, 2018
Insider Ownership (OWN1)	Management shareholding/Total shares	Chen and Dhiensiri, 2009, Kania and Bacon, 2005, Rizqia and Sumiati, 2013, Mutenheri, 2003
Institutional Ownership (OWN5)	Total shares owned by Institutional Investors/Total Shares	Kania and Bacon, 2005, Mutenheri, 2003
Firm size (SIZE2)	Log of Total Assets	Ahmad and Javid, 2009; Arif and Akbarshah, 2013; King'wara, 2015, Arshad et al, 2013
Money Supply (MSP)	M2 over GDP, as a decimal	Elly and Hellen, 2013
Earnings per Share (EPS)	Earnings over total shares outstanding	Adediran and Alade, 2013, Tran and Nguyen, 2014
Taxation (TP)	Tax paid/Operating income	Arif and Akbarshah, 2013; Chetty and Saez, 2010.

\*The Table contains definitions of main variables as they are applied in this study.

#### 4. Results and Discussion

##### 4.1 Diagnostic Tests and Descriptive Statistics

The study employs Levin, Lin and Chu (LLC) and Im, Pesaran and Shin (IPS) to test for unit root at 5% level of significance and results show that all variables are stationary at levels. The study considers multicollinearity using Pearson correlation matrix. Correlation coefficients are mostly less than 0.5 which implies that there is limited multicollinearity between any pair of variables. Thus, all the variables could be used in the same model without giving spurious results.

All the variables (Table 2) are positively and highly skewed except for the measure of investment decisions. Variables in the analysis are leptokurtic with a measure of kurtosis higher than 3. The study shows that the average dividend per share is US\$0.025. The average firm growth rate is 11.9% and firms are not highly geared since the average level is slightly above 50%. The average inflation rate is 136190.1% during the period of analysis. Management hold about 8.6% of shares while institutional shareholders hold 74.4% of shares on average. The average of money supply is 55% of GDP for Zimbabwe. Earnings per share are US\$0.041 while the tax paid is around 12% on average. The level of investment fell, on average, by about 16%, during the period of analysis.

**Table 2: Descriptive Statistics**

	PR1	FG	FLEV6	INFLN	OWN1	SIZE2	MSP	EPS	TP	INV1	OWN 5
Mean	0.03	0.12	0.52	136190.1	0.09	17.91	0.55	0.04	0.12	-0.16	0.74
Median	0.01	0.01	0.36	0.55	0.04	17.88	0.45	0.02	0.11	-0.13	0.83
Max	0.43	4.53	6.63	2310000	1.44	20.57	1.52	0.41	0.63	0.70	8.72
Min	0.00	-0.86	-0.90	-0.02	3.0e-05	15.38	0.27	-0.05	0.00	-1.95	0.04
S. Dev.	0.04	0.53	0.59	544554.7	0.13	0.94	0.28	0.06	0.08	0.34	0.45
Skew	4.57	2.39	4.40	3.75	3.95	0.46	2.41	3.14	1.70	-0.98	10.86
Kur	36.75	14.85	36.78	15.03	28.12	3.50	9.02	15.25	9.72	5.78	197.7
Obs	509	509	509	509	509	509	509	509	509	509	509

**Notes:** obs=Observations, kur=kurtosis, skew=skewness, min=minimum, s.dev=standard deviation & max=maximum. All variables defined in Table 1.

##### 4.2 Quantile Regression Analysis

Table 3 and Figure 1 show results during hyperinflation period while Table 4 and Figure 2 show results under dollarization. The most robust determinants of corporate dividend policy, in both periods, are ownership structure variables, earnings per share and taxation. Findings show that investment decisions, firm growth (Edmund, 2018), leverage (Rizqia and Sumiati, 2013, Alzomaia and Al-Khadhiri, 2013) and inflation are insignificant under hyperinflation. Inflation, money supply and size are not important in explaining dividend policy under dollarization which is consistent with previous studies (Elly and Hellen, 2013, King'wara, 2015, Mohsin and Ashraf, 2011).

**Table 3: Quantile Regression Model: PR1 as Dep. Var (2000-2008)**

Variable	FE	10 <sup>th</sup> Quant	20 <sup>th</sup> Quant	30 <sup>th</sup> Quant	40 <sup>th</sup> Quant	50 <sup>th</sup> Quant	60 <sup>th</sup> Quant	70 <sup>th</sup> Quant	80 <sup>th</sup> Quant	90 <sup>th</sup> Quant
FG	-0.0021***	-0.0012	-0.0018	-0.0012	-6.95e-06	0.0004	0.0001	0.0016	0.0010	-0.0014
FLEV6	-0.0013**	0.0011	0.0012	0.0010	0.0016	0.0015	0.0020	0.0010	0.0024	0.0011
INFLN	-5.03E-10	-9.97e-11	-6.25e-10	-4.09e-10	-7.37e-10	-6.69e-10	-7.73e-10	-1.94e-09	-2.05e-09	-1.73e-09
OWN1	0.0505***	0.0248***	0.0249***	0.0216***	0.0219***	0.0223***	0.0152***	0.0252***	0.0393***	0.0491***
SIZE2	-0.0012	-3.71e-05	-8.32e-05	-6.91e-05	-0.0001	-0.0001	-4.62e-05	7.48e-05	0.0003	0.0012**
MSP	-0.0001	-0.0025	-0.0010	-0.0014	8.84e-06	0.0005	0.0002	-0.0010	-0.0049	-0.0096**
EPS	0.0701***	0.1230***	0.1699***	0.2538***	0.3163***	0.3662***	0.4470***	0.5142***	0.6830***	1.0281***
TP	0.0173***	0.0146**	0.0225**	0.0218**	0.0187*	0.0190	0.0215*	0.0215	0.0227	0.0165
INV1	0.0016	0.0008	0.0012	0.0006	0.0006	-7.59e-06	-0.00028	0.0014	-0.0006	0.0023
OWN5	-0.0037*	0.0011	0.0010	0.0011	0.0015	0.0011	-0.0001	0.0006	-0.0023	-0.0149*
R <sup>2</sup>	0.79									
F-Test	21.69***									
DW	1.98									

\*\*\* significant at 1%; \*\* significant at 5%; \*significant at 10%. Definitions of all variables are in Table 1. The Fixed Effects (FE) provides base results in the first column. The table provides results for 9 quantiles for the period 2000-2008. There is a total of 270 observations. Bootstrap method is used to estimate standard errors for coefficients using quantile analysis. The dependent variable is dividend per share (PR1). Results from quantile regression for OWN1, EPS, TP & OWN5 are consistent with those using FE model.

Figure 1 presents quantile process estimates and definitions of all variables are in Table 1. The Fixed Effects (FE) provides base results in the first column. The table provides results for 9 quantiles for the period 2000–2008. There is a total of 270 observations. Bootstrap method is used to estimate standard errors for coefficients using quantile analysis. The dependent variable is dividend per share (PR1). Results from quantile regression for OVN1, EPS, TP & OVN5 are consistent with those using FE model.

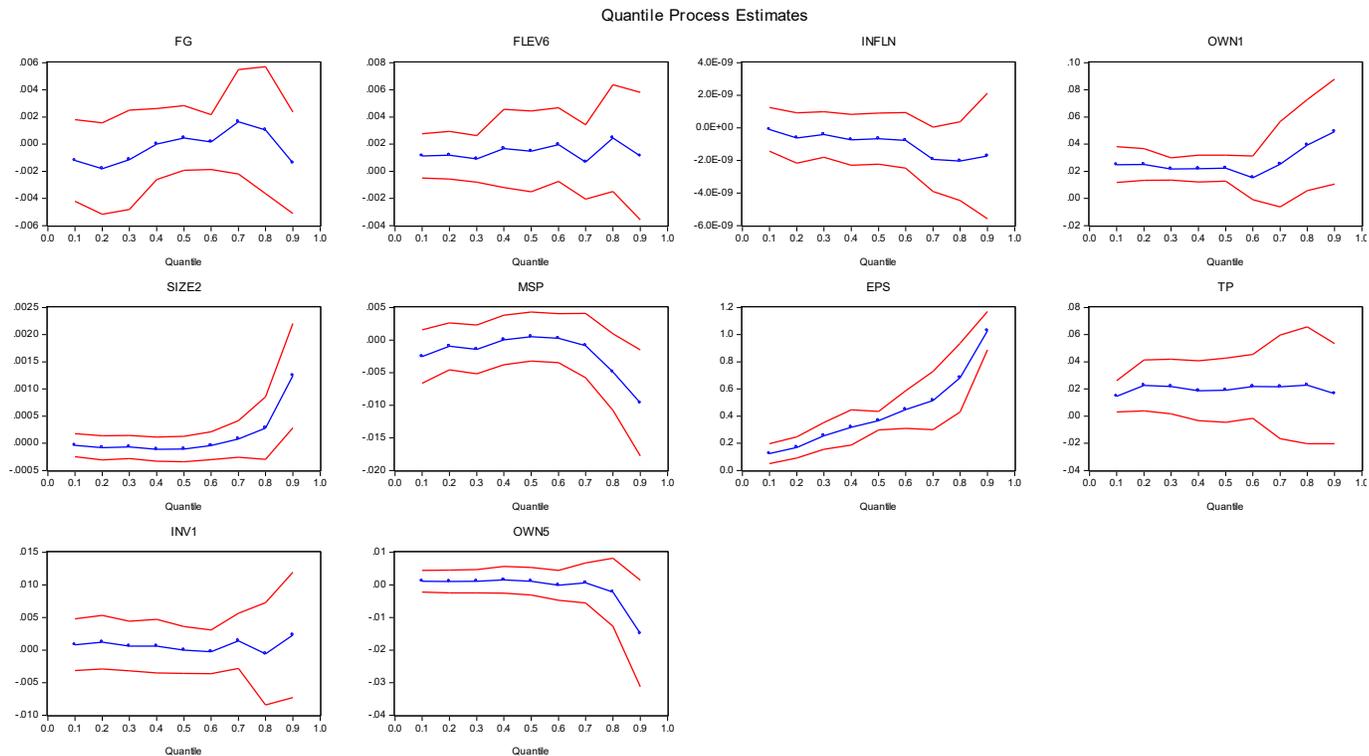


Figure 1: Determinants of Dividend Policy 2000 – 2008

**Table 4: Quantile Regression Model: PR1 as Dep. Var (2009-2016)**

Variable	FE	10 <sup>th</sup> Quant	20 <sup>th</sup> Quant	30 <sup>th</sup> Quant	40 <sup>th</sup> Quant	50 <sup>th</sup> Quant	60 <sup>th</sup> Quant	70 <sup>th</sup> Quant	80 <sup>th</sup> Quant	90 <sup>th</sup> Quant
FG	-0.0010**	0.0004	0.0005	0.0010	-5.56e-05	-5.30e-05	-0.0013	-0.0016	-0.0030	-0.0068**
FLEV6	0.0016*	0.0002	-4.04e-05	-0.003	-0.003	0.0002	-9.23e-05	0.0050***	0.0051***	0.0042***
INFLN	0.0049	-0.0175	-0.0060	0.0011	0.0047	0.0006	0.0117	0.0186	0.0805	0.017
OWN1	0.0389***	0.0147	0.0186	0.0281***	0.0334***	0.0358***	0.0436***	0.0591***	0.0930***	0.1359***
SIZE2	-0.0029*	5.95e-05	-7.78e-06	5.98e-06	0.0001	0.0001	1.45e-05	0.0002	0.0005	0.0015
MSP	0.0029	-0.0043	0.0002	0.0008	-0.0016	0.0016	0.0172	0.0066	0.0015	0.0537
EPS	0.0492*	0.2017***	0.2396***	0.2683***	0.2690***	0.2892***	0.3346***	0.4131***	0.4678***	0.6606***
TP	0.0033	-0.0023	-0.0011	-0.0019	-0.0001	3.77e-05	0.0002	-0.0040	-0.0133	-0.0453**
INV1	0.0042**	0.0016	0.0010	0.0018	0.0025*	0.0023	0.0048**	0.0050*	0.0064	0.0127
OWN5	0.0046**	0.0008	0.0009	0.0008	-0.0003	-0.0015	-0.0053*	-0.0081	-0.0101	-0.0347***
R <sup>2</sup>	0.83									
F-Test	24.83***									
DW	2.02									

\*\*\* significant at 1%; \*\* significant at 5%; \*significant at 10%. Definitions of all variables are in Table 1. The Fixed Effects (FE) provides base results in the first column. The table provides results for 9 quantiles for the period 2009-2016. There is a total of 239 observations. Bootstrap method is used to estimate standard errors for coefficients using quantile analysis. The dependent variable is dividend per share (PR1). Results from quantile regression for FG, FLEV6, OWN1, EPS & INV1 are consistent with those using FE model.

Figure 1 presents quantile process estimates and definitions of all variables are in Table 1. The Fixed Effects (FE) provides base results in the first column. The table provides results for 9 quantiles for the period 2009-2016. There a total of 239 observations. Bootstrap method is used to estimate standard errors for coefficients using quantile analysis. The dependent variable is dividend per share (PR1). Results from quantile regression for FG, FLEV6, OWN1, EPS & INV1 are consistent with those using FE model.

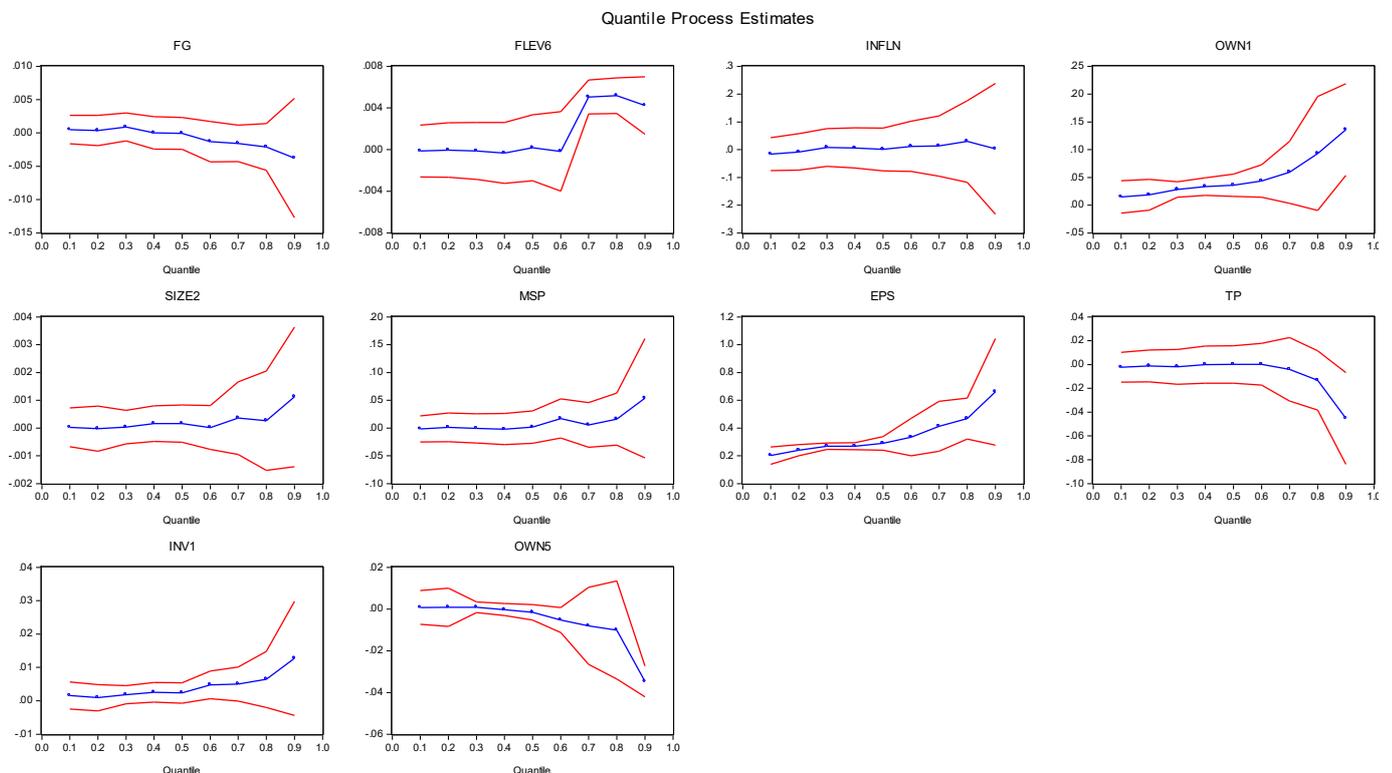


Figure 2: Determinants of Dividend Policy 2009 - 2016

The study shows that insider ownership has a positive effect on dividend policy which is consistent with the results based on the FE model. However, quantile regression shows clear variations in the magnitude of coefficients as firms move from low to high quantiles. Under hyperinflation, there is evidence of managerial entrenchment throughout the distribution. Under dollarization, insider ownership is important from 30<sup>th</sup> quantile onwards. In both periods, the effect of inside ownership increases as firms move to higher levels of the distribution of dividend policy. Findings are consistent with past studies (Mossadak, Fontaine and Khemakhem, 2016, Gowri and Saravanan, 2016) which support strong managerial entrenchment as firms move towards higher levels of dividend policy.

Institutional ownership has a negative effect in both structural periods. Firms with high institutional ownership can successfully reduce the payment of dividends. This is consistent with previous studies (Reyna, 2017, Yusof and Ismail, 2016). This study shows that their monitoring role is effective for firms with high dividend policy or payout ratios. The significance of institutional ownership is in the 90<sup>th</sup> quantile and starts from 60<sup>th</sup> quantile under hyperinflation and dollarization respectively.

Under hyperinflation, expansionary monetary policy reduces the payment of dividend at the higher level of the distribution of dividend policy. This is consistent with Akyildirim *et al.* (2013) who suggest that high money supply is inflationary which further erodes cashflows meant for dividend payouts. Under dollarization, the effect of money supply is insignificant. Consistent with Mohsin and Ashraf (2011), the results show that expansionary monetary policy has no effect on dividend policy. Firms have alternative sources of finance to improve dividend payouts.

The positive impact of earnings per share differs across the conditional distribution of firms' dividend policy in both periods. The magnitude of the coefficient increases as firms move from lower to higher quantiles. This shows the persistent impact of earnings per share on dividend payout as predicted by theory. Thus, at higher levels of dividend policy, firms with higher earnings pay more dividends as supported by previous studies (King'wara, 2015, Bassey et al, 2014).

Taxation has a positive impact on dividend payout at lower quantiles, under hyperinflation upto the 60<sup>th</sup> quantile. The positive effect is consistent with past studies (Atia, 2017, Amidu and Abor, 2010). This may indicate their desire to maintain a certain level of dividend policy and more so their ability to source funding elsewhere. At high levels of

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dividend policy, profitable firms are not considering the effects of taxation when deciding to pay or not to pay dividends. However, under dollarization, taxation has a negative effect within the 90<sup>th</sup> quantile. In our context, this shows that firms face the real burden of taxation at higher quantiles considering that the economy is using a stable currency. Previous studies (Arif and Akbarshah, 2013, Chuang et al, 2018) show that higher taxation adversely affects remuneration for shareholders.

The study shows that firm size explains dividend policy under hyperinflation and it is significant in the 90<sup>th</sup> quantile. Thus, at higher levels of dividend policy, larger firms are likely to increase their dividend payout ratio and move towards the upper levels. This confirms the argument by Arif and Akbarshah (2013) that large firms have more access to debts market and hence experience fewer external constraints. Dividend policy is not sensitive to firm size under dollarization.

Investment decisions are important under dollarization and have a positive effect between the 40<sup>th</sup> and 70<sup>th</sup> quantiles only. The positive effect is consistent with Bildik et al (2015). Thus, policy makers' focus should be on firms that are within this range since they are likely to withstand any financial constraints within the economy and continue to pay dividends. Such firms can access alternative sources of investment funds like debt and retained profits. Our results suggest that a study like Lestari (2018), showing that investment has no effect on dividend policy may have analysed behavior of firms at the lowest parts of the distribution.

Consistent with past studies (Bushra and Mirza, 2015, Cristea and Cristea, 2017), this study shows that firm growth has a negative effect on dividend policy under dollarization. Thus, firms at the high level of the distribution reduce payment of dividend to free up funds for taking up new opportunities. More so, the study shows that leverage has a positive effect on dividend policy from the 70<sup>th</sup> quantile. This is consistent with past studies (Thirumagal and Vasantha, 2017, Gowri and Saravanan, 2016) which show that firms are willing to acquire more debt to finance dividend payouts which acts as a signaling device to shareholders. This behavior is expected where firms are not afraid of the risk of bankruptcy as they are exposed to more debt.

## **5. Conclusion**

This study contributes to corporate finance literature by examining dynamics of dividend policy under unique market conditions. It identifies the major determinants and examines their contribution at different positions of the firm's dividend distribution. By using quantile regression analysis, the study brings useful information which is critical for policy making. The study confirms the importance of dividend relevance theories by showing role played by institutional shareholders, managerial share ownership and taxation. The results are more informative than those from previous studies which are based on OLS methodology. They indicate the points, on the distribution, at which key variables affect dividend policy. For example, under hyperinflation firm size, money supply and institutional ownership have a positive, negative and negative effect, respectively, on dividend policy at 90<sup>th</sup> quantile. Earnings per share and inside ownership are positive and significant throughout the distribution while taxation has a positive effect at lower quantiles. Under dollarization, the behavior of institutional ownership and firm growth suggests a non-linear relationship with dividend policy since the sign of the parameter changes from positive to negative. Insider ownership is significant from the 30<sup>th</sup> quantile onwards. Other variables like leverage, taxation and investment decisions are important at specific points on the distribution. These results provide a firm foundation for understanding dividend policy in markets under unique conditions. They show the importance of developing policies by focusing on the position of the firm on the distribution of dividend policy. A dividend policy that focus on reducing informational inefficiencies would be desirable for the Zimbabwean market.

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### Appendix: Fixed Effects models

Table 5: MODEL FOR THE PERIOD 2009-2016								
Variable	1	2	3	4	5	6	7	8
C	0.0655**	0.0645**	0.0677**	0.0714**	0.0583**	0.0127***	0.0697**	0.0710**
FG	-0.0010**		-0.0011**	-0.0011***	-0.0010**	-0.0010***	-0.0011**	-0.0010**
FLEV6	0.0016*	0.0016**		0.0015*	0.0011*	0.0014*	0.0016*	0.0017**
INFLN	0.0049	0.0111	0.0041		-0.0040	0.0134	0.0047	0.0036
OWN1	0.0389***	0.0378***	0.0382***	0.0405***		0.0386***	0.0431***	0.0385***
SIZE2	-0.0029*	-0.0028*	-0.0030*	-0.0033**	-0.0026*		-0.0031*	-0.0032**
MSP	0.0029	0.0003	0.0011	0.0029	0.0035	0.0007	0.0022	0.0026
EPS	0.0492*	0.0493*	0.0452*	0.0421*	0.0698*	0.0536**		0.0492*
TP	0.0033	0.0013	0.0045	0.0011	0.0026	0.0044	0.0036	
INV1	0.0042**	0.0040**	0.0035**	0.0037**	0.0022**	0.0030**	0.0045**	0.0043**
OWN5	0.0046**	0.0049***	0.0050***	0.0051***	0.0098***	0.0050***	0.0051***	0.0047**
R <sup>2</sup>	0.83	0.83	0.82	0.83	0.82	0.83	0.82	0.83
Adj R <sup>2</sup>	0.80	0.80	0.79	0.80	0.79	0.80	0.79	0.80
F-Test	24.83***	26.40***	24.48***	25.39***	23.98***	25.90***	24.67***	25.61***
DW	2.02	2.03	2.00	2.02	1.95	2.02	2.05	2.03
Obs	239	239	239	239	239	239	239	239

\*\*\* significant at 1%; \*\* significant at 5%; \*significant at 10%

The models are estimated using FE and with robust standard errors. The first model contains all explanatory variables which are removed one at a time to check for robustness. The results remain fairly stable for all models.

Table 6: MODEL FOR THE PERIOD 2000-2008								
Variable	1	2	3	4	5	6	7	8
C	0.0425**	0.0367**	0.0413**	0.0458***	0.0352**	0.0217***	0.0351**	0.0453**
FG	-0.0021***		-0.0023***	-0.0019***	-0.0022***	-0.0021***	-0.0024***	-0.0008**
FLEV6	-0.0013**	-0.0016**		-0.0014**	-0.0014*	-0.0010**	-0.0013*	-0.0017**
INFLN	-5.03E-10	-5.18E-10	-6.59E-10		-5.24E-10	-5.02E-10	-4.33E-10	-3.65E-10
OWN1	0.0505***	0.0526***	0.0504***	0.0506***		0.0487***	0.0509***	0.0529***
SIZE2	-0.0012	-0.0009	-0.0012	-0.0013	-0.0007		-0.0006	-0.0012
MSP	-0.0001	-9.07E-05	-0.0001	4.59E-05	1.90E-05	-0.0005	-9.13E-05	2.68E-05
EPS	0.0701***	0.0948***	0.0703***	0.0638***	0.0773***	0.0635***		0.0777***
TP	0.0173***	0.0125***	0.0184***	0.0145***	0.0207***	0.0185***	0.0141***	
INV1	0.0016	0.0011	0.0014	0.0020	0.0016	0.0012	0.0015	0.0017
OWN5	-0.0037*	-0.0046**	-0.0034*	-0.0038**	-0.0017*	-0.0036*	-0.0036*	-0.0047**
R <sup>2</sup>	0.79	0.79	0.78	0.83	0.76	0.80	0.78	0.78
Adj R <sup>2</sup>	0.75	0.76	0.75	0.80	0.72	0.77	0.75	0.74
F-Test	21.69***	22.88***	21.83***	25.39***	19.62***	24.87***	21.99***	21.62***
DW	1.98	2.00	2.00	2.02	1.92	2.01	2.02	1.96
Obs	270	270	270	270	270	270	270	270

\*\*\* significant at 1%; \*\* significant at 5%; \*significant at 10%

The models are estimated using FE and with robust standard errors. The first model contains all explanatory variables which are removed one at a time to check for robustness. The results remain fairly stable for all models.

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## Assessing the Impact of Electricity Production on Industrial and Agricultural Output Growth in Nigeria

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### ABSTRACT

#### **Purpose:**

While the relationships between energy or electricity consumption and economic growth are of great interest to economists, previous studies have not examined the dynamic effect of electricity production on industrial and agricultural output growth in Nigeria; this study attempts to fill the gap. This study thus investigates the dynamic effects of electricity production from renewable and non-renewable energy sources on industrial and agricultural output growth in Nigeria.

#### **Design/methodology/approach:**

This study disentangled electricity production by source - into renewable and non-renewable - and employed a Structural Vector Autoregressive (SVAR) and other time series econometrics analysis.

#### **Findings:**

This study found that electricity production from both sources has a slight impact on the growth of the Nigerian industrial and agricultural sectors. In addition, this study supports the existing claim that economic growth and energy are linked and thus disproves the neo-classical assumption of the *neutrality hypothesis*.

#### **Research limitations/implications:**

This study considers annual data for all the variables due to the available data frequency for electricity production. However, the study assesses the validity of the estimated SVAR, and the results show that the analysis is robust for this study.

#### **Originality/value:**

This study contributes to the existing empirical literature by disentangling electricity production into renewable and non-renewable- and then examine their impacts on the crucial sectors of the Nigerian economy. This study shows that electricity production from the two energy sources contributes marginally to the growth of the industrial and agricultural sectors in Nigeria. Therefore, among other policy prescriptions, the author recommends that acceleration of projects that focus on off-grid electricity production under the Nigerian Energy Support Program (NESP) could minimize the current challenges of electricity production and its impact on the economy.

#### **Keywords:**

Structural VAR  
Industrial output,  
Agricultural output,  
Electricity production

### 1. Introduction

As in many other countries, the challenges posed by an unreliable power supply in Nigeria threaten social and economic life in the face of surging population growth. The country grapples with an insufficient supply of energy, which adversely affects the quality of life of citizens both in urban and rural areas and limits inclusive growth. However, as utilities are a key component of economic, social and political development, a *reliable* energy supply that results in an improved standard of living is necessary (NEERP, 2015).

Nigeria is blessed with energy resources that include non-renewable energy sources (such as coal, oil and gas) and renewable energy sources (such as hydropower, sun, and wind). In particular, the main sources of on-grid electricity generation in Nigeria come from fossil fuel and hydropower. As of 2014, electricity production from oil, gas and coal accounted for 82.41% of the total electricity produced, with the remainder produced by hydropower (17.59%) (World

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Bank, 2017). Over the years, the on-grid electricity generation in Nigeria has been based on fossil fuel and hydropower energy sources. The following analysis provides background information about fossil fuel and hydropower electricity generation in Nigeria.

### Hydropower

Nigeria is endowed with large rivers and some natural falls, which are responsible for the high hydropower potential of the country. The Niger and Benue rivers and their tributaries constitute the core of Nigeria's river system, which offers a significant source of renewable energy including hydropower (greater than 100MW). Technically, the total exploitable scale of the hydropower potential of the country is estimated at over 14,120 MW, which is capable of producing over 50,800 GWh of electricity annually. However, as of 2012, only about 15% of the potential had been developed. The installed hydropower capacity is estimated to be 2,062 MW as of 2017 (International Hydropower Association (IHA), 2019).

### Fossil fuel

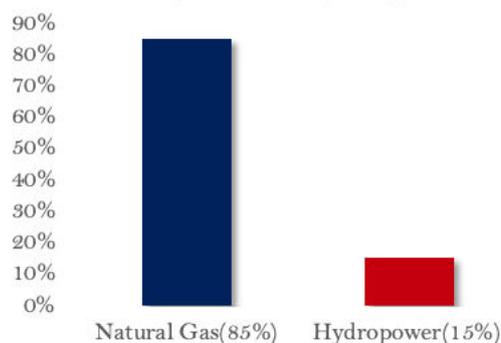
As an OPEC nation, Nigeria possesses abundant oil and gas resources, which make the country the largest in Africa in terms of oil and gas reserves. As of 2018, Nigeria's oil and gas reserve stood at 37 billion barrels and 192 trillion cubic feet respectively (OPEC, 2019). Likewise, coal reserves are estimated to be at least 2 billion metric tons; these reserves remain less exploited to date. With these vast fossil fuel-based reserves, as of 2016, the total electricity generated came from natural gas and was estimated to be 23.79 billion kilowatt-hours, an increase from 9.16 billion kilowatt-hours in 1997, with an average annual growth rate of 5.83 % (Report: Knoema, 2016). The following diagrams show the state of on-grid electricity production in Nigeria:

#### Energy Source from Nigeria's Natural Resources

Renewable Energy Sources	Nigeria
Falls and Rivers	✓
Sun	✗
Wind	✗
Non -Renewable Energy Sources	
Coal	✗
Oil	✗
Natural Gas	✓

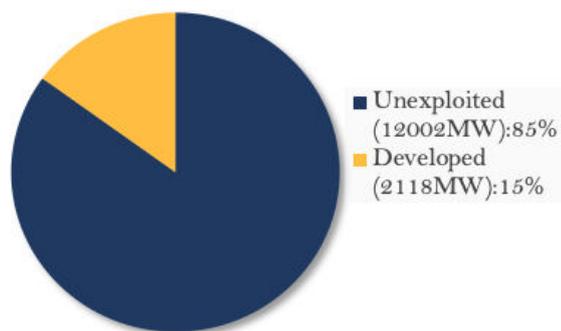
Source: Author's Compilation

#### On Grid Electricity Production by Energy Sources



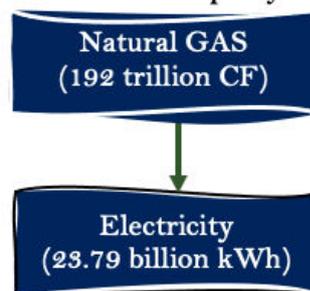
Source: Author's Compilation

#### Hydropower Capacity



Source: International Hydropower Association, 2019

#### Natural Gas Capacity



Source: Author's Compilation

Figure 1: State of on-grid electricity production in Nigeria

Despite the abundant renewable (hydropower) and non-renewable (fossil-fuel) energy resources, the Nigerian energy sector has yet to meet the electricity demand of the country, leading to the question of to what extent this impacts the economic development of the country. Therefore, it is important to establish whether or not electricity production from non-renewable and renewable energy sources contributed significantly to the industrial and agricultural output growth over the previous years. Hence, the study sought to empirically investigate the dynamic effects of electricity production from renewable and non-renewable energy sources on industrial and agricultural output growth in Nigeria. This study considers industrial and agricultural sectors due to their importance to the

socio-economic development of the country. For instance, employment in industrial and agricultural sectors accounts for about 44.12 % of total employment by economic activity (National Bureau of Statistics, 2010).

The results of the econometric analysis show that electricity production contributes marginally to the growth of the industrial and agricultural sectors in Nigeria. In addition, the results support the existing fact that energy and economic growth are linked. Therefore, as the shortage of electricity supply remains a threat to the growth of the Nigerian economy, the following are necessary: prioritization of policies for the development of the energy sector; eradication of mismanagement and lack of monitoring; diversification of electricity production across the potential energy sources; and acceleration of projects under the NESP.

The remainder of the paper is organized as follows: after the introductory section, section 2 provides a review of the literature. Section 3 describes the data handling and sources, the econometrics model and the empirical methods. Section 4 reports the empirical results and discussion. Section 5 concludes the study and offers pertinent policy prescriptions.

## 2. Review of Literature

To a large extent, the nexus between electricity generation from renewable and non-renewable energy resources and economic activity has long been a subject of impressive argument in the literature. Empirical evidence shows diverse relationships. In studies of the relationships between renewable and non-renewable electricity generation and economic activities, several studies have found bidirectional causality of these variables (i.e., power generation stimulates economic activities, vice versa) (Apergis and Payne, 2011; Ohler and Fetters, 2014; among others), unidirectional causality (Akinlo, 2009; Ackah, 2015; Cerdeira Bento and Moutinho, 2016; among others), and positive relationship (Al-mulali et al. 2014; among others).

Ohler and Fetter (2014) found a bidirectional relationship between aggregate renewable generation and real gross domestic product (GDP) in 20 OECD Countries. On the other hand, Marques et al. (2014) found no evidence of causal relationships between renewable electricity to economic growth but economic growth gives rise to renewable electricity. Al-mulali et al. (2014) showed that both renewable electricity consumption and non-renewable electricity consumption have a long-run positive effect on GDP growth in 18 Latin American Countries and all the three variables have a feedback causal relationship. In support of Al-mulali et al (2014) and Ohler and Fetter (2014), Dogan (2015) found that in the long-run, there is a bidirectional relationship between renewable and non-renewable electricity consumption and economic growth in Turkey (i.e., supports the feedback hypothesis in the long-run). On the other hand, Cerdeira Bento and Moutinho (2016) findings disagreed with those of Dogan (2015). They found that there is unidirectional causation running from output to renewable electricity production in Italy.

Apergis and Payne (2009) found bidirectional causality between electricity consumption and economic growth in both the short-run and long-run for 88 Countries. Unlike the findings of Apergis and Payne (2009), Tiwari et al (2014) argued that there is no long-run relationship between renewable energy production and economic growth in sub-Saharan African Countries. Considering recent studies, Maji, Sulaiman, and Abdul-Rahim (2019) found that energy consumption slowed down economic growth in 15 West African Countries. On the other hand, Rahman (2020) argued that there is unidirectional causality from economic growth to energy consumption in the 10 most electricity-consuming Countries. Using panel data for 174 Countries, Atems and Hotaling (2018) reported that there is a positively strong significant relationship between renewable and non-renewable electricity generation and growth. The authors also argued that electricity generation is more important than consumption since consumption is determined by distribution and transmission, which are largely affected by distribution theft and loss.

The existing empirical studies on Nigeria and West Africa have focused on the relationship between renewable and non-renewable energy consumption and economic growth (Ackah, 2015; Maji Sulaiman and Abdul-Rahim, 2019; Tiwari et al., 2014) and few empirical studies have examined the relationship between electricity consumption and economic growth (Akinlo, 2009; Iyke, 2015; among others). Akinlo (2009) found unidirectional Granger causality running from electricity consumption to real GDP in Nigeria. In support of Akinlo (2009), Iyke (2015) reported unidirectional causality running from electricity consumption to economic growth in both the short-run and long-run. In the same vein, Odugbesan and Husam (2020) revealed that there is unidirectional causality from energy consumption to economic growth in the case of energy-growth nexus in Nigeria. On the other hand, Ackah (2015) disagreed with Akinlo (2009) and Iyke (2015), showing that there is a long-run unidirectional causality from non-renewable energy to growth in Ghana and a bidirectional relationship in Algeria and Nigeria. Nathaniel and Festus (2020) also found that electricity consumption increases economic growth in Nigeria.

To the best of our knowledge, the gap in the literature surveyed shows that many of these results are inconsistent with the reality in the case of Nigeria for the followings reasons:

Electricity consumption in Nigeria includes off-grid electricity consumption, which is generated by businesses or private individuals due to the failure of the government to meet energy demand. As argued by previous authors (Atems and Hotaling, 2018; Depuru et al., 2011; Jamil 2013; among others), electricity production is more important than consumption since consumption is determined by distribution and transmission of electricity coming from production, both of which are largely affected by distribution theft and loss to weak infrastructure. Hence, it is crucial to establish whether or not electricity production from non-renewable and renewable energy sources drive the growth of the industrial and agricultural sectors.

### 3. Material and Methods

#### 3.1 Data

The dataset for this study covers the period 1981-2013 and was selected depending on the availability of data. This study has a total of 33 years of annual data. The dataset for natural resources indicators is defined as electricity production from hydroelectric sources (which represents electricity production from renewable energy) and electricity production from oil, gas and coal sources (which represents electricity production from non-renewable energy). The data are expressed in total percentages. Sectoral outputs are defined as industrial and agricultural outputs at 1999 constant basic price (₦Billion). All data were retrieved from the World Development Indicator (WDI) database (2015) and the Central Bank of Nigeria (2015) and are described in Table 1.

**Table 1. Unit and Explanation of Statistical Data**

Variables	Units	Explanation	Source
Electricity production from oil, gas and coal sources	% of total	<i>Oil</i> refers to crude oil and oil products. <i>Gas</i> refers to natural gas but excludes natural gas liquids. <i>Coal</i> refers to all coal and brown coal, both primary (including patent fuel, coke oven coke, gas coke, coke oven gas and blast furnace gas).	World Bank Database (World Development Indicator)
Electricity production from hydroelectric sources	% of total	<i>Hydropower</i> refers to electricity produced by hydroelectric power plants.	World Bank Database (World Development Indicator)
Industrial Output	1990 Constant Basic Prices (₦ Billion)	<i>Industrial output</i> refers to the total output of all the facilities producing goods within a country e.g. crude petroleum, natural gas, solid minerals and manufacturing.	Central Bank of Nigeria (CBN)
Agricultural output	1990 Constant Basic Prices (₦ Billion)	<i>Agricultural output</i> refers to the total output of crop, forestry, fishing and livestock products	Central Bank of Nigeria (CBN)

#### 3.2 Observation

The descriptive statistics of the series used in this study are detailed in Table 2. The results show that the standard deviations for both renewable and non-renewable electricity production, industrial output and agricultural output are quite low, implying that the data are evenly dispersed around the mean; the statistics by Jarque-Bera show that all the variables are normally distributed with zero mean and finite covariance.

**Table 2. Summary of descriptive statistics of the variables**

Variables	Average	Median	Skewness	Kurtosis	SD	Min	Max	JB
lnREP	3.437039	3.496524	-0.82405	2.858039	0.213359	2.912351	3.734448	3.762524(0.152398)
lnNREP	4.219244	4.204684	0.315781	2.222071	0.089979	4.062770	4.401829	1.380561(0.501435)
lnIND	5.100526	5.049438	0.197919	1.970348	0.450055	4.394187	5.900657	1.673198(0.433181)
lnAGR	4.761117	4.761041	-0.222144	1.837775	0.252790	4.280295	5.110930	2.128718(0.344949)

Note: SD is standard deviation, JB is Jarque-Bera and the values in parentheses are probabilities of JB.

**Table 3. Correlation Matrix**

Variables	lnREP	lnNREP	lnIND	lnAGR
lnREP	1.0000000			
lnNREP	-0.9875121	1.0000000		
lnIND	-0.4549090	0.394527	1.0000000	
lnAGR	-0.2911690	0.240681	0.944211	1.0000000

The pair-wise correlation results are reported in Table 3. The results show that industrial output and agricultural output are negatively correlated with renewable electricity production. Similarly, Non-renewable electricity production is inversely correlated with renewable electricity production. On the other hand, positive correlations are found between industrial output and non-renewable electricity production and between agricultural output and non-renewable electricity production. Likewise, a positive correlation was reported between agricultural output and industrial output.

**3.3 Unit roots**

In this study, Augmented Dickey-Fuller (ADF), Phillip Perron (PP) and Zivot-Andrews (ZA) unit root tests were used to check for the stationarity of each variable. The main aim of a unit root test is to test whether time series are affected by transitory or permanent shocks. The ADF and PP unit root models are presented thus:

$$ADF : \Delta Y_t = \mu_t + \lambda t + \psi Y_{t-1} + \sum_{k=1}^p d_k \Delta Y_{t-k} + \varepsilon_t \tag{1}$$

$$PP : \Delta Y_t = \mu_t + \psi Y_{t-1} + \varepsilon_t \tag{2}$$

Where  $\Delta$  denotes the first difference,  $y_t$  is the time series being tested,  $t$  is the time trend variable, and  $p$  is the number lag which is added to the model to ensure that the residual,  $\varepsilon_t$ , is a disturbance term (i.e., it has zero mean and constant variance). The Schwarz information criterion (SIC) was used to determine the optimal lag length,  $p$ . In the equations above, we tested the null hypothesis of  $\psi=0$  against the alternative hypothesis of  $\psi<0$ . Non-rejection of the null hypothesis implies that the series is non-stationary, whereas the rejection of the null hypothesis indicates the time series is stationary.

Many studies in the field of energy and natural resource economics in Nigeria have applied conventional unit root tests without checking if the presence of significant structural breaks in the deterministic trend renders the outcome of these conventional unit root tests biased (see, for example, Akinlo, 2009; Akpan and Akpan (2012); Ackah, 2015 among others). The motivation for a structural break in this study is that natural disaster affects electricity producing facilities, which could lead to a sudden break in electricity production. To consider the possible presence of a structural break in the time series data and strengthen the inference of this study, the Zivot-Andrews (ZA) unit root test, which accounts for a structural break, was adopted. The test utilizes the entire sample with different dummy variables for each possible break date (Zivot and Andrews, 1992).

The following regressions were used:

$$\text{Model I: } y_t = \mu + \theta DU_t(\tau_b) + \beta t + \alpha y_{t-1} + \sum_{i=1}^k \varphi_i \Delta y_{t-i} + e_t, \tag{3}$$

$$\text{Model II: } y_t = \mu + \theta DT_t(\tau_b) + \beta t + \alpha y_{t-1} + \sum_{i=1}^k \varphi_i \Delta y_{t-i} + e_t, \tag{4}$$

$$\text{Model III: } y_t = \mu + \theta DU_t(\tau_b) + \beta t + \lambda DT_t(\tau_b) + \alpha y_{t-1} + \sum_{i=1}^k \varphi_i \Delta y_{t-i} + e_t, \tag{5}$$

Where  $DU_t(\tau_b) = 1$  if  $t > \tau_b$  and 0 otherwise;  $DT_t(\tau_b) = t - \tau_b$  for  $t > \tau_b$  and 0 otherwise;  $\Delta$  is the first difference operator; and  $e_t$  is a white noise disturbance term with variance  $\sigma^2$ .  $DU_t$  is a sustained dummy variable that captures a shift in the intercept and  $DT_t$  represents a shift in the trend occurring at time  $\tau_b$ . Model I includes the intercept; Model II includes the trend; and Model III captures the possibility of a change in both the intercept and trend.

**3.4 Cointegration test analysis**

The Johansen cointegration test was employed (Johansen, 1988; Johansen and Juselius, 1990). This test sets up the non-stationarity time series as a vector autoregression (VAR) of order  $p$ :

$$\Delta Y_t = \sum_{i=1}^p \Gamma_i \Delta Y_{t-i} + \sum_{k=1}^p \Gamma_{k-i} \Delta Y_{t-k-i} + \Pi Y_{t-1} + \mu_t \tag{6}$$

Given that  $Y_t$  is a vector of non-stationary  $I(0)$  variables, then  $\Delta Y_{t-1}$  are  $I(1)$  and  $\Pi Y_{t-1}$  must be  $I(0)$  in order to have  $\mu_t \approx I(0)$  and therefore to have a well-behaved system.

The trace test and the maximum eigenvalue test were used to test the hypothesized existence of the  $r$  cointegrating vector. The trace test statistic describes the null hypothesis when the number of distinct cointegrating vectors is less than or equal to  $r$ . On the other hand, the maximum eigenvalue test statistic describes the null hypothesis when the number of cointegrating vectors is  $r$  against the alternative of  $r+1$  cointegrating vectors.

### 3.5 Hatemi-J Threshold cointegration approach

A cointegration test between variables with unit root is an integral part of empirical time series analyses. Most conventional cointegration tests (i.e. Engle and Granger (1987), Johansen and Juselius (1990) and Pesaran et al (2001)) assume that the cointegration vector remains the same during any period of study. There are many reasons to expect that the long-run relationship between variables might change (i.e. a shift in the cointegration vector can occur). Structural change can take place because of economic crises; technological shock; changes in the economic actors, preferences and behavior; policies and regime changes; and organizational or institutional evolution (Hatemi-J, 2008). Therefore, to identify the long-term relationship among the variables, this study also adopted the Hatemi-J cointegration test that accounts for two structural breaks through two possible regime shifts (i.e. regime changes endogenously with level and slope dummies). This model is defined as follows:

$$y_t = \kappa + \delta' x + u_t, \quad t = 1, 2, \dots, n \quad (7)$$

To account for the effect of two structural breaks on both the intercept and the slope (two regime shifts), equation 1 is generalized as follows:

$$y_t = \kappa_0 + \kappa_1 D_{1t} + \kappa_2 D_{2t} + \delta_0' x_t + \delta_1' D_{1t} x_t + \delta_2' D_{2t} x_t + u_t, \quad (8)$$

Where  $D_{1t}$  and  $D_{2t}$  are dummy variables defined as

$$D_{1t} = \begin{cases} 0 & \text{if } t \leq [n\tau_1] \\ 1 & \text{if } t > [n\tau_1] \end{cases}$$

and

$$D_{2t} = \begin{cases} 0 & \text{if } t \leq [n\tau_2] \\ 1 & \text{if } t > [n\tau_2] \end{cases}$$

With the unknown parameters  $\tau_1 \in (0, 1)$  and  $\tau_2 \in (0, 1)$  signifying the timing of the regime change point and the bracket denoting the integral part. To test the null hypothesis of no cointegration, the ADF test was calculated by the corresponding t-test for the slope of  $\hat{u}_{t-1}$  in a regression of  $\Delta \hat{u}_t$  on  $\hat{u}_{t-1}, \Delta \hat{u}_{t-1}, \dots, \Delta \hat{u}_{t-k}$ , where  $\hat{u}_t$  signifies the estimated error term from regression (2). The  $Z_\alpha$  and  $Z_t$  test statistics are based on the calculation of the bias-corrected first-order serial correlation coefficient estimation.

### 3.6 SVAR model and identification assumption

The variables in this study are analyzed using SVAR approach and they are proxied as  $\ln REP_t, \ln NREP_t, \ln IND_t$  and  $\ln AGR_t$ , where  $\ln IND_t$  is the natural logarithm of industrial output growth;  $\ln AGR_t$  is the natural logarithm of agricultural output;  $\ln REP_t$  is the natural logarithm of renewable electricity production; and  $\ln NREP_t$  is the natural logarithm of non-renewable electricity production. The structural representation of the VAR is given as follows:

$$AY_t = \sum_{i=1}^p \delta_i Y_{t-i} + \varepsilon_t \quad (9)$$

where  $A$  denotes a contemporaneous coefficient matrix and  $\varepsilon_t$  denotes a vector of serially and mutually uncorrelated structural shocks. The lag-length,  $P$ , is determined based on the Akaike Information Criterion (AIC).

The reduced form of the structural representation of Eq. (9) is shown here:

$$Y_t = \sum_{i=1}^p \lambda_i Y_{t-i} + B\varepsilon_t \quad (10)$$

Where  $B=A^{-1}$ ,  $\lambda_i = A^{-1}\delta_i$ . The prediction reduced form errors of  $Y_t$ , condition on the information contained in the vector of lagged endogenous variables  $X_t = [Y_{t-1}', \dots, Y_{t-p}']'$  were used together with restrictions imposed on  $B\varepsilon_t$  to obtain the structural shock, where elements of matrix  $B$  are known if the instantaneous relation between

structural and reduced innovations is known. However, in this study, I used a short-run SVAR model (AB model) following Amisano and Giannini (1997). Therefore, (11) can be written as follows

$$AA(L)Y_t = A\varepsilon_t = B e_t \quad (11)$$

$$A\varepsilon_t\varepsilon_t'A' = BB' \quad (12)$$

Where L is the lag operator ; A, B are  $(n \times n)$  invertible matrices ;  $E(\varepsilon_t) = 0$  and  $E(\varepsilon_t\varepsilon_t') = \Sigma$ ;  $E(e_t) = 0$  and  $E(e_t e_t') = I_k$ . The identifications were obtained by placing restriction on the matrices A and B as in (13), which the study assumed to be nonsingular. The orthogonalization matrix  $\Pi = A^{-1}B$  is related to the error covariance matrix  $\Sigma = \Pi\Pi'$ . Hence, given the symmetric nature of  $\Sigma$ , there are  $K(K+1)/2$  free parameters, although many parameters may be estimated in the matrices A and B as in  $2K^2$ . However, the order of condition for identification requires  $2K^2 - K(K+1)/2$  restrictions be placed on the free elements of these matrices.

To impose the recursive structure the short-term restrictions, (11) can be constructed as matrix algebra as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 \\ a_{41} & a_{42} & a_{43} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{\ln rep} \\ \varepsilon_{\ln nrep} \\ \varepsilon_{\ln ind} \\ \varepsilon_{\ln agr} \end{bmatrix} = \begin{bmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{bmatrix} \begin{bmatrix} e_{\ln rep} \\ e_{\ln nrep} \\ e_{\ln ind} \\ e_{\ln agr} \end{bmatrix} \quad (13)$$

Where  $\varepsilon_t = [\varepsilon_{\ln rep}, \varepsilon_{\ln nrep}, \varepsilon_{\ln ind}, \varepsilon_{\ln agr}]'$  is the vector of reduced form disturbances of four-dimensional VAR;  $e_{\ln rep}, e_{\ln nrep}, e_{\ln ind}, e_{\ln agr}$  are mutually uncorrelated structural shocks; and  $a_{21}, a_{31}, a_{32}, a_{41}, a_{42}, a_{43}, b_{11}, b_{22}, b_{33}$  and  $b_{44}$  are the structural parameters. Finally, the study employed maximum likelihood approach via Newton Raphson analytic derivation to estimate the AB model. The value of the elements in (13) are reported in subsection 3.6.

### 3.7 Multivariate causality analysis

After the long-run relationship between the variables was examined, the granger causality/block exogeneity Wald test was used to determine causality between the variables. If no cointegration between the series was found, then the VAR method was developed as follows:

$$\begin{bmatrix} \ln rep_t \\ \ln nrep_t \\ \ln ind_t \\ \ln agr_t \end{bmatrix} = \begin{bmatrix} \varphi \\ \mathcal{G} \\ \rho \\ \pi \end{bmatrix} + \begin{bmatrix} A_{11,n} & A_{12,n} & A_{13,n} & A_{14,n} \\ A_{21,n} & A_{22,n} & A_{23,n} & A_{24,n} \\ A_{31,n} & A_{32,n} & A_{33,n} & A_{34,n} \\ A_{41,n} & A_{42,n} & A_{43,n} & A_{44,n} \end{bmatrix} \begin{bmatrix} \ln rep_{t-k} \\ \ln nrep_{t-m} \\ \ln ind_{t-p} \\ \ln agr_{t-q} \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \end{bmatrix} \quad (14)$$

In Eq. (14), the existence of a significant relationship of the variables provides the evidence for the direction of causality. In this model, we have three relationships: unidirectional, bidirectional, and not causal.

## 4. Empirical Results and Discussions

### 4.1 Unit root tests results

The results of unit root tests with and without accounting for a structural break are reported in Tables 4 and 5 respectively. The results of augmented Dickey Fuller (ADF) and Philip Perron (PP) for the series with and without trends show that none of the variables at levels are stationary at the 5% significance level. For the first-order difference series, the statistics consistently indicate that all the variables are stationary at the 1% significance level. Hence, the results of unit root tests without structural breaks suggest that all the series are integrated of order one [I(1)].

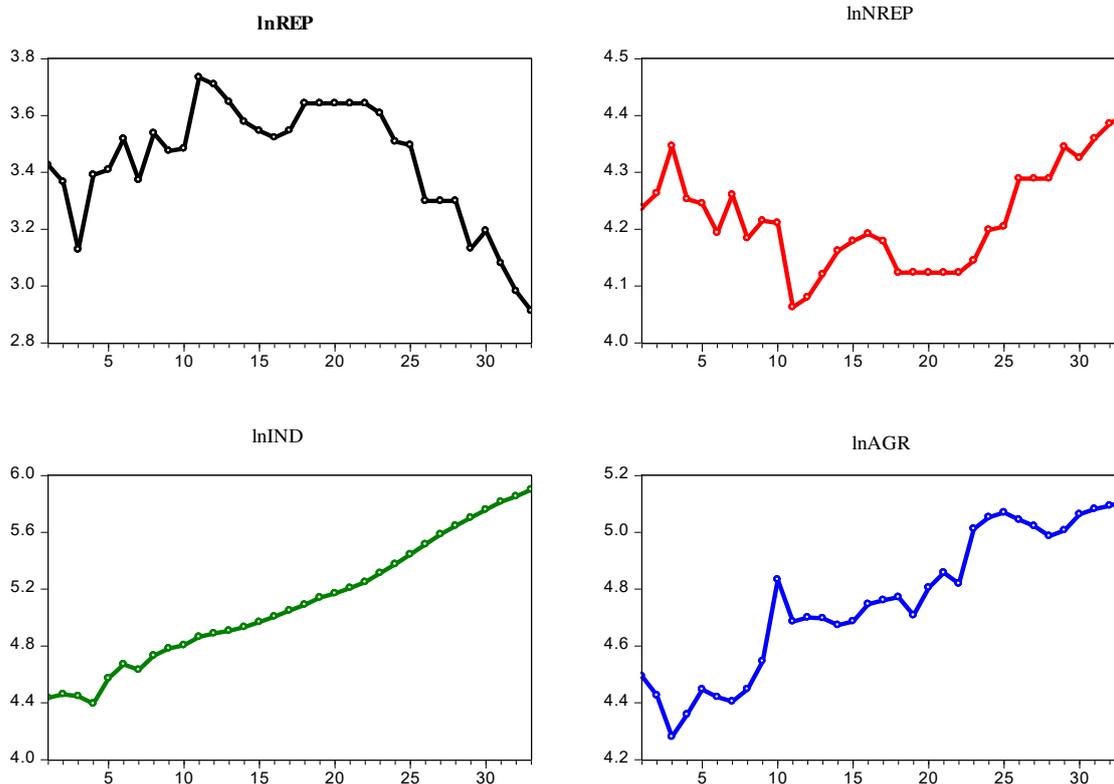


Figure 2: Variables in level

Table 4. Unit root analysis without structural break

Variables	ADF Test		PP Test	
	Without Trend	With Trend	Without Trend	With Trend
levels:				
lnREP	-0.395028	-0.936110	-0.107841	-0.477200
lnNREP	-0.872243	-1.275401	-0.791618	-1.073577
lnIND	1.543849	-1.279067	0.800341	-2.243043
lnAGR	-0.694562	-3.554605	-0.388631	-3.554605*
First differences:				
$\Delta$ lnREP	-6.774288***	-7.584907***	-6.743439***	-9.973032***
$\Delta$ lnNREP	-6.423337***	-3.764723**	-6.432286***	-8.522343***
$\Delta$ lnIND	-5.884710***	-5.981884***	-5.898573***	-5.981884***
$\Delta$ lnAGR	-6.055522***	-5.940918***	-7.454738***	-7.225411***

\*, \*\* and \*\*\* indicate significant at the 10%, 5% and 1% respectively.

Table 5. Zivot and Andrew's structural break unit root test

Variables	Test	t-statistic	1% Critical value	Break year	Lag length
lnREP	C	-1.683480	-5.34000	2006	4
	T	-3.509503	-4.80000	2002	4
	C/T	-3.367889	-5.57000	2001	4
lnNREP	C	-2.697204	-5.34000	2006	4
	T	-3.978229	-4.80000	2001	4
	C/T	-3.888137	-5.57000	1991	4
lnIND	C	-2.245591	-5.34000	2005	4
	T	-3.818242	-4.80000	2002	4

	C/T	-3.670063	-5.57000	2000	4
lnAGR	C	-4.519253	-5.34000	1989	4
	T	-3.974500	-4.80000	1991	4
ΔlnREP	C/T	-4.245238	-5.57000	2003	4
	C	-7.804221	-5.34000	2004	4
	T	-6.376083	-4.80000	2007	1
ΔlnNREP	C/T	-6.674531	-5.57000	1998	1
	C	-7.129262	-5.34000	1993	4
	T	-5.377409	4.80000	2007	1
ΔlnIND	C/T	-5.525713	-5.57000	1993	1
	C	-7.328851	-5.34000	2003	2
	T	-8.09780	-4.80000	1994	2
ΔlnAGR	C/T	-7.946097	-5.57000	1996	2
	C	-6.103486	-5.34000	2005	4
	T	-5.471369	-5.34000	2006	1
	C/T	-6.215096	-5.57000	1991	1

The unit root tests included an intercept (C), a trend (T), and both intercept and trend (C/T). The null hypothesis was that the series has a unit root with a structural break in the intercept (C), in the trend (T) and in both intercept and trend (C/T). The table values were obtained from Zivot and Andrews (1992).

Similarly, the unit root without structural breaks generated misleading results in the presence of structural breaks. However, the results consistently suggest that all the variables with structural breaks at constant, trend, and constant and trend are integrated of order 1; thus, the series are stationary after the first difference. Nathaniel and Festus (2020) found similar results in their study on electricity consumption, urbanization and economic growth in Nigeria.

#### 4.2 Cointegration tests results

Since the variables are integrated of order one. That is, they are found to be I (1) processes, which support the theoretical basis that the variables are likely to move together in the long run when they drift apart in the short run. Then, to check for cointegration among variables, the study employed the Johansen cointegration test without structural breaks and the Hatemi-J threshold cointegration test with structural breaks. Table 6 reports the maximum eigenvalue statistics and trace statistics of Johansen's cointegration. The results of Johansen's cointegration test show that neither maximum eigenvalue statistics nor trace statistics reject the null hypothesis of the presence of a no cointegration relationship. This finding validates the conditions for using SVAR techniques.

Likewise, the results of Hatemi-J threshold cointegration with two breakpoint tests are reported in Table 7. The modified ADF\*,  $Z_t^*$ , and  $Z\alpha^*$  test statistics failed to reject the null hypothesis of no cointegration at the 5% level of significance. This finding implies that there is no cointegration relationship between the variables for two regime shifts. However, the timing of the structural breaks is endogenously determined.

**Table 6. Johansen Cointegration test without Structural breaks**

Cointegrating Vectors	Trace statistic	5% CV	Max-Eigen statistic	5% CV
r=0	46.46045	47.85613	24.07610	27.58434
r≤1	22.38435	29.79707	13.31184	21.13162
r≤2	9.072507	15.49471	9.064964	14.26460
r≤3	0.007542	3.841466	0.007542	3.841466
Decision:	No long-run relationship		No long-run relationship	

**Table 7. Hatemi-J Threshold cointegration test with structural break**

$\ln IND = f(\ln REP, \ln NREP)$ :	ADF*	$Z\alpha^*$	$Z_t^*$
C	-5.65663(0.8,0.18)	-4.29242(0.7,0.18)	-4.29242(0.7,0.18)
C/T	-6.14034(0.8,0.15)	-3.28736(0.6,0.14)	-3.287369(0.6,0.14)
C/S	6.45808(0.15,0.21)	6.42757(0.14,0.21)	-6.45808(0.15,0.21)

$\lnAGR=f(\lnREP,\lnNREP)$ :

ADF\*

Z $\alpha$ \*

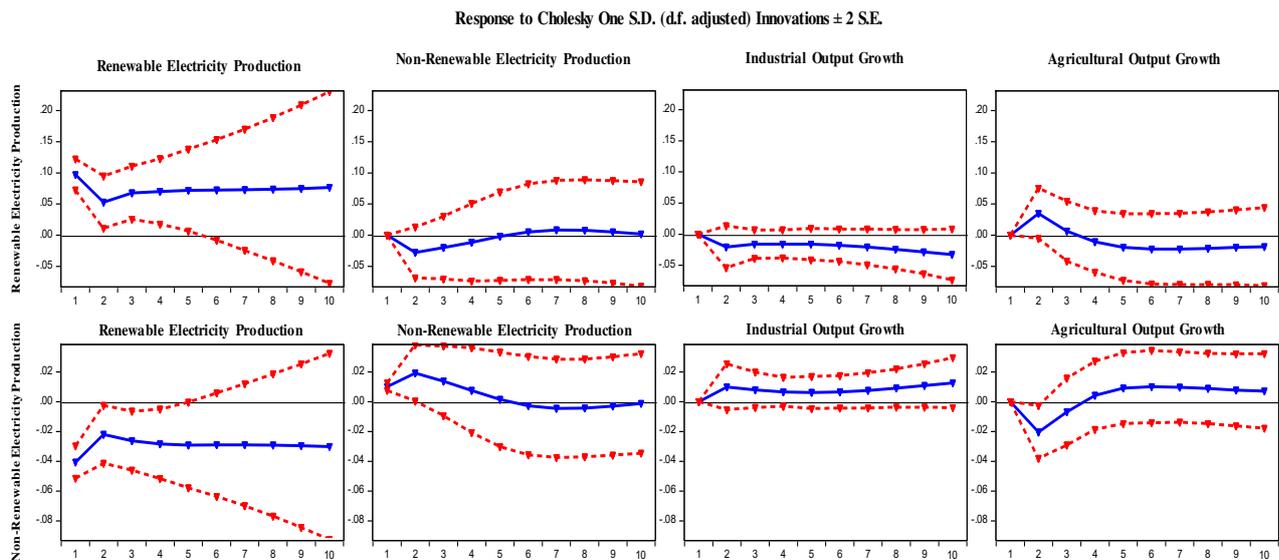
Z $t$ \*

C	-6.74333(0.9,0.22)	-6.74333(0.9,0.22)	-6.74333(0.9,0.22)
C/T	-6.68662(0.9,0.22)	-6.68662(0.9,0.22)	-6.68662(0.9,0.22)
C/S	-6.70437(0.9,0.22)	-6.70437(0.9,0.22)	-6.70437(0.9,0.22)
5% CV	-6.45800	-83.6440	-6.45800

Note: The critical values are provided in Hatemi-J (2008, pp 501). The cointegration test includes level of shift (C), level shift with trend (C/T) and regime shift(C/S). The number in parenthesis represents break points.

### 4.3 Impulse response to structural shock

Looking at the impact of changes in electricity production on industrial and agricultural output growths, the study used impulse response analysis to estimate the effects of shocks coming from renewable and non-renewable electricity production on industrial and agricultural output growth. Figure 3 shows the response of the sectoral output variables to structural shocks across 10 periods. The dotted lines represent two standard error bands.



**Figure 3:** The Impulse response of the dynamic impact of renewable electricity production and non-renewable electricity production on sectoral output growth in Nigeria. Note: the dotted line represents two-standard error bands derived from the structural VAR model described in this paper. Standard errors for the impulse responses are calculated with the analytic (Asymptotic) approach.

In addition, Figure 3 shows that shocks to renewable electricity production have a negative impact on industrial output growth over the time horizon. This impact is less pronounced since the values are close to zero. In contrast, shocks to non-renewable electricity production have a positive impact on industrial output growth and remain positive throughout all horizons. However, despite the immediate increase in industrial output, the results show that both shocks to renewable and non-renewable electricity production have a marginal impact on industrial output growth. On the other hand, shocks to renewable electricity production have an asymmetric impact on agricultural output growth within the period. The response increases sharply in the positive region and decreases from the positive to negative regions and remains flat in the long run. Hence, since the values are close to zero, renewable electricity production has a marginal impact on agricultural output growth.

Similarly, shocks to non-renewable electricity production have asymmetric impacts on agriculture output growth within the period. The response decreases sharply at the initial period in the negative region and increases from the negative regions to the positive regions. This impact is also marginal since the values are close to zero. The main conclusion that can be drawn from these results is that electricity production from renewable and non-renewable energy sources contributes slightly to the growth of the industrial and agricultural sectors in Nigeria.

### 4.4 Variance decomposition analysis

This section examines the contribution of different structural shocks to the fluctuations of the industrial and agricultural output growth by estimating the variance decomposition of the forecast error. Table 8 shows the share of the fluctuations of the industrial and agricultural output growth, caused by their own shock compared with the shocks of the other variables. The value in parentheses represents the t-statistics.

The first panel shows that a shock to renewable electricity production accounts for about 25% fluctuations in industrial output growth in the short run, but decreases to 20% in the long run. On the other hand, in the initial period, a shock to non-renewable electricity production accounts for 20% fluctuations in the industrial output growth and the fluctuation increases to 26% in the long run. These results suggest that the contribution of non-renewable

electricity production to industrial output fluctuations is slightly more substantial than the contribution of renewable electricity production in Nigeria. However, the contributions in terms of percentages are marginal since they are far from 100%.

In the same vein, a shock to renewable electricity production accounts for 16% fluctuations in agricultural output growth in the short run but increased to 50% in the long run. On the other hand, a shock to non-renewable electricity production accounts for 16% fluctuations in agricultural output growth and the fluctuations slightly decrease to 14% in the long run. These results show that the contribution of renewable electricity production to agricultural output fluctuations is more substantial compare to the case of renewable electricity production. However, the contributions in terms of percentages are marginal since they are far from 100%.

Overall, the results imply that electricity production from renewable and non-renewable energy sources are not the major determinant of growth in the industrial and agricultural sectors. These findings disagree with those of Salim et al. (2014), who found that non-renewable energy consumption is a major determinant of industrial output in both the short- and long-run in OECD countries.

**Table 8. Variance Decomposition of lnIND and lnAGR:**

Decomposition of lnIND:					
Month	S.E.	LNREP	LNNREP	LNIND	LNAGR
1	0.035098	17.64072 (12.0430)	2.717923 (6.12018)	79.64135 (12.5464)	0.000000 (0.00000)
3	0.068795	25.75247 (14.1814)	20.50470 (13.7077)	52.01525 (14.4089)	1.727585 (5.44905)
6	0.102522	24.71839 (16.8885)	24.00335 (17.7635)	49.93581 (18.6240)	1.342450 (7.22763)
9	0.127635	22.45059 (19.7666)	26.05033 (19.3057)	50.50818 (21.4825)	0.990905 (8.21146)
12	0.148757	20.41360 (22.4360)	26.93285 (19.6694)	51.88437 (23.0636)	0.769188 (8.91306)
Decomposition of lnAGR:					
Month	S.E.	LNREP	LNNREP	LNIND	LNAGR
1	0.077093	2.126300 (6.27090)	16.03735 (11.3717)	1.174416 (4.61279)	80.66193 (12.3524)
3	0.094216	16.40503 (12.4234)	14.26794 (11.2412)	3.945309 (5.80874)	65.38172 (14.0444)
6	0.113729	36.56568 (17.2554)	11.50965 (12.2004)	6.699592 (6.09345)	45.22508 (14.5837)
9	0.132274	44.75839 (20.4397)	12.90255 (14.3666)	7.782013 (7.27418)	34.55705 (15.1535)
12	0.147234	50.21408 (22.5897)	13.54462 (15.7973)	7.760414 (8.41341)	28.48088 (15.2136)

Cholesky Ordering: lnREP lnNREP lnIND lnAGR. Standard Errors: Monte Carlo simulation (1000 replication).

#### 4.5 Granger causality analysis

Granger causality tests were performed to investigate the causal relationship among renewable electricity production, non-renewable electricity production, industrial output, and agricultural output. The results are shown in Table 10: there is a strong bidirectional causality between renewable electricity production and industrial output (lnREP $\leftrightarrow$ lnIND). In addition, there is a strong bidirectional causality between non-renewable electricity production and industrial output (lnNREP $\leftrightarrow$ lnIND).

A strong unidirectional causal relationship runs from agricultural output to non-renewable electricity production (lnAGR $\rightarrow$ lnNREP); a unidirectional causality runs from agricultural output to renewable electricity production (lnAGR $\rightarrow$ lnREP). For other variables, there is a bidirectional causal relationship between renewable and non-renewable electricity production (lnREP $\leftrightarrow$ lnNREP) and a weak unidirectional causal relationship running from industrial output to agricultural output (lnIND $\rightarrow$ lnAGR).

**Table 9. SVAR Granger Causality/Block Exogeneity Wald Tests**

	Dependent variable			
	lnREP	lnNREP	lnIND	lnAGR
lnREP does not cause	-	10.96291**	19.39796***	1.849338
lnNREP does not cause	12.06802***	-	17.60629***	1.735077
lnIND does not cause	14.27558***	13.1057***	-	7.145431*
lnAGR does not cause	10.03156**	14.05939***	2.097744	-
All	57.94412***	48.24437***	33.14876***	8.068812

Notes: "All" means the Granger causality test set for all independent variables. Wald tests are based on the  $\chi^2$  statistic, with 3df, except for "All", 9df. \* denotes significance at 10% , \*\* denotes significance at 5%, respectively, \*\*\* denotes significance at 1%.

In short, the empirical results provide evidence that supports the feedback hypothesis between renewable electricity production and industrial output; and between non-renewable electricity production and industrial output; The results also provide evidence in support of the conservation hypothesis between agricultural output and non-renewable electricity production; and between agricultural output and renewable electricity production.

Overall, the results validate the theoretical basis for using the SVAR model (i.e. the block exogeneity confirms the endogeneity of all variables). These findings are in line with several studies (see e.g. Jebli and Youseff , 2015; Salim et al 2014, Marques et al. , 2014, Apergis and Payne, 2011, Al-mulali et al, 2013).

**Table 10. Summary of the direction of causality**

IND and REP	Feedback hypothesis
IND and NREP	Feedback hypothesis
AGR and REP	Conservation hypothesis
AGR and NREP	Conservation hypothesis

#### 4.6 Robustness Analysis

This section assesses the validity of the estimated SVAR model. The section comprises SVAR diagnostic tests, estimated coefficients of A and B matrices and SVAR lags order selection criteria. Table 11 shows the results of normality, autocorrelation, and heteroskedasticity. The results prove the evidence of normality both for the individual components and the components considered jointly. The results also fail to reject the null hypothesis of no serial correlation. For the white test, the result strongly shows non-rejection of the null hypothesis of homoskedaticity at the 10% level of significance (p-value=0.185)

**Table 11**

SVAR Diagnostic tests.

Normality tests						Autocorrelation LM test	
Component	Skewness	Chi-sq	Kurtosis	Chi-sq	Jarque-Bera	Lags	LM-Stat
lnREP	-0.115309	0.066481	2.890789	0.014909	0.081389	1	15.05675
lnNREP	0.344441	0.593196	2.886339	0.016149	0.609345	2	26.73386
lnIND	0.435776	0.949502	3.330203	0.136293	1.085795	3	15.5324
lnAGR	0.598224	1.789358	4.729412	3.738581	5.527939	4	14.79516
Joint		3.398537		3.905931	7.304468	5	20.04155
White Heteroskedasticity:						$\chi^2(240)$	259.4156***(0.1858)

\*\*\* Denotes 1% level of significance

**Table 12**

SVAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	120.7936	NA	4.88E-09	-7.786239	-7.59941	-7.72647
1	231.3236	184.2166	9.06E-12	-14.08824	-13.15411**	-13.7894
2	254.5715	32.54713	5.96E-12	-14.57144	-12.89	-14.0335
3	283.5881	32.88548**	2.96e-12**	-15.43921**	-13.0105	-14.66223**

\*\* Indicates lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level). FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion

The number of lags for the SVAR model was chosen according to the lag length criterion tests. LR test statistic, Final Prediction Error (FPE), Hannan-Quinn Information Criterion and Akaike info criterion (AIC) and LM test suggest three lags since the null hypothesis of no serial correlation was accepted at lags 3. The estimated matrices A and B show the contemporaneous structural parameters of the dynamic relationship between renewable electricity production, non-renewable electricity production, industrial output and agricultural output which determines the instantaneous relationship among the elements of the variables and the elements of the structural shock contained in the disturbance term of each variable. The values in parenthesis are probability values of the estimated matrices A and B. It was shown that all the structural shocks are highly significant. Estimated coefficients of A and B matrices using the AB model approach suggested by Amisano and Giannini (1997).

$$\hat{A} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0.417164 & 1 & 0 & 0 \\ -0.389514 & -0.570457 & 1 & 0 \\ -1.281390 & -2.891544 & -0.266731 & 1 \end{bmatrix} \quad \hat{B} = \begin{bmatrix} 0.097278 & 0 & 0 & 0 \\ 0 & 0.010143 & 0 & 0 \\ 0 & 0 & 0.031322 & 0 \\ 0 & 0 & 0 & 0.069239 \end{bmatrix}$$

## 5. Conclusions and policy implications

This study sought to empirically investigate the dynamic effects of electricity production from renewable and non-renewable energy sources on industrial and agricultural output growth in Nigeria. The analysis shows that policy changes in the Nigerian energy sector, which are captured by shocks to renewable and non-renewable electricity production are slightly consequential to the growth of the industrial and agricultural sectors. Specifically, shocks to renewable and non-renewable electricity production on average account for about 22% and 20% of the fluctuations in industrial output growth respectively. Likewise, shocks to renewable and non-renewable electricity production on average account for about 30% and 14% of the fluctuations in the agricultural output growth.

More importantly, the granger causality supports the existing claim that economic growth and energy are linked. Particularly, the analysis shows a bidirectional causality between industrial output and renewable electricity production, likewise, between industrial output and non-renewable electricity production. These results disprove the existence of the neutrality hypothesis but support the feedback hypothesis. On the other hand, there is a unidirectional causality running from agricultural output to renewable and non-renewable electricity production, which supports the conservation hypothesis. Overall, these results imply that in spite of the importance of energy to the growth of the Nigerian economy, the Nigerian energy sector has a marginal impact on the growth of the industrial and agricultural sectors.

The evidence provided in this paper explains the current challenges faced by industries operating in Nigeria due to a lack of on-grid power supply. As reported in January 2020, losses to Nigeria's electricity sector reached 25.77 billion naira due to poor distribution and transmission facilities, inadequate gas, among other factors.<sup>1</sup> Hence, as the shortage of the supply of electricity remains an impediment to doing business in the country, the government should diversify electricity production across the potential energy sources. One of the possibilities the government could explore is to invest in off-grid and mini-grid electricity projects. In addition, the following are also necessary: prioritization of policies for the development of the energy sector; eradication of mismanagement and lack of monitoring; and acceleration of projects under the NESP.

Further research could take several directions. Firstly, it would be interesting to investigate the sectoral impact of off-grid and on-grid electricity production in Nigeria. Disentangling electricity production into off-grid and on-grid will show which of the two contribute the most to the growth of the Nigerian industries. Secondly, it would be interesting to incorporate in this study the factors of political instability and mismanagement, to see if these two institutional problems could explain the shocks to renewable and non-renewable electricity production.

<sup>1</sup> <https://www.vanguardngr.com/2020/01/state-of-nigerias-electricity-sector-worsens-investigation/>

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