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The Nexus between Improvements in Economic Freedom and Growth: Evidence from CEE Countries in Transition

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Abstract

This study examines the causal links between improvements in economic freedom and changes in GDP per capita of new EU members in transition in the period 2000-2009. The empirical results suggest significant causality running from changes in monetary and fiscal freedom, trade openness, regulation of credit, labour, and business, legal structure and security of property rights, and access to sound money to movements in GDP per capita, especially in less and moderately developed CEE transition countries. Moreover, we find evidence that improvements in economic freedom are one of the main factors stimulating the convergence of these economies towards rich EU members. The evidence of causality in the opposite direction is much weaker.

Keywords: economic growth, economic freedom, CEE transition economies

JEL Classification: O10, O40.

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1 Introduction

The empirical and theoretical literature on the relationship between improvements in economic freedom and economic development/growth usually emphasises the positive impact of changes in freedom on development and growth. However, at present there are not many studies concerned with the analysis of these links in the specific case of Central and Eastern Europe (CEE) economies in transition, which joined EU in 2004 and 2007. Moreover, due to the specificity of the CEE countries in transition it is uncertain whether a simple extrapolation of the results of previous papers dealing with wider range of countries would lead to reliable and consistent conclusions also in this particular case.

In general, the motivation to analyze the dynamic links between improvements in economic freedom and growth in GDP per capita (henceforth GDP per capita will be denoted as GDP) in the case of new EU member countries in transition from CEE region is twofold. First, it seems reasonable to expect that the dynamic links between variables should be much stronger for the rapidly transforming economies of CEE region than for stable and well developed economies, which already have a high standard and quality of law and regulation. Thus, the examination of this particular group of countries should provide a lot of useful information about the real importance of changes in economic freedom for GDP per capita growth. Second, to the best of our knowledge, in the literature there have been no detailed analyses dedicated to the links between economic growth and changes in economic freedom for the group of CEE economies in transition, which would use recent data along with carefully selected econometric methods. This paper fills the gap in the existing literature by providing extensive analysis of movements in various forms of economic freedom and growth in GDP per capita in case of the group of examined economies in the period 2000-2009.

Two indexes are most often applied as a measure of overall economic freedom: the *Index of Economic Freedom* provided by the Heritage Foundation and the index provided by the Fraser Institute in annual reports entitled *Economic Freedom of the World*. In general, there is ongoing scientific discussion on these two indexes, especially in terms of pointing out the advantages and disadvantages of each one. Some authors say that the best choice for researchers is the measure provided by the Heritage Foundation, since it is primarily based on policy variables, which governments can actually control (Heckelman 2000). On the other hand, the index provided by the Fraser Institute is often described as the most ambitious attempt to quantify economic freedom, and the one which has been used more extensively in academic contexts (Berggren 2003). One should bear in mind that Index of Economic Freedom in every year actually refers to the level of freedom in previous year. On the other hand, Economic Freedom of the World Annual Report in year x actually refers to the year $x - 2$. Moreover, the Fraser Institute provides annual data on its indexes starting from 2000. Therefore, the period 2000-2009 is the longest possible for which data on both indexes was available in the moment of preparation of this paper.

To summarize, the application of both these measures in one empirical study seems to be especially important in terms of comprehensiveness of analysis as well as robustness and validation of empirical findings.

In order to perform the empirical analysis in a similar and comparable way to the most of the previous studies on links between changes in freedom and GDP, in this paper the well-known concept of Granger causality was used. Beside the traditional variant of testing for Granger causality, which is based on checking the statistical significance of lagged variables, we also used the method of comparing the predictive accuracy in panel framework developed by Granger and Huang (1997). This method has often been used in recent empirical papers dealing with panel-based causality analysis (e.g. Weinhold and Reis 2001; Pérez-Moreno 2009), since it is relatively easy to use, free of complex pretesting procedures and may be applied even for relatively short time series or a small number of observations in each cross-section. It is also worth to note that conducting the analysis of Granger causal links only for the variables in first differences (i.e. changes in freedom indexes and economic growth) without examining causal links between levels of the variables (levels of freedom indexes and GDP) was mainly forced by technical restrictions (described in detail in Section 5) imposed by a small sample available.

In this paper six research hypotheses were examined. The empirical results confirmed that improvements in economic freedom played an important role in the growth in GDP per capita of new EU members in transition in the period 2000-2009. Moreover, the empirical findings provided a basis to claim that it was one of the factors stimulating the process of convergence of these countries towards highly developed EU members (Hypothesis 1). The outcomes of this study also confirmed that the positive role of changes in economic freedom in supporting rise in GDP per capita was especially important in the case of less and moderately developed new EU members (Hypothesis 2). Support was also found for claiming that the most important areas of economic freedom in the case of CEE countries in transition with respect to the promotion of GDP per capita were monetary and fiscal policy, trade openness and labour and business regulations (Hypothesis 3). On the other hand only weak evidence was found in favour of the next hypothesis (Hypothesis 4), which reflected the supposition that causality running from growth in GDP per capita to changes in economic freedom for the group of CEE countries in transition in the period 2000-2009 was statistically significant. The fact that growth of GDP per capita was a significant causal factor for a rise in economic freedom mostly for moderately and highly developed new EU members in transition in the period 2000-2009 (Hypothesis 5) was partly confirmed. Finally, the supposition that in the case of examined economies the growth in GDP per capita significantly promoted improvements in freedom from corruption, reduction of government size and expenditure and freedom to trade internationally was clearly supported (Hypothesis 6).

This paper is organized as follows. In the next section we present a literature overview and provide the Reader with the most important notions and key ideas concerning

the role of economic freedom, political stability and other in-stitutional variables in stimulating economic growth. In the third section we formulate the main hypotheses concerning causalities between the variables used. In the fourth section we present the dataset applied and give a short description of all considered measures of freedom. In the fifth section we discuss the methodology of applied Granger causality tests. Section six contains empirical results. Finally, in the last section we draw major conclusions and suggest directions for future research.

2 Literature overview

Empirical research on the impact of levels or changes in economic freedom on GDP or economic growth is relatively recent. Only a few empirical studies were conducted before the middle of 1990s. However, from the 1990s onwards there has been a rapidly growing interest in this issue, mostly due to the availability of longer time series of freedom indexes. In general, in this short literature review we focus on the most recent studies concerning the interrelation between levels of economic freedom (improvements in economic freedom) and GDP (economic growth). In general, in almost all contributions the dependent variable is related to GDP or economic growth. On the other hand, a suitable measure of economic freedom is typically one of the explanatory variables. In early studies economic growth rates were usually regressed on the levels of economic freedom. However, more recent contributions show that changes in economic freedom, rather than its levels, are causally related to economic growth. De Haan, Lundstrom, Sturm (2006) criticized the tendency in many studies to use both the level and the change in the economic freedom (EF) index as regressors in the growth model. In their opinion only changes in the EF index should be taken into account. On the other hand, Lawson (2006) advocated the use of both level and change EF indicators.

Empirical studies concentrate mainly on the relationship between economic growth on the one hand and changes in various forms of economic freedom and political stability on the other. In order to test the interrelations between economic freedom and political rights, and their relation to growth, some intensive research has been conducted, which, in general, has led to the suggestion that there may exist a virtuous circle between improvements in economic freedom, growth and changes in political stability. These relations have been tested in the literature, using mainly cross-section and, to a lesser extent, panel data. Some contributors point out that there are also indirect channels through which changes in freedom may affect growth (Aixala and Fabro 2009; de Haan, Lundstrom, Sturm 2006).

When discussing the relationship between economic freedom and economic development, strong and beneficial effects of the level of economic freedom and of its improvement on GDP and economic growth rates are usually stressed (Ali 1997; Ali and Crain 2001, 2002; Barro 1997; Clark and Lawson 2008; Dawson 2003; de Haan and Siermann 1998; de Haan and Sturm 2000; Gwartney, Holcombe, Lawson

2006; Heckelman and Stroup 2000; Lawson 2006). In addition, most contributors clearly stress that economic growth depends not only upon changes in various areas of economic and political freedom, but on purely economic factors as well, which establishes a need to test the discussed dynamic dependencies in a multidimensional framework.

Easton and Walker (1997) concluded that economic freedom is important with respect to income levels, which increases the explanatory power of the neoclassical growth model. In addition, la Porta, Lopez de Silanes, Shleifer, Vishny (1997, 1998) demonstrated that movements in several legal variables, such as respect for the rule of law, protection of property rights, enforceability of contracts, and legal heritage, exhibit a causal relationship with levels of economic growth.

Heckelman (2000) investigated causality between growth and changes in economic freedom by means of the index of the Heritage Foundation. Because of short time series only short-term relations were checked. Moreover, the application of this index made it necessary to use annual data on GDP growth. However, this did not dispose of effects resulting from the business cycle. The major finding of the paper is that changes in the levels of economic freedom precede growth while growth supports movements in only some of the components of freedom.

Guiso, Sapienza, Zingales (2004) provided empirical evidence that differences in local financial development explain the spread of entrepreneurship and economic growth. Equal access to financial sources is an important feature of economic freedom. The contributors constructed a new indicator of financial development by estimating the regional effect of probability that ceteris paribus a household is shut off from the credit market. By using this indicator, they found that financial development at a regional level equalizes the opportunity to get credit and therefore enhances the probability that an individual can start his own business, increases competition, favours entry of new firms, and promotes rise in GDP.

Cole (2003) argued that the positive effect of improvements in economic freedom on economic growth seems to be independent of the theoretical framework used. The particular measure of economic freedom employed - the Economic Freedom of the World (EFW) index - was found to be quite robust with respect to relatively major changes in model specification. This conclusion has important implications because the EFW index stresses a broad set of policy variables that are known to affect economic efficiency: inflation rates, taxes, public spending, government enterprises, state-directed investment, tariff protection, nontariff trade barriers, price controls, and distortions in labour and credit markets. The negative effects of these policy-induced distortions are almost surely mutually reinforcing and, in any case, tend to be highly correlated (countries with a poor system of laws tend to be consistently bad along many policy dimensions), thus it is hard to sort out their separate effects.

As already mentioned, some authors have not concentrated solely on the impact of movements in economic freedom on economic growth, but searched somewhat deeper by asking what the main sources of economic freedom are. Most of them stressed that

the most important precondition for economic freedom is political freedom.
The impact of political freedom on economic freedom has been proven by de Haan and Sturm (2003) using cross-section and panel data. According to the authors higher levels of political freedom cause increases in economic freedom in developing countries and in that way contribute to economic growth. A similar conclusion was drawn by Pitlik and Wirth (2003). By means of panel data, they found a significantly positive impact of an increasing degree of democracy on the magnitude of economic liberalization. Moreover, these results were supported by suitable theoretical arguments.
Doucouliagos and Ulubasoglu (2006) in their quantitative review of the literature found that the relation between changes in economic freedom and growth was overestimated when capital was excluded from a growth regression model (the problem of omitted variables). However, in a more recent study that used panel data, Stroup (2007) pointed out that the expansion of economic freedom significantly improves economic welfare (economic growth).
The position of the OECD on these questions was presented in a report from 2009. According to the OECD (2009), governments must be cautious and avoid jeopardizing economic freedom or political stability when seeking methods to strengthen and restructure their economies. In other words, nations must try to support and promote economic freedom and political stability. The concern in this context is that the abandonment of economic freedoms and/or policies consistent with political stability could lead to a reduction in economic growth and a slowdown in the world economy.
Faria and Montesinos (2009) found a positive and significant statistical and economic relation between growth, income level and the improvement in EFW index. The findings of this paper, including results of instrument validity tests, support the importance of policies and institutions for increasing economic freedom and fostering prosperity.
Aixala and Fabro (2009) studied the causal relations between changes in institutional dimensions (economic freedom, civil liberties and political rights) and economic growth, using Granger methodology with panel data for 187 countries and five-yearly observations for the period 1976-2000. The results for variables in levels show the presence of a bilateral causality between movements ineconomic freedom and growth with a significant long-run effect.
A study by Cebula (2011) investigated the impact of improvements in ten forms of economic freedom developed by the Heritage Foundation, as well as a measure of political stability developed by the World Bank, on economic growth in OECD. The author found that both panel least squares estimations and panel two-stage least squares estimations show that growth in the natural logarithm of purchasing-power-parity adjusted per capita real GDP in OECD countries was positively impacted by changes in monetary freedom, business freedom, investment freedom, labour freedom, fiscal freedom, property rights freedom, and freedom from corruption. Economic growth was also found to be positively influenced by political stability.

Wu (2011) noted that the Chinese economy grew about 10 percent per year during the sample period, but its rapid economic growth was accompanied by a relatively undeveloped legal and financial system, lack of economic freedom, and a high level of corruption. The author asked some important questions: "What is the secret of China's economic miracle? Can it continue without sound legal, financial, and political institutions and economic freedom?" He stressed that we do not have clear answers to these questions- an obvious indication of some possible areas for future research.

It is also worth noting that some contributors argue that state control (which clearly contradicts the principle of economic freedom), if properly applied, can actually promote growth (see e.g. Cao 2008). This phenomenon is usually explained by the fact that competition is not always effective.

Taking into account the research results and views presented in the above overview of the literature, in the next section we will formulate the main hypotheses concerning the impact of improvements in economic freedom on economic growth of CEE countries in transition. To the best of our knowledge, this is the first contribution, which examines links between changes in freedom and growth for the group of new EU members in transition on the basis of the most recent statistical data and carefully selected methodology.

3 Main research hypotheses

A mere glance at measures of freedom shows that new EU member countries in transition have indeed launched political, institutional and economic reforms, which in consequence have caused a rise in economic freedom. At this point an important question arises: "Was this rise in economic freedom a causal factor for a dynamic growth in GDP per capita and did it support the catching-up process of the new EU members towards the old EU countries?" To examine this issue one should test the following hypothesis, which also partly reflects the major findings of the papers (e.g. Stroup 2007; Aixala a Fabro 2009; Cebula 2011) mentioned in the previous section:

Hypothesis 1: Improvement in economic freedom played an important role in the growth in GDP per capita of new EU members in transition in the period 2000-2009. Moreover, it was one of the factors stimulating the process of convergence of these countries towards highly developed EU members.

In recent decade relatively different countries gained access to the EU. At the moment of accession CEE countries in transition exhibited different levels of economic development, especially in the levels of GDP per capita. On the one hand the highest levels of GDP per capita had been reached by Slovenia and the Czech Republic, while Bulgaria and Romania showed the lowest levels of this indicator. Thus, the question arises whether the differences in initial economic development between new EU members in transition were reflected in the structure of the causal links between

changes in economic freedom and economic growth. It seems likely in the light of literature (e.g. OECD 2009; Aixala and Fabro 2009) that these dynamic links would be more pronounced for less developed countries. In order to verify this supposition one should test:

Hypothesis 2: The role of improvements in economic freedom in supporting a rise in GDP per capita was especially important in the case of less and moderately developed new EU members. In general, the sign of this impact was positive.

Another important research problem is to analyze which areas of economic freedom are most important for promoting growth in GDP per capita. In the light of economic theory and the empirical results reviewed in Section 2, especially the contribution by Cebula (2011), improvements in monetary policy, trade openness and suitable policy reforms seem to play important role in promoting economic growth. Thus, it is likely that following hypothesis holds true:

Hypothesis 3: The most important areas of economic freedom in the case of CEE countries in transition with respect to the promotion of GDP per capita were monetary and fiscal policy, trade openness and labour and business regulations.

Some empirical studies, especially those on well developed market economies (e.g. Heckelman 2000; Dawson 2003), detected significant reverse causality running from economic growth to changes in economic freedom. Therefore, one may claim that the following hypothesis could (at least to some extent) hold true:

Hypothesis 4: Causality running from growth in GDP per capita to changes in economic freedom for the group of CEE countries in transition in the period 2000-2009 was statistically significant.

As already mentioned, in the light of the available statistical data and results reported in previous empirical studies causality running from economic growth to changes in economic freedom seems to be more likely for developed economies, as they e.g. pay more attention to combating corruption and their societies support the introduction of various reforms, which in turn boost economic freedom.
This process is conditioned by the rule of law in countries with an established democratic system. In the period under consideration the leading CEE transition countries introduced important political and economic reforms and their economic and legal systems became similar to the systems of highly developed market economies.
The theoretical argument (see Aixala and Fabro 2009) about the existence of a virtuous circle, in which changes in economic freedom generate growth and the latter stimulates the expansion of civil liberties, which, in turn, promote economic freedom, provides a basis to formulate the following:

Hypothesis 5: Growth in GDP per capita was a significant causal factor for changes in economic freedom mostly for moderately and relatively well developed new EU members in transition in the period 2000-2009. In general, the sign of this impact

was also positive.

The last test of causal links between economic growth and economic freedom is somewhat the reverse of the one expressed in Hypothesis 3.
The economic growth has been the highest priority from very beginning of the transition of all CEE countries. On the other hand, improving economic freedom was somewhat less important. This is reflected in the observation that work on freedom from corruption, or the practical implementation of the principle of equality before the law still causes special problems in transitional countries.
However taking into consideration the theoretical reasoning, stylized facts and empirical results (e.g. Heckelman (2000), who underlined that economic growth may support improvements in some of the components of freedom) one may expect that GDP per capita in CEE countries could cause such areas of economic freedom as freedom from corruption, government size and expenditure and freedom for international trade:

Hypothesis 6: In the case of the group of economies under study growth in GDP per capita significantly promoted (in the causal sense) changes in freedom from corruption, reduction of government size and expenditure and freedom to trade internationally.

All the hypotheses listed above will be tested by causality analysis. The details on applied dataset are presented in the next section.

4 The dataset and its properties

The dataset used in this paper contains annual data on GDP per capita in Purchasing Power Standards (PPS) expressed in relation to the European Union (EU-27) average in ten new EU member countries in transition in the period from 2000 to 2009 (in the period 2004-2007 twelve countries joined the EU, however, Malta and Cyprus have not been taken into consideration in this study since the evolution of the economies of these countries is significantly different than that of the ten other new EU members, e.g. these two economies have never been in a transition phase). The choice of such an indicator ensures that as well as analysing the existence of causal dependencies between economic growth and changes in economic freedom one may check whether these links were important for countries under study in relation to the economic growth of the whole European Union, including the old and rich member countries. Thus, any evidence of causality may provide some additional information about the role of improvements in economic freedom in the process of convergence of CEE countries towards old EU members. Moreover, we used annual data on employment in the period from 2000 to 2009 for all ten countries, since a simple two-dimensional approach based only on GDP per capita and one measure of economic freedom is likely to produce spurious results due to the omission of an important variable. The technical aspect is not the only reason for including employment in the model, since

this variable is also important in terms of basic theoretical growth models. As stressed by de Haan, Lundstrom, Sturm (2006) the set of additional variables is notably varied among previous empirical papers. Moreover, in the short-run employment is often treated as the only variable factor of production (Takayama 1985; Mansfield 1991). Thus, values of employment seem to be a reasonable alternative to the application of large number of additional and control variables, which would seriously reduce the number of degrees of freedom in case where the group of economies analyzed is relatively small. However, it is out of the question that adding employment to the model will not completely remove the risk of obtaining spurious results. In other words, the simplicity of the structure of the model, partly forced by the small sample available, is likely to have a negative impact on the robustness of empirical results. The data on GDP per capita and employment was obtained from the Eurostat database.

A common problem related to the Index of Economic Freedom provided by the Heritage Foundation and the index provided by the Fraser Institute is the fact that each of them transforms large sets of statistical data from various fields (financial sector, demography, property rights etc.) into a single annual value. This is naturally helpful for general applications, such as answering the question whether economic growth and changes in freedom are somehow dynamically linked, but the formulation of useful and detailed policy recommendations is almost impossible. In order to deal with this difficulty, along with overall measures of economic freedom we have applied several central components of both indexes, which are related to different aspects of economic freedom.

One of the major technical problems related to analysing the role of improvements in economic freedom for each individual CEE country, especially in terms of causal interrelations with the country's economic growth, is the lack of reliable time series data of sufficient size. This means that a traditional causality examination based on time series modelling for individual countries is hardly applicable due to poor statistical properties of the test. Moreover, uncertainty about the application of asymptotic distribution theory is also present for small panel datasets. Therefore, the analysis of causal dependencies between economic growth and changes in various measures of economic freedom applied in this paper has been based on an alternative approach to the evaluation of panel datasets. Moreover, as well as asymptotic distribution theory we have also applied bootstrap critical values. Detailed information on the methodology is presented in Section 5.

In this paper abbreviations were used for all variables. Tables 1 and 2 contain a summary of some basic information on all variables.Throughout this paper (especially for model presentation purposes) the subscript i describes the alphabetical order of sample countries (i.e. for Bulgaria $i = 1$, for the Czech Republic $i = 2$, etc.).

It should be noted that along with the overall score the Heritage Foundation provides detailed information on 10 major components of the index. In this paper we have not applied the component data on Investment Freedom, Financial Freedom and

Table 1: Abbreviations and short description of examined variables part 1

Full name [Abbreviation]	Short description
GDP per capita in country i in year t in Purchasing Power Standards (PPS) expressed in relation to the EU-27 average [$GDP_{i,t}$]	*The application of values expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries, allows meaningful comparisons of GDP per capita between countries and may provide some basic information on the convergence process.*
Employment rate in age group 15-64 in country i in year t [$EMPL_{i,t}$]	*This indicator is based on the EU Labour Force Survey, which covers the entire population living in private households and excludes those in collective households such as boarding houses, halls of residence and hospitals.*
Heritage *overall* index of economic freedom in country i in year t [$HERITAGE_{i,t}$]	*The summary index of economic freedom provided by the Heritage Foundation based on the average of 10 economic measurements.*
Heritage *business freedom* index in country i in year t [$HERITAGE^1_{i,t}$]	*The business freedom index reflects the individual's right to establish and run an enterprise without interference from the state. The most common barriers to the free conduct of entrepreneurial activity are redundant and burdensome regulations.*
Heritage *trade freedom* index in country i in year t [$HERITAGE^2_{i,t}$]	*The trade freedom index reflects an economy's openness to the import of goods and services from around the world. Moreover, this index measures the citizen's ability to interact freely as buyer or seller in the international marketplace.*
Heritage *fiscal freedom* index in country i in year t [$HERITAGE^3_{i,t}$]	*The fiscal freedom index measures the extent to which individuals and businesses are permitted by government to keep and control their income and wealth for their own benefit and use.*
Heritage *government spending* index in country i in year t [$HERITAGE^4_{i,t}$]	*The burden of excessive government is one of the key issues in economic freedom, both in terms of generating revenue (comp. fiscal freedom index) and in terms of spending. Some expenditure, such as providing infrastructure or funding research or even improvements in human capital, may be thought of as investments. However, excessive government spending runs a serious risk of crowding out private consumption, thereby thwarting the choices of individuals. Moreover, a government's insulation from market discipline often leads to inefficiency and waste.*

Source: Gwartney, Lawson, Hall (2011), The Heritage Foundation database, Eurostat database

Property Rights indexes, since for most of countries under study these variables were found to be quasi-constant, which in general excludes the possibility of using them (especially their first differences) in regression-based causality testing (in some cases these indexes remained unchanged during the whole period under study - for example, the Heritage Investment Freedom Index for Estonia was at a level of 90 each year in the period 2000-2009). Moreover, the index of Labour Freedom was also not taken into consideration, since in this case the annual data was available only from 2005 onward.

Table 2: Abbreviations and short description of examined variables part 2

Heritage *monetary freedom* index in country i in year t $[HERITAGE^5_{i,t}]$	*Every economy needs a steady and reliable currency as a medium of exchange and store of value. Without monetary freedom, it is extremely difficult to create long-term value.*
Heritage *freedom from corruption* index in country i in year t $[HERITAGE^6_{i,t}]$	*Corruption can simply infect all parts of an economy. Political corruption manifests itself most commonly in the form of graft, bribery, nepotism or embezzlement. Openness in regulatory processes and procedures can promote equitable treatment and improve regulatory efficiency.*
Fraser *overall* freedom index in country i in year t $[FRASER_{i,t}]$	*The summary index provided by the Fraser Institute reflects the average degree of economic freedom measured in five major areas.*
Fraser *size of government: expenditures, taxes, and enterprises* index in country i in year t $[FRASER^1_{i,t}]$	*This index measures the degree to which a country relies on personal choice and markets rather than government budgets and political decision-making.*
Fraser *legal structure and security of property rights* index in country i in year t $[FRASER^2_{i,t}]$	*The protection of persons and their rightfully acquired property is a key element of economic freedom and civil society. By common consent it is the basic function of every government.*
Fraser *access to sound money* index in country i in year t $[FRASER^3_{i,t}]$	*The absence of sound money undermines gains from trade. Sound money is essential to protect property rights and, thus, economic freedom.*
Fraser *freedom to trade internationally* index in country i in year t $[FRASER^4_{i,t}]$	*In a world of high technology and relatively low costs of communication and transportation, freedom of exchange across national boundaries is a natural ingredient of economic freedom.*
Fraser *regulation of credit, labour, and business* index in country i in year t $[FRASER^5_{i,t}]$	*This index focuses on regulatory restraints that limit freedom of exchange in the credit, labour, and product markets.*

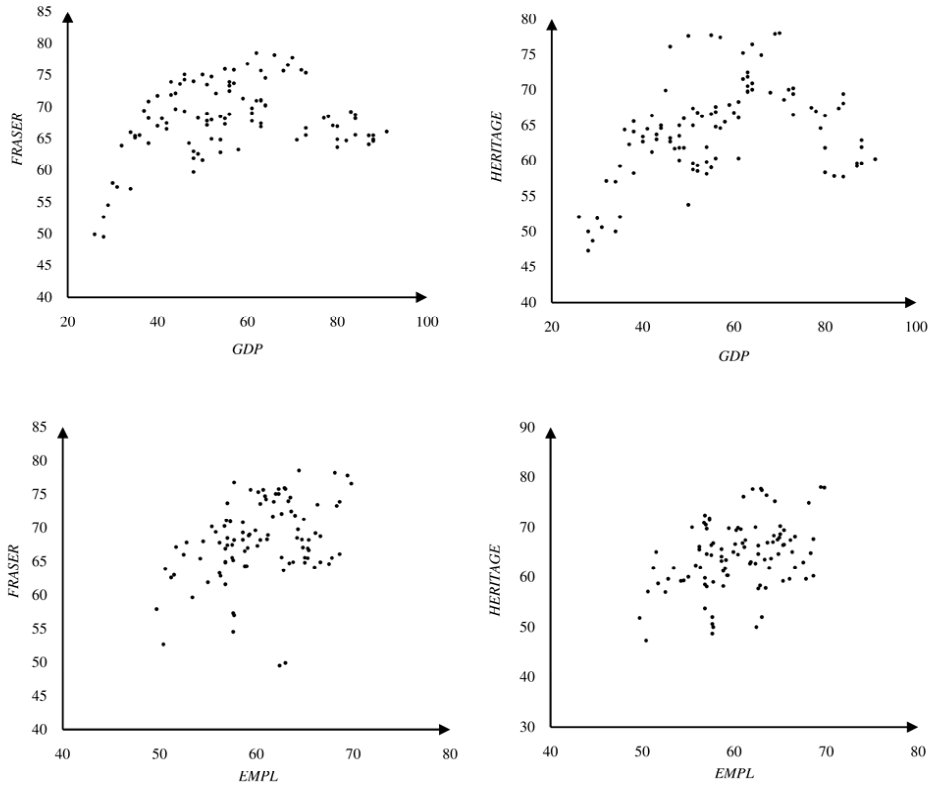
Source: Gwartney, Lawson, Hall (2011), The Heritage Foundation database, Eurostat database

To summarize, in this paper we have applied two overall indexes, six component indexes provided by the Heritage Foundation and five component indexes provided by the Fraser Institute. It is worth noting that in this study all Fraser component indexes were applied in their chain-linked versions, which are most consistent through time (Gwartney, Lawson, Hall 2011). All Fraser indexes were also multiplied by 10 to be of similar order of magnitude as other data.

In the initial part of our analysis we examine some basic properties of our data. Instead of presenting a large number of descriptive statistics, we have decided to present the data in suitable scatterplots. Figure 1 contains four scatterplots: GDP vs $FRASER$, GDP vs $HERITAGE$, $EMPL$ vs $FRASER$ and $EMPL$ vs $HERITAGE$ for all sample countries.

The plots presented in Figure 1 provide some preliminary visual (correlation) evidence on the research problems discussed in this paper. In general, one can see some evidence of positive correlation between GDP and both overall freedom indexes, especially

Figure 1: The scatterplots: GDP vs $FRASER$, GDP vs $HERITAGE$, $EMPL$ vs $FRASER$ and $EMPL$ vs $HERITAGE$



the $FRASER$ variable. Moreover, Figure 1 provides some evidence of existence of correlations between $EMPL$ and both overall freedom indexes. However, the correlations summarized in the four scatterplots provide no clue as for the directions of causal links, neither between levels or changes in freedom and GDP. Therefore, in order to examine causal links between growth in GDP and changes in indexes of economic freedom, specify subgroups of countries, for which these links were strongest in period 2000-2009and select areas of economic freedom, which were most important for economic growth, we performed formal statistical verification based on carefully selected methods of testing for Granger causality.

It is worth to mention that for some countries (e.g. Bulgaria, Romania) the rise in freedom indexes was much higher than for others (e.g. Czech Republic, Slovenia).These results may also suggest that the change in economic freedom in the period under study is partly related to initial GDP per capita. In general, countries with a relatively high GDP per capita in 2000 were in advanced stages of the transition

process and often a significant improvement in the level of economic freedom had already taken place. Poorer countries (e.g. Bulgaria, Romania), which started from low levels of GDP per capita end economic freedom in 2000 were in the early stages of transition and had more to improve in their levels of economic freedom. These facts provide some justification of the need to examine specific subgroups of "leaders" and "followers".

5 Methodology

In this paper we use the method of evaluating panel datasets developed by Granger and Huang (1997). This approach focuses on the forecasting properties of examined models rather than on significance tests (as in the case of the traditional approach). This method has often been used in recent empirical papers dealing with panel-based causality analysis (e.g. Weinhold and Reis 2001; Pérez-Moreno 2009), since it is relatively simple to use, free of complex pretesting procedures and may be applied even for relatively short time series or a small number of observations in each cross-section.

In order to present this idea we will begin with an analysis of the case of testing for causality in the direction from level of economic freedom measured by the Heritage overall index to the level of GDP per capita relative to the EU average (testing for causality in the opposite direction and/or based on the application of different indexes requires an analogous procedure). Let I denote the group of examined countries (e.g. all examined countries, all but the poorest countries etc.) and T denote the number of time points. Next, consider the following two models:

$$\begin{aligned} GDP_{i,t} = \quad & \mu_i + \sum_{j=1}^{p} \alpha_j GDP_{i,t-j} + \sum_{j=1}^{p} \beta_j EMPL_{i,t-j} + \\ & + \sum_{j=1}^{p} \gamma_j HERITAGE_{i,t-j} + \varsigma_{i,t} \end{aligned} \tag{1}$$

$$GDP_{i,t} = \quad \mu_i' + \sum_{j=1}^{p} \alpha_j' GDP_{i,t-j} + \sum_{j=1}^{p} \beta_j' EMPL_{i,t-j} + \varsigma_{i,t}' \tag{2}$$

where $i \in I$, p denotes the lag length and $t = p+1, \ldots, T$. A constant source of conflict in the freedom-GDP growth literature is the appropriate use of fixed and random effects. It turns out that previous empirical studies used different, and often even incompatible, definitions of these two effects. In practice the Hausman test is often applied to choose which type of effects should be considered. However, this procedure has relatively poor small sample properties. Moreover, the results of this simple test cannot be treated as more important than the well-justified theoretical structure of the model. As a consequence the same factor could be "fixed" according to one definition and "random" in another. This problem was caused not only by subtle intricacies in mathematical aspects of models, but often by the lack of a clear conception of the

research. In this paper we follow the suggestions of Gelman (2005) and instead of using the overloaded terms "fixed" and "random" we consider two types of effects (or coefficients) in a multilevel model: "constant", if they are identical for all members of a group, and "varying", if they are allowed to differ from country to country. Thus, the models in (1) and (2) allow for varying effects in the intercept terms (some preliminary results (available from the authors upon request) based on significance tests provided no solid evidence in favor of adding any time trends (constant or varying) in models (1) and (2)). When turning to estimation details (including the choice of method of evaluating variance of the error term), we rely on the standard OLS-related methods, since in the case of our dataset it is rather hard to justify the use of linear unbiased prediction (Robinson 1991) approach.As already mentioned, application of one simple model constructed for a very large group of (often dissimilar) countries may sometimes lead to formulation of spurious conclusions. This paper is aimed at describing the structure of freedom-growth causal links only for a particular group of (relatively similar) CEE countries. In other words, in our research the sample used exhausts the *underlying* population, which actually makes decomposition of the variance of error term needless (Gelman 2005).

However, one should bear in mind that in case of samples as small as the one analyzed in this paper, several problems occur during estimation of panel models for variables in their levels. Note that an estimation of all varying intercepts in models (1) and (2) (using e.g. an LSDV approach) would significantly reduce the number of degrees of freedom. The simplest solution is the application of first differences, which may easily eliminate individual characteristics (varying effects expressed in intercepts μ_i and μ_i') and significantly improve the performance of lest squares estimators. Therefore, instead of evaluating equations (1) and (2) we analyze the following (differenced) equations:

$$\begin{aligned}\Delta GDP_{i,t} = \quad & \sum_{j=1}^{p} \alpha_j \Delta GDP_{i,t-j} + \sum_{j=1}^{p} \beta_j \Delta EMPL_{i,t-j} + \\ & \sum_{j=1}^{p} \gamma_j \Delta HERITAGE_{i,t-j} + \varepsilon_{i,t}\end{aligned} \tag{3}$$

$$\Delta GDP_{i,t} = \sum_{j=1}^{p} \alpha_j' \Delta GDP_{i,t-j} + \sum_{j=1}^{p} \beta_j' \Delta EMPL_{i,t-j} + \varepsilon_{i,t}' \tag{4}$$

This way further empirical investigations presented this paper involve only variables in first differences. It is easy to see that formulas (3) and (4) describe competitive models of changes in per capita GDP in the countries included in group I. According to Granger and Huang (1997), if model (3) forecasts a change in GDP per capita more accurately than model (4), one may claim that information on the past values of changes in economic freedom is indeed important. In other words, changes in economic freedom have significant explanatory power in describing the variability in GDP levels in the countries included in group I.

Following previous papers of Granger and Huang (1997), Weinhold and Reis (2001) and Pérez-Moreno (2009), we have applied two forecast-based testing procedures to test for Granger causality in the discussed framework:

PROCEDURE I
(count method)

1. Set $i_0 \in I$.
2. Estimate models (3) and (4) using $i \in I \backslash \{i_0\}$ and $t = p+1, \ldots, T$.
3. Obtain two sequences of forecasts for i_0-th country for $t = p+1, \ldots, T$, using models (3) and (4).
4. Obtain two sequences of forecast errors, i.e. $\left\{\eta_t^{i_0}\right\}_{t=p+1,\ldots,T}$ (forecast errors for model (3)) and $\left\{\xi_t^{i_0}\right\}_{t=p+1,\ldots,T}$ (errors for model (4)).
5. After performing points 1-4 for all possible choices of $i_0 \in I$, define $p_1 = n\left(\left\{(i,t) \in I \times \{p+1,\ldots,T\} : \left(\eta_t^i\right)^2 > \left(\xi_t^i\right)^2\right\}\right)$ and $p_2 = n\left(\left\{(i,t) \in I \times \{p+1,\ldots,T\} : \left(\eta_t^i\right)^2 < \left(\xi_t^i\right)^2\right\}\right)$, where $n(A)$ denotes the number of elements of set A.
6. Let $z_{1-\frac{\omega}{2}}$ denote the $\left(1-\frac{\omega}{2}\right)$-quantile of standard normal distribution. If:
   a) $\frac{p_1}{p_1+p_2}$ lies outside the interval $\left(\frac{1}{2} - \frac{z_{1-\frac{\omega}{2}}}{2\sqrt{p_1+p_2}}, \frac{1}{2} + \frac{z_{1-\frac{\omega}{2}}}{2\sqrt{p_1+p_2}}\right)$;
   b) the variance of $\{\eta_t^i\}_{t=p+1,\ldots,T,\, i\in I}$ is smaller than the variance of $\{\xi_t^i\}_{t=p+1,\ldots,T,\, i\in I}$,

   then the $\Delta HERITAGE_{i,t}$ Granger causes $\Delta GDP_{i,t}$ for countries included in group I at $(100 \cdot \omega)\%$ significance level.

PROCEDURE II
(out-of-sample sum-difference test)

1. Conduct points 1-4 from PROCEDURE I.
2. Define $\{SUM_t^i\}_{t=p+1,\ldots,T,\, i\in I} := \{\eta_t^i + \xi_t^i\}_{t=p+1,\ldots,T,\, i\in I}$ and $\{DIFF_t^i\}_{t=p+1,\ldots,T,\, i\in I} := \{\eta_t^i - \xi_t^i\}_{t=p+1,\ldots,T,\, i\in I}$
3. Estimate via OLS the regression: $SUM_t^i = a + bDIFF_t^i + \varepsilon_t^i$.
4. If:
   a) the result of a Student's t-test rejects the null that $b = 0$ (at chosen significance level);

b) the variance of $\{\eta_t^i\}_{t=p+1,\ldots,T,\, i\in I}$ is smaller than the variance of $\{\xi_t^i\}_{t=p+1,\ldots,T,\, i\in I}$,

than the $\Delta HERITAGE_{i,t}$ Granger causes $\Delta GDP_{i,t}$ for countries included in group I (at a chosen significance level).

In general, both procedures presented above are based on finding out-of-sample forecasts for models (3) and (3) and then checking whether the augmented model is indeed more accurate than the restricted one. PROCEDURE I is not always as powerful as PROCEDURE II but it is robust to any covariance between and heteroscedasticity of the errors (Granger and Huang 1997). For the sake of the comprehensiveness of our research we additionally applied a traditional in-sample Granger causality procedure:

PROCEDURE III
(in-sample test)

1. Estimate model (3) using all available information (i.e. $t = p+1, \ldots, T,\ i \in I$).
2. Test the null hypothesis that $\forall_{j=1,\ldots,p}\, \gamma_j = 0$.
3. If the null hypothesis is rejected at the chosen significance level then the $\Delta HERITAGE_{i,t}$ Granger causes $\Delta GDP_{i,t}$ in the case of countries included in group I.

One should be aware of two problems which arise while performing significance tests (e.g. t-test, F-test) of regression coefficients on the basis of asymptotic distribution theory (as in step 4a of PROCEDURE II or step 2 of PROCEDURE III) or establishing asymptotic-based confidence intervals (step 6a of PROCEDURE I). Firstly, if some required modelling assumptions do not hold, the application of asymptotic theory may simply lead to spurious results (Lütkepohl 1993). Secondly, when dealing with small samples, the distribution of the test statistic may still be significantly different from an asymptotic pattern, even when all modelling assumptions are generally fulfilled. One possible way to overcome these difficulties is the application of the bootstrap technique. Bootstrapping is used to estimate the distribution of a test statistic (or to construct a confidence interval) by resampling the data. Since the estimated distribution depends only on the available dataset, one may expect that this procedure does not require assumptions as strong as parametric methods.
In order to minimize the undesirable influence of heteroscedasticity, the bootstrap test was based on resampling leveraged residuals. This approach has often been applied in recent empirical causality investigations based on relatively small datasets (see e.g. Gurgul and Lach 2011, 2012). A detailed description of this resampling procedure may be found in Hacker and Hatemi (2006). In order to control for heteroscedasticity one may alternatively use the well-known concept of *wild bootstrap*

(Liu 1988). For the sake of the comprehensiveness we have additionally considered this standard approach. Because the results obtained after the application of both bootstrap approaches were not significantly different, in further parts of this paper we will report only the results obtained by the leverage-based scheme. In case of PROCEDURE I we applied percentile bootstrap confidence intervals.

Academic discussion on the establishment of the number of bootstrap replications has attracted considerable attention in recent years (see e.g. Horowitz 1995). In this paper we have applied the procedure of establishing the number of bootstrap replications developed by Andrews and Buchinsky (2000). In all cases we aimed to choose a value of the number of replications which would ensure that the relative error of establishing the bootstrap critical values (at a 10% significance level) would not exceed 5% with a probability equal to 0.95. The Gretl script including the complete implementation of PROCEDURES I-III is available from the authors upon request.

The application of such a variety of methods is believed to ensure the verification of robustness and the validation of empirical findings. Despite using differenced data (elimination of varying effects), the structure of dynamic interrelations between economic growth and changes in various areas of economic freedom may still depend, at least to some extent, on individual characteristics of sample countries. In other words, even within the group of new EU member countries in transition one may select "leaders", "moderate ones" and "followers" clusters. Therefore, to examine this issue we also use several possibilities of choosing members of group I.

Taking into account all previously presented remarks (based mainly on a visual inspection of variables), we have distinguished a subgroup of "leaders" comprising Slovenia and the Czech Republic and a subgroup of "followers" comprising Bulgaria and Romania. However, it should be underlined that the outcomes of analysis of causal dependencies for groups containing data only on two specific countries would be seriously biased. Note that when the Granger-Huang (1997) approach (PROCEDURE I and II) is applied to the panel of two countries the forecasts for each country are based only on the data on the other one, which may lead to significant errors, especially in the case of weak similarity between the two economies. Moreover, the statistical performance of all approaches (including traditional PROCEDURE III) is also likely to suffer from the small (extremely small in the case of two economies) sample considered. Therefore, we have decided to analyze "all but the followers" and "all but the leaders" subgroups. The complete list of groups of countries examined in this paper is presented in Table 3. For the sake of the comprehensiveness three values of the lag parameter were applied for each of the pairs of models (augmented and restricted) analyzed. In addition, the application of up to three years of lags is important in terms of obtaining unbiased results, as it helps to minimize the risk of picking up normal business cycle effects unrelated to the real impact of economic freedom (Heckelman 2000). Despite using first differences, we examined the stationarity properties of the (differenced) data, since it is a well known fact that an OLS-based approach is likely to produce spurious results for short (in both the

Table 3: Description of the groups of countries examined in this paper

Group of countries	Countries included
I_0	All sample countries;
I_1	All but the followers (i.e. Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia);
I_2	All but the leaders (i.e. Bulgaria, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia);
I_3	All but the followers and leaders (i.e. Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia).

time and cross-sectional dimensions) nonstationary panels and time series (Phillips 1986). Moreover, at present there are only some preliminary theoretical results on the availability of bootstrap to provide any asymptotic refinements when the analyzed data is integrated or cointegrated (Horowitz 1995). Thus, before performing pooled-OLS-based tests of significance (PROCEDURE III) we applied a number of unit root tests allowing for common (Levin, Lin and Chu test, Breitung test) or individual (Im, Pesaran and Shin test) unit root processes. Similarly, we used ADF, KPSS and PP tests before performing each sum-difference test (PROCEDURE II). We applied the Schwarz criterion for choosing the optimal lag length before unit-root testing and the Newey and West (1987) method for bandwidth selection. In all cases (various freedom indexes, different groups of countries, time series tests (PROCEDURE II) and pooled-OLS-based tests (PROCEDURE III)) we found no evidence of nonstationarity at a 5% level. Finally, it is worth to mention, that in each case the residuals in models (3)-(4) were found to have relatively better statistical properties (in terms of autocorrelation, heteroscedasticity etc.) in comparison to residuals in models (1)-(2).

6 Empirical results

In this section the results of examining causal dependencies between growth in GDP per capita and changes in various indexes of economic freedom in new EU members in transition are presented. The data analyzed in this paper covers the period from 2000 to 2009 (this naturally means that the data in first differences covers the period from 2001 to 2009).

6.1 The importance of movements in economic freedom for economic growth

Table 4 contains the results of testing for Granger causality in the direction from the set of changes in freedom measures to growth in GDP per capita of all countries (group I_0). This part of research was particularly aimed at verifying Hypothesis 1. All testing procedures were performed at a 10% significance level. In order to present the empirical results in the possibly most readable way we used shading to mark

the finding of significant causality in tables 4-11 (in case of significance tests shading was used when the asymptotic- or bootstrap-based p-value was smaller than or equal to 0.10). Results obtained after the application of bootstrap-based critical values are presented in square brackets.In this paper the number of replications chosen according to Andrews and Buchinsky (2000) algorithm varied between 1979 and 3259 for each bootstrap application. In general, results obtained after construction of asymptotic- and bootstrap-based confidence intervals were not significantly different in the case of each conducted test, so we present detailed results of asymptotic variant only.

Table 4: Results of testing for Granger causality from changes in indexes of economic freedom to growth in GDP per capita in all countries in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	✓	-	–	p-value=0.49 [0.55]	✓	p-value=0.08 [0.01]
	2	✓	-	–	p-value=0.52 [0.51]	–	p-value=0.21 [0.29]
	3	✓	-	–	p-value=0.75 [0.79]	–	p-value=0.33 [0.38]
$\Delta HERITAGE^1$	1	✓	-	–	p-value=0.57 [0.48]	–	p-value=0.59 [0.62]
	2	–	6a) unfulfilled	–	p-value=0.78 [0.68]	–	p-value=0.62 [0.71]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.65 [0.53]
$\Delta HERITAGE^2$	1	–	6a) unfulfilled	–	p-value=0.91 [0.96]	–	p-value=0.94 [0.92]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.44 [0.43]
	3	–	6a) unfulfilled	–	p-value=0.85 [0.58]	–	p-value=0.62 [0.74]
$\Delta HERITAGE^3$	1	✓	-	–	p-value=0.34 [0.23]	✓	p-value=0.02 [0.03]
	2	✓	-	–	p-value=0.40 [0.27]	✓	p-value=0.08 [0.09]
	3	✓	-	–	p-value=0.37 [0.49]	✓	p-value=0.01 [0.00]
$\Delta HERITAGE^4$	1	–	6a) unfulfilled	–	p-value=0.82 [0.75]	–	p-value=0.56 [0.61]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.54 [0.39]
	3	–	6a) unfulfilled	–	p-value=0.97 [0.95]	–	p-value=0.93 [0.83]
$\Delta HERITAGE^5$	1	✓	-	–	p-value=0.51 [0.38]	✓	p-value=0.09 [0.01]
	2	✓	-	✓	p-value=0.15 [0.09]	✓	p-value=0.10 [0.02]
	3	✓	-	–	p-value=0.59 [0.48]	✓	p-value=0.09 [0.06]
$\Delta HERITAGE^6$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.75 [0.82]
	2	✓	-	–	p-value=0.33 [0.39]	✓	p-value=0.03 [0.00]
	3	✓	-	–	p-value=0.84 [0.79]	✓	p-value=0.13 [0.04]
$\Delta FRASER$	1	✓	-	✓	p-value=0.22 [0.08]	✓	p-value=0.02 [0.08]
	2	✓	-	–	p-value=0.59 [0.42]	✓	p-value=0.00 [0.06]
	3	✓	-	–	p-value=0.54 [0.39]	✓	p-value=0.05 [0.05]
$\Delta FRASER^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.01 [0.04]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.30 [0.32]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.41 [0.52]
$\Delta FRASER^2$	1	✓	-	–	p-value=0.58 [0.53]	–	p-value=0.83 [0.74]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.67 [0.52]
	3	✓	-	–	p-value=0.46 [0.39]	–	p-value=0.55 [0.54]
$\Delta FRASER^3$	1	✓	-	–	p-value=0.51 [0.52]	✓	p-value=0.01 [0.03]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.74 [0.53]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.89 [0.61]
$\Delta FRASER^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.48 [0.51]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.61 [0.72]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.55 [0.39]
$\Delta FRASER^5$	1	✓	-	–	p-value=0.53 [0.61]	✓	p-value=0.02 [0.01]
	2	✓	-	–	p-value=0.42 [0.39]	✓	p-value=0.09 [0.00]
	3	–	6a) unfulfilled	–	p-value=0.47 [0.45]	–	p-value=0.32 [0.26]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

As one can see, the test results provided evidence that movements in economic freedom Granger caused growth in all countries, which is especially visible in the results obtained for the Fraser overall index. These outcomes provided support for Hypothesis 1. Note that variables in both sets (related to GDP per capita and freedom measures) have in general experienced stable growth, which provides some information on sign of the causal impact. Visual inspection may often turn out to be a helpful method supporting description of the signs of causal links, as traditional vector-autoregression-based estimates of impulse response analysis are often criticised due to their high sensitivity to misspecification of the underlying properties of the data, which leads to serious inaccuracy of results, especially for small datasets and relatively long horizons (see e.g. Faust and Leeper 1998; Phillips 1998).
When turning to component indexes one can see that the most robust and strong evidence of causality was found for changes in $HERITAGE^5$ (monetary freedom), $HERITAGE^3$ (fiscal freedom), $HERITAGE^6$ (freedom from corruption), $FRASER^2$ (legal structure and security of property rights), $FRASER^3$ (access to sound money) and $FRASER^5$ (regulation of credit, labour, and business), which clearly supports Hypothesis 3. On the other hand, movements in both government-size-related indexes ($HERITAGE^4$, $FRASER^1$) were found to have a very weak causal impact on economic growth.
In order to examine the stability of these results and verify Hypothesis 2 we repeated the causality analysis for all subgroups listed in Table 3. Results obtained for the first subgroup (I_1) are presented in Table 5.

In comparison to previous case the evidence of causality running from movements in summary freedom measures to growth in GDP per capita is much weaker. Moreover, for countries in group I1 relatively solid evidence of causality was found only in the case of the movements in $HERITAGE^3$, $HERITAGE^5$, $HERITAGE^6$ and $FRASER^5$ indexes. One may interpret these results as evidence supporting the hypothesis that increases in economic freedom were particularly conducive for growth in GDP per capita in poorer and less developed CEE countries.
In order to confirm this supposition one should analyze the outcomes obtained after an analysis of group I_2. Relevant results are presented in Table 6.

In general, the results of Granger causality analysis presented in Table 6 are in line with the outcomes presented in Table 4, both for overall and component indexes. This in turn would mean that although, in general, change in economic freedom was found to be important for all new EU member countries in transition, its influence was especially present in the case of less and moderately developed countries (confirmation of Hypothesis 2). Moreover, since evidence supporting the causal impact of change in $HERITAGE^6$ on growth in GDP per capita was much weaker this may imply that freedom from corruption was not a key area of economic freedom in this context.
The analysis conducted for the group of "moderate ones" would provide some more detail, important for the verification of the above-mentioned suppositions. Table 7 contains relevant data.

Table 5: Results of testing for Granger causality from changes in indexes of economic freedom to growth in GDP per capita for countries included in group I_1 in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	✓	-	–	p-value=0.87 [0.83]	–	p-value=0.33 [0.39]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.62 [0.46]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.68 [0.59]
$\Delta HERITAGE^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.76 [0.82]
	2	–	6a) unfulfilled	–	p-value=0.22 [0.31]	–	p-value=0.36 [0.39]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.89 [0.94]
$\Delta HERITAGE^2$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.66 [0.62]
	2	✓	-	–	p-value=0.87 [0.81]	–	p-value=0.38 [0.43]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.79 [0.74]
$\Delta HERITAGE^3$	1	✓	-	–	p-value=0.37 [0.45]	✓	p-value=0.04 [0.02]
	2	✓	-	–	p-value=0.56 [0.61]		p-value=0.12 [0.19]
	3	✓	-	–	p-value=0.67 [0.72]	✓	p-value=0.03 [0.04]
$\Delta HERITAGE^4$	1	✓	-	–	p-value=0.88 [0.79]	–	p-value=0.81 [0.71]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.68 [0.53]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.78 [0.72]
$\Delta HERITAGE^5$	1	✓	-	–	p-value=0.84 [0.78]	✓	p-value=0.09 [0.02]
	2	✓	-	–	p-value=0.64 [0.59]	✓	p-value=0.19 [0.10]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.20 [0.18]
$\Delta HERITAGE^6$	1	✓	-	–	p-value=0.88 [0.74]	–	p-value=0.43 [0.42]
	2	✓	-	–	p-value=0.33 [0.41]	✓	p-value=0.01 [0.02]
	3	✓	-	–	p-value=0.55 [0.41]	✓	p-value=0.03 [0.04]
$\Delta FRASER$	1	✓	-	–	p-value=0.42 [0.50]	✓	p-value=0.10 [0.12]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.26 [0.32]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.39 [0.51]
$\Delta FRASER^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.18 [0.14]
	2	–	6a) unfulfilled	–	p-value=0.52 [0.45]	–	p-value=0.59 [0.24]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.64 [0.57]
$\Delta FRASER^2$	1	–	6a) unfulfilled	–	p-value=0.82 [0.89]	–	p-value=0.62 [0.44]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.71 [0.84]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.66 [0.75]
$\Delta FRASER^3$	1	✓	-	–	p-value=0.64 [0.58]	✓	p-value=0.07 [0.02]
	2	–	6a) unfulfilled	–	p-value=0.19 [0.27]	–	p-value=0.82 [0.73]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.49 [0.31]
$\Delta FRASER^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.84 [0.71]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.91 [0.83]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.88 [0.79]
$\Delta FRASER^5$	1	✓	-	–	p-value=0.23 [0.29]	✓	p-value=0.05 [0.01]
	2	✓	-	–	p-value=0.38 [0.31]	✓	p-value=0.07 [0.13]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.33 [0.46]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

In general, the outcomes presented in Table 7 are in line with the results presented in Table 4 and Table 6, since the strongest evidence of causality was found for changes in $HERITAGE^5$, $HERITAGE^3$, $FRASER^5$ and $FRASER^2$. However, in this case some weak evidence supporting the causal impact of movements in $FRASER^4$ and $HERITAGE^1$ was also found.

To summarize, the results of causality analysis conducted for groups I_0-I_3 provided a solid basis to claim that in the period 2000-2009 improvement in economic freedom was an important growth factor, especially for less and moderately developed new

Table 6: Results of testing for Granger causality from changes in indexes of economic freedom to growth in GDP per capita for countries included in group I_2 in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	✓	-	–	p-value=0.40 [0.49]	✓	p-value=0.04 [0.01]
	2	✓	-	✓	p-value=0.27 [0.09]	✓	p-value=0.09 [0.06]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.17 [0.02]
$\Delta HERITAGE^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.28 [0.33]
	2	✓	-	–	p-value=0.59 [0.50]	–	p-value=0.46 [0.32]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.23 [0.26]
$\Delta HERITAGE^2$	1	✓	-	–	p-value=0.98 [0.92]	–	p-value=0.72 [0.70]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.49 [0.52]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.62 [0.65]
$\Delta HERITAGE^3$	1	✓	-	–	p-value=0.50 [0.42]	✓	p-value=0.06 [0.00]
	2	✓	-	✓	p-value=0.24 [0.09]	✓	p-value=0.05 [0.09]
	3	✓	-	–	p-value=0.93 [0.85]	✓	p-value=0.05 [0.09]
$\Delta HERITAGE^4$	1	✓	-	–	p-value=0.93 [0.85]	–	p-value=0.71 [0.65]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.55 [0.59]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.87 [0.81]
$\Delta HERITAGE^5$	1	✓	-	–	p-value=0.61 [0.42]	✓	p-value=0.11 [0.01]
	2	✓	-	✓	p-value=0.23 [0.04]	✓	p-value=0.11 [0.07]
	3	✓	-	–	p-value=0.75 [0.82]	✓	p-value=0.15 [0.05]
$\Delta HERITAGE^6$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.75 [0.62]
	2	✓	-	–	p-value=0.41 [0.33]	–	p-value=0.50 [0.34]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.78 [0.72]
$\Delta FRASER$	1	✓	-	✓	p-value=0.02 [0.15]	✓	p-value=0.01 [0.02]
	2	✓	-	–	p-value=0.72 [0.60]	✓	p-value=0.00 [0.00]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.00 [0.00]
$\Delta FRASER^1$	1	–	6a) unfulfilled	–	p-value=0.21 [0.39]	✓	p-value=0.08 [0.04]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.33 [0.23]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.43 [0.47]
$\Delta FRASER^2$	1	✓	-	–	p-value=0.72 [0.73]	–	p-value=0.43 [0.31]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.52 [0.54]
	3	✓	-	–	p-value=0.69 [0.65]	–	p-value=0.37 [0.35]
$\Delta FRASER^3$	1	✓	-	–	p-value=0.78 [0.68]	✓	p-value=0.02 [0.00]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.01 [0.03]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.49 [0.31]
$\Delta FRASER^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.41 [0.39]
	2	✓	-	–	p-value=0.79 [0.82]	–	p-value=0.24 [0.23]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.37 [0.58]
$\Delta FRASER^5$	1	✓	-	–	p-value=0.69 [0.33]	✓	p-value=0.06 [0.09]
	2	✓	-	–	p-value=0.71 [0.76]	✓	p-value=0.06 [0.11]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.04 [0.06]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

EU economies in transition, which supports Hypothesis 1 and 2. Moreover, one may specify the areas of economic freedom which were found to be especially important for growth in GDP per capita (based on relatively strong and robust evidence of causality provided by both traditional and forecast-based tests), i.e. monetary and fiscal freedom; trade openness; regulation of credit, labour, and business; legal structure and security of property rights; access to sound money, which supports Hypothesis 3.

Table 7: Results of testing for Granger causality from changes in indexes of economic freedom to growth in GDP per capita for countries included in group I_3 in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	✓	-	–	p-value=0.64 [0.62]	✓	p-value=0.21 [0.09]
	2	✓	-	–	p-value=0.59 [0.38]	✓	p-value=0.06 [0.10]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.21 [0.29]
$\Delta HERITAGE^1$	1	✓	-	–	p-value=0.47 [0.32]	–	p-value=0.30 [0.43]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.66 [0.82]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.80 [0.75]
$\Delta HERITAGE^2$	1	✓	-	–	p-value=0.62 [0.65]	–	p-value=0.95 [0.82]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.86 [0.78]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.99 [0.95]
$\Delta HERITAGE^3$	1	✓	-	✓	p-value=0.39 [0.10]	✓	p-value=0.05 [0.07]
	2	✓	-	–	p-value=0.94 [0.87]	✓	p-value=0.14 [0.08]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.12 [0.04]
$\Delta HERITAGE^4$	1	✓	-	–	p-value=0.56 [0.47]	–	p-value=0.93 [0.86]
	2	✓	-	–	p-value=0.79 [0.62]	–	p-value=0.40 [0.51]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.57 [0.52]
$\Delta HERITAGE^5$	1	✓	-	✓	p-value=0.71 [0.74]	✓	p-value=0.23 [0.10]
	2	✓	-	✓	p-value=0.48 [0.39]	✓	p-value=0.15 [0.03]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.24 [0.09]
$\Delta HERITAGE^6$	1	✓	-	–	p-value=0.54 [0.43]	–	p-value=0.35 [0.22]
	2	✓	-	–	p-value=0.58 [0.56]	–	p-value=0.43 [0.40]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.41 [0.38]
$\Delta FRASER$	1	✓	-	✓	p-value=0.24 [0.08]	✓	p-value=0.05 [0.02]
	2	✓	-	–	p-value=0.51 [0.29]	–	p-value=0.23 [0.17]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.45 [0.48]
$\Delta FRASER^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.05 [0.14]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.33 [0.23]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.43 [0.47]
$\Delta FRASER^2$	1	✓	-	–	p-value=0.51 [0.32]	–	p-value=0.83 [0.43]
	2	✓	-	–	p-value=0.99 [0.83]	✓	p-value=0.28 [0.09]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.69 [0.75]
$\Delta FRASER^3$	1	✓	-	–	p-value=0.46 [0.28]	✓	p-value=0.18 [0.06]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.83 [0.71]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.62 [0.35]
$\Delta FRASER^4$	1	✓	-	–	p-value=0.92 [0.99]	–	p-value=0.73 [0.89]
	2	✓	-	–	p-value=0.84 [0.83]	–	p-value=0.31 [0.20]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.29 [0.28]
$\Delta FRASER^5$	1	✓	-	–	p-value=0.55 [0.63]	–	p-value=0.26 [0.29]
	2	✓	-	–	p-value=0.91 [0.72]	✓	p-value=0.14 [0.02]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.18 [0.10]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

6.2 The importance of economic growth for movements in economic freedom

An important research avenue is to examine causal dependencies in the opposite direction, i.e. from growth in GDP per capita to movements in economic freedom. This part of research was particularly aimed at verifying Hypothesis 4. The analysis may also help to specify which areas of economic freedom were especially influenced by growth in GDP per capita. In other words, it can provide some general information on areas of economic freedom most important for the policy of new EU members in

transition, which in turn may help to test Hypotheses 5 and 6. Table 8 contains results of testing for Granger causality in the direction from economic growth to movements in the freedom measures in case of all countries (group I_0).

Table 8: Results of testing for Granger causality from growth in GDP per capita to changes in indexes of economic freedom in all countries in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.14 [0.09]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.12 [0.02]
	3	–	6a) unfulfilled	–	p-value=0.48 [0.52]	–	p-value=0.74 [0.68]
$\Delta HERITAGE^1$	1	✓	-	–	p-value=0.87 [0.82]	–	p-value=0.93 [0.82]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.89 [0.84]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.95 [0.93]
$\Delta HERITAGE^2$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.29 [0.79]
	2	–	6a) unfulfilled	–	p-value=0.88 [0.91]	✓	p-value=0.04 [0.16]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.06 [0.14]
$\Delta HERITAGE^3$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.04 [0.09]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.36 [0.41]
	3	–	6a) unfulfilled	–	p-value=0.32 [0.39]	–	p-value=0.80 [0.73]
$\Delta HERITAGE^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.79 [0.81]
	2	✓	-	–	p-value=0.65 [0.58]	–	p-value=0.86[0.73]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.95 [0.81]
$\Delta HERITAGE^5$	1	✓	-	–	p-value=0.94 [0.89]	–	p-value=0.34 [0.54]
	2	–	6a) unfulfilled	–	p-value=0.87 [0.75]	✓	p-value=0.05 [0.02]
	3	✓	-	–	p-value=0.72 [0.54]	✓	p-value=0.15 [0.04]
$\Delta HERITAGE^6$	1	✓	-	–	p-value=0.84 [0.77]	✓	p-value=0.08 [0.03]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.40 [0.32]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.19 [0.09]
$\Delta FRASER$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.00 [0.04]
	2	–	6a) unfulfilled	–	p-value=0.88 [0.87]	–	p-value=0.12 [0.16]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.46 [0.67]
$\Delta FRASER^1$	1	✓	-	–	p-value=0.41 [0.47]	✓	p-value=0.03 [0.08]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.05 [0.02]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.47 [0.48]
$\Delta FRASER^2$	1	✓	-	–	p-value=0.76 [0.80]	✓	p-value=0.07 [0.04]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.40 [0.42]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.37 [0.34]
$\Delta FRASER^3$	1	–	6a) unfulfilled	–	p-value=0.36 [0.32]	✓	p-value=0.06 [0.03]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.35 [0.43]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.07 [0.01]
$\Delta FRASER^4$	1	✓	-	–	p-value=0.77 [0.82]	–	p-value=0.42 [0.43]
	2	–	6a) unfulfilled	–	p-value=0.63 [0.62]	–	p-value=0.78 [0.75]
	3	✓	-	–	p-value=0.89 [0.92]	–	p-value=0.97 [0.92]
$\Delta FRASER^5$	1	✓	-	–	p-value=0.74 [0.72]	✓	p-value=0.00 [0.01]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.05 [0.09]
	3	–	6a) unfulfilled	–	p-value=0.57 [0.51]	✓	p-value=0.06 [0.01]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

In general, the results presented in Table 8 provided evidence of relatively weak (e.g. not supported by any of out-of-sample tests) causality running from growth to changes in both summary freedom measures, which partly contradicts Hypothesis 4. However,

the analysis of component indexes provided stronger evidence in favour of causality running from growth in GDP per capita to movements in $HERITAGE^5$ (monetary freedom), $HERITAGE^6$ (freedom from corruption), $FRASER^1$ (size of government: expenditures, taxes, and enterprises), $FRASER^2$ (legal structure and security of property rights) and $FRASER^5$ (regulation of credit, labour, and business), which supports Hypothesis 6. For the remaining freedom measures the weaker and even less robust evidence of causality was found.

As in the previous subsection, the causality analysis was also performed in the case of the three subgroups listed in Table 3. This part of research was particularly aimed at checking Hypothesis 5. The results obtained for group I_1 are presented in Table 9.

In comparison to the previous case the results presented in Table 9 provided even weaker evidence of causality running from growth in GDP per capita to movements in both summary freedom measures. However, it is worth noting that strong and robust evidence of causality was found for changes in $FRASER^4$. On the other hand, no evidence of significant causality was reported for fluctuations in $HERITAGE^3$, $HERITAGE^4$ and $HERITAGE^6$.

The next table (Table 10) contains results of causality analysis performed for group I_2.

In this case the evidence supporting causality running from growth in GDP per capita to movements in both summary economic freedom indexes was similar to the one based on Table 8. The strongest evidence of causality was found for changes in $HERITAGE^5$, $HERITAGE^6$ and $FRASER^1$.

The last part of our research was dedicated to an examination of causal links in the direction from growth to changes in economic freedom in the case of countries included in group I_3. Relevant results are presented in Table 11.

To summarize, the results presented in tables 8-11 provided a basis to claim that growth in GDP per capita had a causal impact on changes in economic freedom mostly for countries listed in group I_3 and I_2, while markedly weaker evidence was found in the case of group I_1, which in turn provides only partial support for Hypothesis 5. Moreover, this impact was especially important for areas of freedom from corruption, government size and expenditure and freedom to trade internationally, which in turn provides quite solid evidence in favour of Hypothesis 6. One should note that the analysis of growth-change in employment and change in employment-freedom direct dynamic links (on the basis of suitably adapted models (3) and (3)) can provide some information on the implicit dependencies between growth and movements in freedom. In most cases, we found that the results of the analysis of these indirect links are not contradictory to the outcomes presented in Tables 4-11, which may somewhat be interpreted as further evidence of the robustness of the major findings of this paper. These supplementary results are available from the authors upon request.

In order to examine the impact of the financial crisis of 2008 on the structure of these causal links we additionally re-ran all causality tests on the basis of the pre-crisis subsample (2000-2008). In general, only slight differences were found between results

Table 9: Results of testing for Granger causality from growth in GDP per capita to changes in indexes of economic freedom for countries included in group I_1 in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.98 [0.89]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.86 [0.73]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.82 [0.88]
$\Delta HERITAGE^1$	1	✓	-	–	p-value=0.96 [0.92]	–	p-value=0.42 [0.32]
	2	–	6a) unfulfilled	–	p-value=0.69 [0.70]	–	p-value=0.51 [0.44]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.40 [0.36]
$\Delta HERITAGE^2$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.00 [0.05]
	2	–	6a) unfulfilled	–	p-value=0.51 [0.37]	✓	p-value=0.01 [0.00]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.04 [0.05]
$\Delta HERITAGE^3$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.27 [0.31]
	2	–	6a) unfulfilled	–	p-value=0.72 [0.77]	–	p-value=0.68 [0.63]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.73 [0.62]
$\Delta HERITAGE^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.80 [0.72]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.84 [0.83]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.66 [0.58]
$\Delta HERITAGE^5$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.81 [0.84]
	2	–	6a) unfulfilled	–	p-value=0.68 [0.55]	✓	p-value=0.09 [0.03]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.13 [0.29]
$\Delta HERITAGE^6$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.23 [0.27]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.88 [0.76]
	3	–	6a) unfulfilled	–	p-value=0.52 [0.53]	–	p-value=0.61 [0.57]
$\Delta FRASER$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.02 [0.14]
	2	–	6a) unfulfilled	–	p-value=0.81 [0.77]	–	p-value=0.21 [0.16]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.73 [0.59]
$\Delta FRASER^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.17 [0.16]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.05 [0.04]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.47 [0.48]
$\Delta FRASER^2$	1	✓	-	–	p-value=0.85 [0.82]	–	p-value=0.61 [0.65]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.79 [0.68]
	3	✓	-	–	p-value=0.90 [0.95]	–	p-value=0.81 [0.78]
$\Delta FRASER^3$	1	–	6a) unfulfilled	–	p-value=0.64 [0.67]	✓	p-value=0.16 [0.07]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.58 [0.63]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.19 [0.27]
$\Delta FRASER^4$	1	✓	-	✓	p-value=0.09 [0.02]	✓	p-value=0.08 [0.03]
	2	✓	-	✓	p-value=0.10 [0.14]	–	p-value=0.30 [0.35]
	3	✓	-	✓	p-value=0.03 [0.00]	–	p-value=0.95 [0.93]
$\Delta FRASER^5$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.00 [0.00]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.05 [0.02]
	3	–	6a) unfulfilled	–	p-value=0.28 [0.31]	✓	p-value=0.01 [0.00]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

obtained for both samples, thus, we do not present pre-crisis results in separate tables. However, it is without question that this issue deserves more attention in the future, when more post-crisis data will be available. One should note that in the case of every group listed in Table 3 the difference between the size of the full and reduced sample is equal to the number of considered countries, thus it is hard to expect that suitable results (PROCEDURE III) could differ significantly, even in the face of possible structural change in third quarter of 2008. In the case of out-of-sample tests (PROCEDURE I and II) one should also bear in mind that forecasts based

Table 10: Results of testing for Granger causality from growth in GDP per capita to changes in indexes of economic freedom for countries included in group I_2 in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.20 [0.23]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.21 [0.20]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.12 [0.03]
$\Delta HERITAGE^1$	1	✓	-	–	p-value=0.96 [0.94]	–	p-value=0.78 [0.83]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.55 [0.47]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.64 [0.62]
$\Delta HERITAGE^2$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.86 [0.82]
	2	–	6a) unfulfilled	–	p-value=0.62 [0.40]	–	p-value=0.29 [0.22]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.20 [0.15]
$\Delta HERITAGE^3$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.35 [0.38]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.86 [0.72]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.34 [0.28]
$\Delta HERITAGE^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.42 [0.39]
	2	✓	-	–	p-value=0.71 [0.74]	–	p-value=0.59 [0.56]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.63 [0.59]
$\Delta HERITAGE^5$	1	✓	-	–	p-value=0.86 [0.84]	–	p-value=0.36 [0.38]
	2	–	6a) unfulfilled	–	p-value=0.41 [0.43]	✓	p-value=0.11 [0.08]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.50 [0.51]
$\Delta HERITAGE^6$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.28 [0.19]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.58 [0.43]
	3	✓	-	–	p-value=0.47 [0.43]	✓	p-value=0.18 [0.09]
$\Delta FRASER$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.01 [0.02]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.07 [0.01]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.41 [0.22]
$\Delta FRASER^1$	1	✓	-	–	p-value=0.43 [0.40]	✓	p-value=0.02 [0.00]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.04 [0.13]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.35 [0.33]
$\Delta FRASER^2$	1	✓	-	–	p-value=0.84 [0.89]	–	p-value=0.21 [0.15]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.25 [0.47]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.32 [0.25]
$\Delta FRASER^3$	1	–	6a) unfulfilled	–	p-value=0.36 [0.29]	✓	p-value=0.06 [0.01]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.33 [0.20]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.10 [0.03]
$\Delta FRASER^4$	1	✓	-	–	p-value=0.72 [0.64]	–	p-value=0.46 [0.32]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.85 [0.59]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.85 [0.86]
$\Delta FRASER^5$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.00 [0.00]
	2	–	6a) unfulfilled	–	p-value=0.29 [0.38]	✓	p-value=0.06 [0.10]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.05 [0.00]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

on equations (3) and (4) suffer equally from all model specification imperfections (Granger and Huang 1997). Moreover, we measured change in GDP per capita in relation to EU-27 average, which additionally made the impact of crisis less apparent. A common observation across Tables 4-11 is that PROCEDURE II yields quite different results to those gained after application of PROCEDURE I and PROCEDURE III. In order to discuss this discrepancy one should recall some facts from previous studies on the issues of predictive accuracy. In the empirical literature, the motivation for using PROCEDURE II is usually justified by the fact that this

Table 11: Results of testing for Granger causality from growth in GDP per capita to changes in indexes of economic freedom for countries included in group I_3 in the period 2000-2009

Causal factor	Lag	PROCEDURE I		PROCEDURE II		PROCEDURE II	
		Result	Details	Result	Details	Result	Details
$\Delta HERITAGE$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.47 [0.37]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.51 [0.50]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.33 [0.29]
$\Delta HERITAGE^1$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.80 [0.83]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.47 [0.52]
	3	–	6a) unfulfilled	–	p-value=0.72 [0.69]	–	p-value=0.43 [0.39]
$\Delta HERITAGE^2$	1	✓	-	–	p-value=0.92 [0.81]	–	p-value=0.93 [0.82]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.10 [0.07]
	3	–	6a) unfulfilled	–	p-value=0.19 [0.31]	✓	p-value=0.04 [0.01]
$\Delta HERITAGE^3$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.15 [0.09]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.39 [0.15]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.11 [0.07]
$\Delta HERITAGE^4$	1	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.98 [0.74]
	2	✓	-	✓	p-value=0.19 [0.08]	–	p-value=0.37 [0.29]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.48 [0.42]
$\Delta HERITAGE^5$	1	✓	-	–	p-value=0.58 [0.46]	–	p-value=0.82 [0.75]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.26 [0.08]
	3	✓	-	–	p-value=0.44 [0.36]	–	p-value=0.58 [0.59]
$\Delta HERITAGE^6$	1	✓	-	–	p-value=0.82 [0.71]	–	p-value=0.52 [0.42]
	2	✓	-	–	p-value=0.84 [0.79]	–	p-value=0.73 [0.65]
	3	✓	-	✓	p-value=0.08 [0.04]	–	p-value=0.67 [0.51]
$\Delta FRASER$	1	–	6a) unfulfilled	–	p-value=0.45 [0.29]	✓	p-value=0.00 [0.02]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.06 [0.07]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.51 [0.47]
$\Delta FRASER^1$	1	✓	-	–	p-value=0.90 [0.82]	✓	p-value=0.05 [0.01]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.02 [0.03]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.43 [0.47]
$\Delta FRASER^2$	1	–	6a) unfulfilled	–	p-value=0.63 [0.49]	–	p-value=0.51 [0.42]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.53 [0.47]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.65 [0.59]
$\Delta FRASER^3$	1	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.09 [0.11]
	2	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.41 [0.56]
	3	–	6b) unfulfilled	–	4b) unfulfilled	–	p-value=0.25 [0.23]
$\Delta FRASER^4$	1	✓	-	✓	p-value=0.15 [0.09]	–	p-value=0.14 [0.19]
	2	✓	-	–	p-value=0.48 [0.46]	–	p-value=0.34 [0.27]
	3	✓	-	–	p-value=0.33 [0.27]	–	p-value=0.92 [0.88]
$\Delta FRASER^5$	1	–	6a) unfulfilled	–	p-value=0.43 [0.58]	✓	p-value=0.00 [0.00]
	2	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.06 [0.01]
	3	–	6b) unfulfilled	–	4b) unfulfilled	✓	p-value=0.12 [0.04]

The symbol ✓ (–) denotes finding (not finding) causality at a 10% significance level.

approach achieves robustness to contemporaneous correlation between two forecasts series being compared, which is a consequence of employing an orthogonalisation (Granger and Newbold 1986). This, in turn, leads to much better power properties in comparison to remaining procedures, however, only in cases when the residuals are normally distributed and are not autocorrelated. As shown in Harvey, Leybourne, Newbold (1998) PROCEDURE II (and its variants) performs relatively poor in case of very small samples and heavy-tailed-distributed series of forecasts being analyzed. Harvey, Leybourne, Newbold (1998) suggested using heteroscedasticity correction to

reduce the bias of the estimator of variance of the slope parameter being tested in step 4a) of PROCEDURE II. As can be seen in Tables 4-11, the significant causality reported after the application of PROCEDURE II was in almost every case indicated only by the heteroscedasticity-corrected bootstrap variant of this procedure. The latter together with Harvey, Leybourne, Newbold (1998) results seems to explain the discussed discrepancy as a consequence of heteroscedasticity and relatively small sample available.
In order to confirm this supposition, which also seems crucial for the verification of empirical results of this paper, we applied a modified version of step 4a) of PROCEDURE II. Using suggestions of Granger and Huang (1997), Harvey, Leybourne, Newbold (1998) and Vilasuso (2001) we applied the heteroscedasticity-consistent estimator (HCE) developed by White (1980) along with the heteroscedasticity- and autocorrelation-consistent (HAC) estimators (based on Bartlett, Parzen and QS kernels) popularized by Newey and West (1987) and Andrews (1991). As expected, both types of modifications of PROCEDURE II (HCE- and HAC-based) provided results (not presented here in detail to save space, but available from authors upon request), which were much closer to those gained after application of PROCEDURE I and PROCEDURE III. This, in turn, seems to provide quite reliable explanation of the discussed discrepancy and what matters most validates the major empirical findings of this paper.

7 Concluding remarks

To the best of our knowledge, this is the first contribution which analyses the role of economic freedom for a particular and relatively small group of economies. The main goal was to examine the structure of Granger causal links between growth in GDP per capita and changes in economic freedom in ten new EU countries in transition. In addition, the specific choice of variables enabled an examination of the impact of improvements in economic freedom on the process of convergence of these economies towards highly developed old EU members. Taking into account the ongoing academic discussion on the relevant sources of data on economic freedom, we applied annual data (covering the period from 2000 to 2009) provided by the two sources most often used in recent empirical investigations: the Heritage Foundation and the Fraser Institute. Using both sources was important in terms of the robustness and validation of the major empirical findings of this study.
In order to examine the stability of the results we additionally performed empirical investigations on three specific subgroups chosen on the basis of differences in the levels of initial GDP per capita of sample countries. Moreover, three methods of testing for Granger causality were applied (two out-of-sample procedures and a traditional significance test) in asymptotic- and bootstrap-based variants, which was also important for the validation of the empirical findings.
The results of first part of the causality analysis provided a solid basis to claim

that in the period 2000-2009 improvement in economic freedom was an important growth factor, especially for less and moderately developed new EU economies in transition. In addition, this result implied that change in economic freedom was one of the significant factors stimulating the convergence of these countries towards highly developed EU members (acceptance of Hypotheses 1 and 2). The empirical analysis also provided a basis to specify the areas of economic freedom which were found to be especially important for growth in GDP per capita - monetary and fiscal freedom; trade openness; regulation of credit, labour, and business; legal structure and security of property rights; access to sound money (acceptance of Hypothesis 3). These findings are in line with empirical results published by other authors, since to the best of our knowledge a causal link from economic freedom to overall GDP or GDP per capita is reported as an empirical regularity in most of the contributions addressing the topic. Thus, market liberalization indeed seems to be an appropriate reform for countries whose concerns include fast economic growth.

On the other hand, the test outcomes provided a basis to claim that growth in GDP per capita had little causal impact on movements in economic freedom (conditional acceptance of Hypothesis 4). This effect was more pronounced for moderately developed new EU economies in transition (conditional acceptance of Hypothesis 5) mostly in respect to freedom from corruption, government size and expenditure and freedom to trade internationally (acceptance of Hypothesis 6).

Besides labour, some other variables such as economic policy may play important role in the context of changes in freedom-growth relations. Moreover, ceteris paribus, proper economic policy is expected to promote economic growth. Therefore, this issue seems especially interesting for the further research of changes in freedom-growth linkages in case of CEE countries in transition.

An important topic is the impact of movements in economic freedom on economic growth in the period of financial crises. In general, the results of our research turned out to be robust when a pre-crisis subsample was applied, although, as already mentioned, this could be mainly due to the statistical properties of the test conducted. It is likely that institutional reforms in CEE countries promoting economic freedom and globalization have different effects in the long and short terms. Usually some positive effects of economic reforms may come at a short-term cost. However, after passing through an initial period the positive effects of certain reforms will be seen after several years. Thus, the analysis of change in freedom-growth dependencies in the long-run also seems to be an important research avenue. This investigation, however, requires significantly longer time series of data.

Our empirical research suffers from the drawback that the relevant time series are too short to conduct a causality analysis based solely on the time series for individual countries. Despite using carefully selected econometric methods and examining a small group of relatively similar economies, we conducted our analysis with the risk of possible heterogeneity, which could have a slight negative impact on the precision of the results. Thus, in the future, as relevant time series become longer, an analysis on

a time series basis for individual CEE countries in transition should also be conducted as a supplement to the presented results.
One should note that reliance on changes in overall economic freedom measures in order to predict economic growth might sometimes lead to the premature conclusion that improvements in freedom do not significantly affect growth. However, it may still be true that more economic freedom in general is beneficial to growth, but not that all economic freedoms have an equal effect (actually some may even have counter effects). Our research was designed to help uncover which freedoms stimulate growth and which are less important. Another goal, quite original in the literature on the subject, was to check whether changes in economic freedom have indeed played a significant role in the process of the convergence of CEE transition economies towards rich members of the EU. In general, the results of this paper confirmed a positive role of improving economic freedom for changes in GDP per capita and this convergence. However, it is likely that some dimensions of freedom did not turn significant because of insufficient variation in (small) data sample available. To summarize, the link between changes in economic freedom and economic growth in case of CEE economies in transition still deserves considerable attention of researchers as many important questions remain open.

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