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MENDELU Working Papers
in Business and Economics

82/2022

Stock market development as a leading indicator of future economic growth in the BRICS countries

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MENDELU Working Papers in Business and Economics
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Citation

Zalesakova, K. (2022). Stock market development as a leading indicator of future economic growth in the BRICS countries. *MENDELU Working Papers in Business and Economics* 82/2022. Mendel University in Brno. Cited from: http://ideas.repec.org/s/men/wpaper.html

Abstract

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This paper deals with the verification of the assumption of forecasting ability of stock indices in the BRICS countries. The literature review focuses on the definition of the financial and stock markets, measuring the economic performance and the interdependence of stock markets and economic growth. The analytical part is based on time series of GDP and stock indices of the BRICS countries, which are processed using correlation analysis, VAR models and Granger causality test, which is used to determine the existence and possible direction and strength of the causal relationship between the variables. The results show that the role of stock indices as a leading economic indicator is overestimated. However, GDP and stock indices interact, the strength and direction of causal relationships is affected by number of factors.

Key words

BRICS, stock market, stock index, economic growth, GDP, correlation analysis, VAR model, causality, Granger test causality

JEL: C320, E440, F430, H540

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Acknowledgements

This outcome was supported by the Internal Grant Schemes of Mendel University in Brno, registration no.: CZ.02.2.69/0.0/0.0/19_073/0016670, funded by the ESF.

Introduction

Across the world, we can see the huge disparities in living standards. This is due to the differences in the wages paid to workers in different countries around the globe. These inequalities in income are reflected in the quality of human life, where people with higher incomes achieve a more valuable material and social background, which are consequent as prerequisites for a longer life expectancy. All these factors can be observed in the context of economic growth, as it tends to vary considerably in different regions.

There are several classical models that explain the sources of economic growth. However, in addition to classical economics, there is also a different perspective from a wide range of scholars, which is somewhat different from classical economic theory, as the catalyst for economic growth ceases to be the variable of technological progress. This concept stems from the mutual causality between stock indices and economic development, whereby based on this causality it is possible to predict future economic development from past stock market developments, as stock indices are so-called leading indicators.

Several studies have been devoted to the topic of economic growth and financial development, as the study of these two areas is important not only from an empirical point of view but also from a political and economic spectrum. Moreover, not only for investment companies but also for economic policy makers. The recent global economic crisis, the effects of which have affected most of the world's countries, has further intensified the study of these two variables, which were mutually unexplored until the beginning of the 20th century – the stock market and the economic market – in an attempt to find the relationships leading to higher economic growth as a result of competitive stock markets.

Thus, the main motivation stems from the decline in national productivity after the global financial crisis and its potential aims at finding out whether stock market indicators can predict economic growth. Most of the studies were aimed at investigating the interdependencies between stock market and economic productivity have been analysed on developed countries. However, this paper will test the relationship on the BRICS countries. These are countries that are very different in nature. In the last few years, the BRICS has been one of the countries experiencing high economic growth, making it one of the fastest growing countries in the world. Besides, their stock markets are also increasingly in the focus of financial institutions and international investors. This is due to the progress these countries have made in recent times. The element of confidence, market stability and the associated vision of achieving high returns. Is the rapid economic

development in these countries spurred by the huge potential in the financial markets? Is it possible to find the causal relationship between stock indices in fundamentally different countries such as China and South Africa?

The role of stock indices can be an important predictor of economic growth volatility and thus become an important guide for economic policy makers in the BRICS countries. Therefore, the aim of this paper is to investigate the correlation between stock market performance and actual economic activity, which will furthermore contribute to the expansion of BRICS country studies, as there is currently a relatively low number of outputs and analyses focusing on BRICS emerging markets.

1 Theoretical background

The existence of a relationship between financial market development and economic growth has long been a highly debated topic among economists. The 19th century was a period when the vast majority of economists argued that the financial structure of the economy did not affect real economic variables, including economic growth. Over time, economists have come to the conclusion that markets that are not affected by regulation do considerably better than those that are regulated. As a result, competitive financial markets should, in principle, achieve higher economic growth (Garcia, 1995). Goldsmith (1969) provided the first tangible evidence of the relationship between capital markets and economic growth, when he almost pioneered in trying to explain the issues in the relationship between financial structure and economic development. McKinnon (1973) is another who introduces a new approach aimed at using domestic capital markets to stimulate economic performance and, like Shaw (1973), suggests easing conditions in domestic financial markets so that interest rates are a true reflection of the scarcity of capital in emerging economies. Thus, McKinnon (1973) and Shaw (1973) present a new approach through which they provide evidence that financial policy in the liberal economic sense exhibits a positive correlation with economic growth. Another author dealing with stock prices and economic growth in the US and other countries is Pearce (1983), who was one of the first to include the stock index among the leading indicators. He evaluates stock indices as valuable but not infallible indicators. This was due to the occasional false signals of economic downturns, despite the fact that stock prices have always risen in the midst of economic downturns in the US since 1955. In the other countries surveyed, stock indices were completely divorced from GDP developments and could not become a variable that could predict future economic developments. Nilsson and Guidetti (2008) also attribute an important role to leading indicators, as they argue that it is possible to identify early

signals of turning points in the business cycle and subsequent fluctuations in economic activity around long-term potential output.

The interdependence in the evolution of stock indices and economic growth can be defined by the following types of causality. The first type is the one-way causality of the *"supply-leading hypothesis"*. According to Karimo and Ogbonna (2017), the *"supply-leading hypothesis"* is based on the proposition that financial development has a positive effect on economic growth. Thus, the effect runs from financial development to economic growth. This effect is due to an increase in capital efficiency or also an increase in the savings rate, correspondingly the investment rate. The most influential idea behind this hypothesis is that investors have access to a new supply of funds through which they raise their expectations, new opportunities open up, they are able to invest through new alternatives, money is allocated efficiently, and funds are injected into the economy through which economic growth is facilitated. Financial development as an engine of economic growth is also discussed by Schumpeter (1934) and McKinnon (1973) and Shaw (1973) mentioned above. Fifth (2014) also believes in a strong positive correlation between GDP and stock market indices. Therefore, he recommends them as a useful tool to predict future business cycles. Morck et al. (1990) define five main channels that link stock prices to actual economic activity. He identifies the channels based on the fact, that firms' and managers' investment decisions are based on information derived from stock markets and thus the stock price reflects the present discounted value of all future dividends. The long-run relationship between financial depth and economic growth for developing countries is also examined by Christopoulos and Tsiaonas (2004), who support unidirectional causality from financial depth to growth. Other authors confirming the *"supply-leading hypothesis"* are Levin and Zervos (1998), Rousseau and Wachtel (2000), Shanbaz (2008) and Caporale et al. (2009).

The direction of causality between financial development and economic growth is also addressed by Calderón and Liu (2003), analyzing it on a sample of 109 developing and developed countries over the time period from 1960 to 1994. The paper shows that financial development in the economies studied is an important stimulant of economic growth and thus it is important to pursue financial deepening that would lead to higher economic welfare. When the population is divided into two parts, i.e. developing and developed countries, a bidirectional relationship was found, i.e. financial structure affects economic growth and at the same time economic growth affects the financial structure in the economy. Further, it was found that financial deepening leads to a greater degree of causality for developing countries. This is because of the greater scope for financial and economic improvement that developing countries offer. The length of the time

period also influences the degree of causality, as a longer time series allows for a larger effect of financial development on economic growth, suggesting that the financial deepening effect takes time.

Sharma and Bardhan (2018) trace Granger causality between stock market performance and economic growth on an unbalanced panel of 25 advanced economies over the period 1975 to 2011. The indicator of economic development is real GDP per capita, and stock market capitalization (*"market cap"*), the ratio of the value of total shares traded to average real market capitalization (*"turnover ratio" - TOR*), and *value traded* are chosen as proxy variables for the stock market. Market cap refers to the size of the stock market and the ability of investors to diversify risk, both *TOR* and value traded reflect the degree of activity in the stock market, where *TOR* measures this activity relative to the size of the stock market, whereas value traded is relative to the size of the economy as a whole. First, the dataset was tested for the presence of cross-sectional dependence. Next, a lagged VAR model was estimated. Based on the results based on the test of the joint Granger causality hypothesis between stock market performance and economic growth, significant evidence of unidirectional causality from market capitalization towards economic growth and further unidirectional causality from *TOR* towards economic growth were identified. These findings support the *"supply-leading hypothesis"* of the stock market in relation to economic growth. In the case of the traded value of stocks, no evidence of Granger causality in either direction is apparent. The absence of this causality is not significant as *TOR* is a more appropriate indicator of stock market liquidity than traded value of shares, since *TOR* is measured with respect to the size of the stock market. The study concludes by arguing that in advanced economies that have adequately developed stock markets, causality runs in the direction from stock market development to economic growth, i.e. economic growth is led by the stock market, confirming the findings of Calderón and Liu (2003).

The second theoretical framework of the relationship between financial development and economic growth is the one-way causality of the *"demand-following hypothesis"*, which assumes that economic growth leads to financial development. This is because increased GDP growth also stimulates demand for financial services and is thus at a higher level than at the beginning. This leads to the establishment of new financial institutions and their expansion, thereby meeting the increased demand for these services. This theory has been supported by, for example, Patrick (1966) and Demetriades and Hussein (1996).

Habibullah (1999) attempts to find a causal direction between financial development and economic growth. Does financial development lead to economic growth or is it otherwise? He seeks the answer

to this question in his empirical study applied to 7 Asian countries which are Indonesia, Malaysia, Myanmar, Nepal, Philippines, Sri Lanka and Thailand. Only in the case of the Philippines, unidirectional Granger causality was found flowing from financial development to economic growth. However, for only three countries, Malaysia, Myanmar and Nepal, a unidirectional causality leading from economic growth to financial development, the demand-following hypothesis, was found. The *"feedback hypothesis"* of bidirectional causality is analysed for Indonesia and Sri Lanka. No causal relationship was found for Thailand through the conventional *"simple-sum"* aggregate, however, the *"feedback hypothesis"* was found for Thailand when using the Divisia aggregate as an alternative proxy for financial development. Thus, the causal response is different for each country.

The direction of causality between financial development and economic growth is also observed by Odhiambo (2007) on three countries in Sub-Saharan Africa - Kenya, South Africa and Tanzania. Three indicators of financial development were used. The first proxy variable for financial development is the monetary variable, which is defined as the ratio of monetary aggregate M2 to GDP. The second proxy variable is represented as the ratio of currency to monetary aggregate M1. Finally, the third proxy variable is represented as the ratio of private sector bank claims to nominal GDP. Economic growth was approximated by real GDP per capita. The main finding of the paper is the considerable sensitivity of causality to the chosen measure for assessing financial development. Among other things, the strength and evidence of causality varies from the specifics of each country and over time. The stronger *"demand-following hypothesis"* has only been demonstrated for Kenya and South Africa. In Tanzania, the response of increased demand due to GDP growth was by no means dominant and causality of this type was rejected here.

Another relationship described is bidirectional causality of the *"feedback hypothesis"* type. Apergis (2007) examines the long-run relationship between financial development and economic growth over the time period from 1975 to 2000 for 15 OECD member countries (i.e., developed) and another 50 non-OECD countries (i.e., emerging). The panel sample thus represents the representation of all income types - from low-income to high-income countries. Financial development can impact economic growth through three types of channels, which the author examines in detail. He uses econometric tools, namely panel unit roots and cointegration tests, which are particularly useful when dealing with heterogeneous coefficients and dynamics occurring across units, which subsequently make it impossible to determine the long-run structure between financial and economic growth. It applies these tools to the GDP of selected countries. The second variable chosen is the financial development rate, which is chosen individually for each country according to its specific characteristics. To assess the state of financial development, the following variables

were selected: liquid liabilities of the financial system as monetary aggregate M3 to GDP, bank loans and loans to the private sector. The cointegration vectors were estimated using an OLS procedure, which provides estimates with consistency and efficiency properties while taking into account the endogeneity of the regressors, integration and cointegration nature of the dataset when estimating the long-run relationship. The finding reached by Apergis (2007) in the study supports the existence of a valid long-run equilibrium relationship between financial depth and economic growth. Thus, the empirical study points to a positive statistically significant relationship between the variables of interest and also provides factual evidence of a bidirectional causal relationship between financial deepening and economic activity referred to as the *"feedback hypothesis"*. The aim of his paper is to make recommendations directed to the policy authorities in charge of financial market development. He encourages them to continuously improve financial structures, and hence financial markets, as this will also result in significant economic growth in the long term. These recommendations are particularly important for emerging countries, for which much stronger bidirectional causality has been found.

The null causal relationship between financial depth and economic growth is referred to as the *"neutral hypothesis"*. The decay of the relationship between stock returns and future actual economic activity is discussed, for example, by Binswanger (2000), as he concluded that current stock returns no longer contain information about future economic activity as they used to. Tcheunta and Dombou-Tagne (2017) also examined whether it is possible for economic growth to be affected through stock market developments. However, they did not find any causal relationships, either from the stock market to GDP or vice versa. The *"neutral hypothesis"* is what Chang (2002) finds in his paper when he conducts empirical testing of two competing hypotheses, namely the *"supply-leading hypothesis"* and the *"demand-following hypothesis"*. Chang aims to find out whether financial development leads to economic growth. To accomplish this objective, he works with three-dimensional VAR models in China's centrally planned economy. The author chooses China as his research area because it has experienced remarkable economic progress over the past few decades. In the decade from 1990 to 2000, the average annual growth rate was more than 10%. Furthermore, China has become one of the giants at the level of trading countries in the world with a foreign exchange reserve estimated at just under US$160,000 at the end of 1999. Last but not least, China was such a politically open country in the late 1970s that it provided sufficient data to come under the scrutiny of researchers to assess the impact of economic liberalization. We test the period from 1987 to 1999 using data on GDP, monetary survey, exports and imports, all at quarterly frequency. The financial development was calculated as the ratio of the monetary survey to GDP and the openness measure as the ratio of the sum of exports

and imports to GDP. The data series were then adjusted by logarithmic regression to achieve stationarity of variance. The KPSS test finds all observed time series to be non-stationary in levels but stationary in first differences. Thus, this means that the data are integrated at order I. He then proceeds to test for cointegration and Granger causality. The results suggest independence between financial development and economic growth. This means that China did not exhibit either type of unidirectional causality during the time period under study. On the contrary, its development replicated the *"neutral hypothesis"* type of causality.

Several authors have produced models giving room for conflicting views on the relationship between the stock market and growth, and the relationship is thus described as the *"negative hypothesis"*. Lucas (1988), for example, refers to the relationship between financial development and economic growth as being overstated and himself rejects any causality in this regard. Naceur and Ghazouani (2007) join the debate regarding the relationship between financial development and economic growth and empirically examine it using 11 countries from the MENA region (i.e., Middle East and North Africa) over the timeframe from 1979 to 2003. The study was limited to 11 countries as not all of them had fully developed stock markets during the period under study. The countries of this developing region were chosen by the authors partly because of the small number of studies focusing on these countries, but also because of the great diversity in the structure of financial systems and companies within the region. The number of observations for all countries is not uniform, ranging from 9 to 25 observations at an annual frequency. Such a data panel needs to be subject to adjustment as it is unbalanced. The dependent variable is GDP per capita, and the explanatory variables are the BINDEX composite index as a measure of bank development, the SMINDEX index as a measure of stock market development, and measures of financial development. Econometric methods were used to assess the degree of dependence, specifically estimating a dynamic model on the panel data using GMM estimators. The final position of the paper is the finding of zero positive impact of the financial sector on economic growth, whether the financial sector is captured through the financial or banking sector. A non-significant negative relationship was identified between bank development and economic growth which may be due to excessive lending to the public sector. The weak link between financial development and economic growth is likely due to the poor quality and structure of financial systems in the MENA region, which decelerate economic growth or cause unstable growth rates.

2 Data and methods

Time series analysis capturing economic and stock market activity was required to test the property of stock indices as leading indicators in the BRICS countries. In order to capture the economic growth

of the BRICS countries, the gross domestic products of these countries were used. The GDP time series were obtained from the OECD database, at a quarterly frequency from the first quarter of 2004 to the third quarter of 2020. According to OECD (2021a), GDP is defined as the aggregate sum of output through the expression of gross value added. Thus, GDP has been calculated based on the production (manufacturing) method. GDP values were obtained in millions of national currencies of each country, at current prices. In order to make the time series comparable with each other, it was necessary to convert them into a common unit of currency. The US dollar (USD) was chosen as the common unit of currency. In addition, GDP was adjusted for the effect of seasonality, as according to Holý (2014), the seasonal component in the time series (climatic conditions, different number of days of each period, but especially the effect of religious and public holidays) can affect the values of the statistical results. Causal relationships were tested over the entire period 2004 to 2020, while the time series were also divided into several units according to the tests of parameter stability (QLR, CUSUM, CUSUMSQ analyses) first into three and then into two sub-periods. In addition, the data were also split uniformly – according to the collapse of Lehman Brothers in 2008, as the time series showed a significant break in the third quarter of 2008.

Stock market developments were approximated by stock indices that are typically representative of the BRICS countries. In selecting the representatives of each stock index, the aim was to ensure that they were among the main stock indices from the BRICS grouping. The original intention was to analyse the representatives of the indices from the Dow Jones BRIC Index Family. However, this was not possible due to the availability of data only from 2011 onwards, and values have only been published for the Dow Jones BRIC Brazil 15 Index, the Dow Jones BRIC India 15 Index and the Dow Jones BRIC China 15 Index. Therefore, alternative indices were chosen that are also dominant within the BRICS stock markets. The Brazilian, Indian and Chinese stock indices from the Dow Jones BRIC Family were used at least in the context of a comparison with the third sub-period indices that were selected for the final analysis of the relationship between stock market indicators and economic performance. The purpose of this comparison is to determine whether or not the same type of causal relationship will be found using different choices of stock indices. Thus, the following stock indices, in addition to the three representatives from the Dow Jones BRIC Index Family, were used to analyze the relationship between stock market and economic performance in the BRICS countries. For the Brazilian stock market, these were the IBOVESPA index, the Russian stock index MOEX 10, the Indian stock index NIFTY 50, China is represented by the SSE Composite Index and South Africa is represented by the FTSE/JSE South Africa Top 40. The stock indices were obtained at their daily closing price frequency from financial data websites and specific stock exchange websites during the same period in which GDP was analysed. Where stock index

values were in their home currencies, they were converted to the common currency USD. In order to achieve the same frequency as for GDP, the median value was always selected from the daily closing price values for a given quarter and was thus representative of the entire quarter. The median is a robust characteristic of the level that is not affected by the inclusion of outliers in the data set. Thus, it does not give a biased result about the overall level of values since the median value is in magnitude from the middle level (Souček, 2006). By selecting medians from each quarter, a total of 67 observations were obtained between the first quarter of 2004 and the third quarter of 2020. The stock index data were obtained without seasonal adjustment and since there was no evidence of a significant effect of seasonality for them, these data were not adjusted for the seasonal component.

The strength of the statistical dependence between the variables was first determined using correlation analysis. In case a certain dependence of the variables GDP and stock market was found through correlation analysis, the possibility of a real existence of causality can be assumed. The Granger causality test was used to decide the correlation between economic development and stock market activity. Cipra (2013) refers to a Granger causal relationship as one in which a correlation is found to exist between the current value of one variable and the past values of other variables. Multivariate time series built in the form of VAR models allow us to investigate Granger causality by testing for nullity of individual blocks in the parameters of the VAR model. When constructing VAR models, it is possible that several comparable models will be created, and it is complicated to select the model with the best characteristics. Therefore, for the purpose of model selection, features were designed to compare the residuals of different models with different lag orders. According to these characteristics, the model selected is the one that takes the minimum values of FPE ("final prediction error") and the multivariate forms of the Akaike criterion (AIC), Hannan-Quinn criterion (HQC) and Schwartz criterion (SC or BIC) (Arlt and Arltova, 2009). If a given model fulfils the stationarity assumption, an F-test can be used to evaluate whether one time series causally affects another time series. Although Cipra (2013) is aware of the possible loss of information about the long-run equilibrium relationships between the modelled series once they are stationary, he, like Gujarati (2009), insists that the VAR model be constructed from stationary time series.

Based on the literature review, four types of causality can be expected between economic developments and stock market developments: “supply-leading” (GDP $\leftarrow$ I), “demand-following” (GDP $\rightarrow$ I), “feedback” (GDP $\leftrightarrow$ I) and “neutral” (GDP $\nleftrightarrow$ I). In the literature search, the "negative" type of causality was also mentioned, however, using Granger causality it is not possible to prove

negative or positive influence of variables, therefore this causality is not considered further. The testing requires estimation of two regression equations, the first one is estimated for GDP and the second one is estimated for stock index. The existence of validity of 4 types of causality and the steps of Granger causality test were based on Gujarati (2009). Greene (2012), however, points out the limitations of Granger causality investigations. Tests of causality may be predicted from a model that may not include all intervening variables or may not include all lagged effects that should be present in the model. If all the appropriate intervening variables are not included in the model, there may be a spurious dependence problem – that is, the finding of causal effects may equally well result from the omission of a variable that is correlated with both dependent variables. This information selection problem is also defined by Arlt and Arltova (2009).

3 Results

From the correlation function for the GDP of the BRICS countries and their respective stock indices, it is possible to analyse the relationships between these variables. The correlation analysis is also applied to lagged values in addition to the lagged values, based on which it is possible to examine the overtaking of the economic performance variable or stock index. However, there may be situations where no relationship is observed between the variables. For the correlation analysis, the maximum possible number of lags of order 6 was chosen. In most cases, these lags were of order 4 because of the quarterly frequency of the data. The results from the correlation analysis suggest three types of causality between the observed economic growth and stock market indicators – "supply-leading", "demand-following" and "neutral hypothesis". Despite the fact, that Pearce (1983) referred to stock indices as leading indicators, no mere "supply-leading" type causality was found between the stock indices of BRICS countries and their economic performance based on correlation analysis. Moreover, as Pearce (1983) himself admits, stock indices can often be an indicator involving many spurious signals, and therefore many other authors also speak of a reverse one-way, two-way, negative direction of causality, or even zero dependence. Thus, the correlation analysis was supported by testing Granger causality, according to which the degree of interdependence between economic developments and the representatives of the main stock market indices for the BRICS countries will be verified.

The unambiguous conclusion that emerges from the individual time series distribution is the high degree of divergence between the results of the correlation analysis and the Granger causality test. Not only did the type of causality often differ when the method of finding correlation was used differently, but also when different lengths of time series were chosen, divided either according

to the identified structural breaks or according to the global economic crisis – the collapse of Lehman Brothers.

It can be observed that in the situation where the break was not taken into account, i.e. the whole length of the time series, the causality of the relationships was not as significant as when structural breaks were included. Furthermore, it can be argued that two breaks in the time series led to a higher level of causality than when only one structural break was included. However, a potential downside of modelling structural breaks is the truncation of time series, with split series subsequently acquiring fewer observations. Splitting according to the global economic crisis was not entirely appropriate as causal links between variables were displaced. The best option is therefore to take an individual approach to each country, and hence model, and to take into account the background economic history of the country in question.

As a different type of causality was often identified in almost every period, the summary results of Granger causality have been presented in the following summary table. Only Granger causality results are presented, and this is because the assumption of univariate and bivariate normality was not met for the correlation analysis for the vast majority of the data (with the exception of Russia in the period before the collapse of Lehman Brothers).

The type of causality can be identified for Brazil, where the predominant type is “demand-following causality”. In South Africa, the "neutral hypothesis" dominates. In the other countries, the identification of the hypothesis is more complicated as no causality typically prevails. In Russia, "neutral" alternates with "supply-leading", with "neutral" being more common; in India, "neutral" is more prevalent; and in China, it is again evident that economic growth is to some extent the basis for stock market developments, so that one can speak of a "demand-following hypothesis", but there are also periods when the relationship between GDP and stock indices is completely divergent.

Tab. 1 Summary results of Granger causality testing

Period and country		B	R	I	C	S
The whole period		*demand*	*demand*	*demand*	*neutral*	*demand*
Three periods	I.	***demand***	*neutral*	***supply***	***demand***	*neutral*
	II.	*neutral*	*supply*	*neutral*	***feedback***	*neutral*
	III.	***demand***	*neutral*	***supply***	*neutral*	***supply***
DJ BRIC – III.		*demand*	×	*neutral*	***demand***	×
Two periods	1.	*demand*	*neutral*	*supply*	***demand***	*neutral*
	2.	***demand***	*neutral*	*demand*	*neutral*	*neutral*
The collapse of LB	before	***demand***	***supply***	*neutral*	*neutral*	*neutral*
	after	*neutral*	*neutral*	*neutral*	*neutral*	*neutral*

VAR models were used to predict the future evolution of important causal variables in each country. In particular, the prediction will focus on ensuring that the model fulfils all assumptions leading to the random component being Gaussian white noise (BUE estimates). In addition, the time series on which the prediction will be based must be Granger causal in the direction that is most common for the country.

In Brazil, where demand-following causality has been demonstrated in most periods, it is possible to see that GDP and the stock market will evolve in roughly the same direction. A slight decline is expected for both variables towards the end of 2020, with stock markets experiencing a deeper decline than GDP. GDP will then experience a short upward trend, which will last a little longer in stock markets. The alternation of growth phases with decline phases for both GDP and IBOVESPA is also visible, with GDP growing in early 2023, while the Brazilian stock market will experience a recovery and stabilization phase with a minimal growth trend after a decline in late 2022.

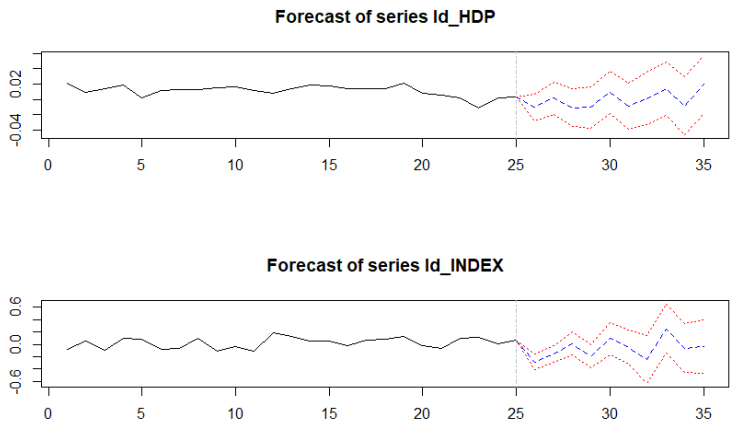

Figure 1 GDP and stock index forecasts for Brazil 2020:Q4 – 2023:Q1.

Although the relationship between the stock index and economic development has been decoupled in China, the "demand-following hypothesis" has been demonstrated in certain periods. Therefore, a prediction will be made for this causal relationship. At the end of 2020, a slight decline in GDP can be noticed, but this will turn into a slight upward trend in the following year. China's GDP will develop steadily from 2021 to the end of the forecast period, with a very slight indication of a gradually declining trend. The development of the SSE stock index shows a very stable trend again from the very end of 2020. In contrast to GDP, the stable development of the stock index is supported by gradual growth.

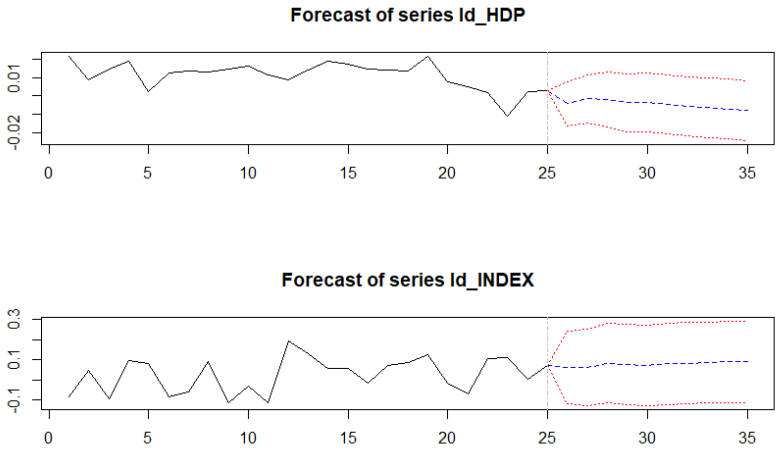

Figure 2 GDP and stock index forecasts for China 2020:Q4 – 2023:Q1.

In the case of Russia, India and South Africa, developments will not be predicted by VAR models, as the prevailing type of causality in all three countries is the "neutral hypothesis", and thus no prediction is possible.

4 Discussion

This paper aims to test the assumption of the forecasting capabilities of stock indices as leading indicators within the BRICS grouping, i.e. whether it is possible to manage economic performance based on information about stock market developments. A sub-objective is the subsequent comparison of the identified dependencies and the prediction of future economic developments in these countries.

The relationship between economic performance and indicators of stock market developments in the observed stock markets of these emerging market economies is examined over the time horizon from the first quarter of 2004 to the third quarter of 2020. The length of the time series is equal to 67 observations at quarterly frequency in all five countries. In addition to the forecasting ability of stock indices, it is possible to find a different type of causality between these two variables than in the direction from the stock market to economic performance as reported by other authors.

The GDP time series of Brazil, Russia, India, China and South Africa were used to capture economic performance. Stock market performance was approximated by the BRICS stock indices – IBOVESPA, MOEX 10, NIFTY 50, SSE Composite Index and FTSE/JSE South Africa Top 40 Index. To achieve the same frequency of stock indices as for GDP, whose values were quarterly, a median representing one given quarter was always chosen. In addition to the median stock index values, the causality

investigation was also conducted using the arithmetic mean as representative of the entire quarter. However, whether the quarterly stock indexes were expressed as medians or arithmetic averages, the same results were obtained using both variables. This was due to the value of the correlation coefficient, where almost 100% direct dependence was achieved between the median and the arithmetic average (r = 0.99).

The search for a causal relationship was first conducted through lagged correlation analysis, which was used to determine the existence of a statistical relationship between GDP and their stock indices for different time series lengths. The correlation analysis eventually pointed to three types of causality – "supply-leading", "demand-following" and "neutral hypothesis". Another tool leading to the objective of the paper is to test Granger causality using bivariate VAR models. Despite the fact that the correlation analysis and Granger causality test did not yield identical conclusions in all cases, it cannot be argued that the observed financial indicators and the state of the economy in all BRICS countries are in any way related to each other. Indeed, the robustness of the correlation analysis was probably impaired by the unfulfilled assumption of univariate and bivariate normality, hence the greater appeal to the results arising from the analysis of VAR models and the subsequent investigation of causality.

The linkage between financial development and economic growth in the BRICS grouping has also been investigated by Guru (2019), who analyzed this relationship between 1993 and 2014, using indicators from the banking sector in addition to stock market indicators. He found a positive determinant effect of both banking and stock market development on economic growth. His study is in complete contradiction with the results of this paper. In the time period from the beginning of 2004 to the third quarter of 2020, supply-leading causality was not found in any of the BRICS countries.

Habibullah (1999) also searches for the direction of causal relationship between financial development and economic growth and attempts to analyze it in 7 Asian emerging countries. Habibullah (1999) finds a different causal relationship for each country, which varies depending on the country chosen and also the aggregate through which the causality is examined. Using Thailand as an example, one can notice the change in causality where no causal relationship was found using the conventional aggregate, while using an alternative proxy for the financial market, the "feedback hypothesis" was found. Comparable to these Asian countries is South Africa, for which no causality was found according to the FTSE/JSE stock index.

Apergis (2007) examines the long-run causality between financial development and economic growth in 65 developed and emerging countries. His study shows a bidirectional positive statistically significant relationship that becomes stronger for countries that are less developed. If Brazil, India and South Africa were included among the less developed countries, it is not possible to find a correspondence between the study of Apergis (2007) and this thesis, even if Russia and China were representative of the developed countries, as the"feedback hypothesis" was not the predominant type of causality in any of the BRICS countries. The only consensus is that the "feedback hypothesis" was demonstrated in China in one of the sub-periods, when two structural breaks were included in the model.

Chang (2002) tests two competing causalities using China as an example. The first running in the direction from GDP to the stock index and the second from the stock index to GDP. He finds the observed time series to be independent of each other, as Granger causality fails to confirm the causality between financial development and economic growth. The conclusion of this paper can be identified with the results of Chang (2002), as the "neutral hypothesis" is the most frequently demonstrated causality in China, despite the fact that Chang analysed China between 1987 and 1999 and used different variables capturing financial market development – monetary survey, exports and imports.

In this paper, the only identifiable type of causality is the "demand-following hypothesis", which clearly dominates in Brazil in the vast majority of all periods. The other demonstrable causality is the "neutral hypothesis", which is valid in South Africa. For other countries, it is difficult to pronounce on the specific type of validity of the relationships between economic growth and selected financial indicators, as the hypotheses alternate across time horizons. In Russia, "supply-leading" occurs with "neutral" occurring more frequently. As in Russia, "neutral" is the prevailing hypothesis in India. As far as China's economy is concerned, it must be said that it is a crucial determinant of future stock market performance, but the existence of this relationship does not persist in all periods where the causal relationship between GDP and the SSE stock index is unwound.

Regarding the prediction of future developments for 2021 and 2022, it is only possible to pronounce a forecast for Brazil and China, as no clearly prevailing type of causality was found in the other BRICS countries. In Brazil, according to the prediction based on the VAR model, a slight decline in both GDP and stock markets is expected at the end of 2020. The prediction is to some extent consistent with economic reality, as the Brazilian economy, despite the ongoing crisis, recorded an economic growth of 3% at the end of 2020, according to the CNB (2021). Although the growth rate has experienced

a slowdown, Brazil is still one of the fastest growing emerging economies after the coronavirus crisis. However, in early 2021, Brazil's GDP is expected to grow slightly, followed by alternating phases of contraction and growth. Here, the VAR model's forecast already diverges from the CNB's (2021) forecast, as GDP is expected to be negatively affected by the second wave of the pandemic crisis. In addition, financial markets have been cooled since the beginning of 2021 due to disputes stemming from regulated fuel prices, which has been reflected in an increase in exchange rate volatility. GDP growth is estimated at around 3% for 2021, but this is generally a slowdown. The CBR (2021) further estimates that China's economy will respond sharply to increased private consumption in 2021, resulting in economic growth. Economic growth will also be further supported by effective government measures and the consolidation of its position as an exporter due to competitive disruptions caused by the worsening global epidemiological situation. China's economy is projected to continue to grow in 2022. China's VAR model forecast is completely at odds with expected economic reality. The reason for the discrepancy in conclusions is the inability of VAR models to capture fluctuations and irregular events (wars, natural disasters, epidemics etc.), which the coronavirus pandemic undoubtedly is.

Conclusions

The main hypothesis of the paper in the wording stock indices have the ability to predict future economic development must be rather rejected. It cannot be said that stock indices and economic performance are in any way intertwined, but it is not possible to unequivocally support supply-leading causality, as it has not been demonstrated at a level for any of the BRICS countries that would make it prevalent. It has appeared in some sub-periods in Russia, India and South Africa, implying that stock indices carry information about future economic developments in some periods, but causality has been found to occur more frequently in these countries. The most conclusive type is the "demand-following hypothesis" in Brazil. Thus, an important finding for economic policy makers in Brazil is that economic growth is a variable that can be used to predict future stock market events. Thus, the Brazilian financial system is dependent on gross domestic product growth and policymakers in Brazil should stimulate economic growth in an effort to get the stock market moving. The causality leading from GDP to stock markets is also important information for financial and investment companies considering investing in Brazil. For them, the expansionary phase of the Brazilian business cycle may be a signal that stock markets will also experience growth in the next few quarters. The likely response time is 2 to 7 quarters (implied by the VAR models' estimates).

Furthermore, the degree of causality was found to be largely influenced by the length of the time period. For the longer time period the interdependence of the variables is tested, the greater the ability of the variables to influence each other. Calderón and Liu (2003) come to the same conclusion in their paper, arguing that a stronger effect of interdependence can be found for a longer time series length, since financial deepening takes time and does not act immediately. The same can be argued in the context of assessing the effects of economic growth. In relation to the length of the time series, it is possible to see a limiting element of this paper, where, especially when the time series is split into several sub-periods, the time series were shorter. While causality was stronger when the time series was split into three sub-periods than when the entire time period was sought, here the appropriate length of the time series is at least on the order of several decades. This paper tested the relationship between GDP and stock indices over the period 2004 to 2020, which is 16 years. Calderón and Liu (2003), however, analyze time series from 1960 to 1994, which is up to twice the length of the time series.

Another fact that emerges from this paper is the sensitivity of causality to the specifics of each country. According to the results, it can be seen that when accounting for specific economic influences by fitting each country's structural breaks into VAR models, the causality found was stronger. It is also highly likely that the causality is highly sensitive depending on the chosen indicator representing the stock market. For example, Guru et al. (2019) found a "supply-leading hypothesis" between financial development and economic growth in China using indicators of stock market size, value of traded shares, and TOR, while Chang (2002) found a "neutral hypothesis" causality using data from the monetary survey, exports, and imports. In this paper, using the SSE Composite stock index as a selected indicator of stock market performance, the "demand-following" causality was found in alternation phases with the "neutral hypothesis". Therefore, it is important to note that with a different choice of instruments representing the stock market, it is highly likely to find quite different types of causality. Odhiambo (2007) also confirms the sensitivity of causality to the chosen measure of financial development assessment, so future research on the relationship between the stock market and economic performance could address the search for causality when instruments other than stock indices are chosen.

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