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EMPIRICAL TEST ON MACROECONOMIC FACTORS AND STOCK
MARKET ANALYSIS
CASE OF KAZAKHSTAN STOCK MARKET

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ABSTRACT

This paper analyzes the interactions between Kazakhstan stock market index and macroeconomic variables. The vector autoregressive model (VAR) is employed; Granger causality, impulse responses and variance decomposition tests are implemented. The results show weak interactions among tested variables and the market. The only variable that could be used as explanatory power for price movements in stock market is Exchange rate (EXR). This can be due to the export oriented firms' power in the country. The weak explanatory power of other macrovariables can be interpreted as inefficiency in the local stock market.

Keywords: Vector Autoregressive Model (VAR), causality, impulse response, variance decomposition

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List of acronyms and abbreviations

KASE	Kazakhstan Stock Exchange
CPI	Consumer Price Index
GDP	Gross Domestic Product
GNP	Gross National Product
IMF	International Monetary Fund
KSE	Karachi Stock Exchange
VAR	Vector Autoregressive Model
VECM	Vector Error Correction Model
ASEAN	Association of Southeast Asian Nations
IPI	Industrial Production Index
M2	Money Supply
ADF	Augmented Dickey Fuller
APT	Arbitrage Pricing Theory
NFRK	National Fund of the Republic of Kazakhstan
PP	Phillips-Perron
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin
ER	Exchange Rate
AIC	Akaike information criterion
BIC	Bayesian information criterion
HQIC	Hannan-Quinn information criterion
GLS	Generalized Least Square
OLS	Ordinary Least Square

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1. INTRODUCTION

1.1 Background

The relationship between stock market and macroeconomic factors has been widely discussed in previous research papers that deal with this topic in various ways. The fact that macroeconomic factors affect stock market prices and financial markets influence the real economy is generally accepted by the economic and financial theory.

Empirical studies related to this issue began to be a topic of interest during the last two decades. New methods were improved to analyze comovements of financial and real economic world. However, the exact relationship (in size and direction) between some macroeconomic factors and stock market returns that could be applied to all markets could not be distinguished. The results obtained from previous research that will be discussed more in literature review show no drastically change over time, however the evidence remains topical for new markets trying to enter global financial world.

After Soviet Union collapse the post soviet countries began to enter the world economic system as independent emerging market units. Development trends of financial sector in these economies are important topic to analyze. As one of the largest economies in this geography Kazakhstan is chosen as a case of this research as an emerging market with rapidly growing securities market. After deep regression and large scale of transformations during last 10 years Kazakhstan practiced high level of economic growth mainly expressed in industrial production (mining) and oil (and gas) export. This is an interesting evidence for finance to see empirically if this changes in macroeconomy influenced stock market returns during last decade.

Kazakhstan Stock Exchange was founded in 1993 is non-profit joint stock company which is the only market in Kazakhstan Republic where financial instruments are traded. Today KASE can be divided into four submarkets including foreign currency market, the government securities market, including supranational securities of Kazakhstan, the market of shares and corporate bonds, the derivatives market.¹ This paper uses KASE share prices index as the measure of stock market movements. Theory suggests that efficient market should reflect the real economy; information about macroeconomic dynamics is included into stock market prices, i.e. no permanent abnormal return can be earned on this information.

¹ http://www.kazakhstan.org.sg/content/intro.php?act=menu&c_id=29

Several papers deal with Kazakhstan recent economic development and problems, especially about relationship of real economy with oil industry. However, stock market indexes interactions with macroeconomic movement remains as a topic of interest. As the market is not perfectly integrated with global financial world, local macroeconomic factors can influence the stock market returns more than global risk factors. In the light of previous empirical evidence this paper purposes to model empirically the KASE market movements cointegration with distinct macroeconomic variables presented in following parts.

1.2 Purpose of the study

Investigation of the interactions among macroeconomic factors and stock market index in Kazakhstan Stock Exchange (KASE share index) is the main purpose of this research. Existence of correlations can explain stock price formulations and movements. However, if the results support irrelevance of macroeconomic factors' and stock market co-movements we cannot use them as a price determination tool for share prices.

Hypothesis: The certain relationship exists between macroeconomic factors as inflation, money supply, industrial production index, exchange rate and KASE shares index within the research time horizon (2000-2009). Hypothesis is based on general intuitive theory suggested by Fama (1981), and previous literature on this topic.

1.3 Approach

The central model is used to determine before stated relationships is Vector Autoregressive Model (VAR). As this research deals with several variables and their interactions VAR is one of the most practical and common way to test such relationships. It is also successful in forecasting of financial time series. Different combinations of variables and their interaction with Stock market price changes are tested with the help of VAR. This paper applies nonstructural VAR where all the variables endogenous. In order to evaluate the results of VAR Impulse responses, Causality tests and Variance decompositions are implemented.

1.4 Contribution to the literature

Although there are numerous papers discussing the aforementioned relation, very few research deals with post soviet countries; especially in central Asia. The reasons; undeveloped stock markets, lack of statistical information, dependent market structure. The same can be said about Kazakhstan, however; this country with its functioning stock market (nearly 20 years), and stable economy is good case for studies in this regard. As there is also a lack of

macroeconomic indicators in these countries (including Kazakhstan) stock market analysis can be one of the main indicators of the economic growth in Kazakhstan. Research of these interactions can give useful information for policymakers. (Muhittin Kaplan)

This paper will contribute further research about Kazakhstan economy as well as simultaneous development of Kazakh stock market and its economy.

1.5 Outline

The second chapter gives Literature review which enlightened the future analysis. Third chapter consist of general review of Kazakhstan economy and Kazakhstan Stock Exchange (KASE), as well as information why Kazakhstan is a topic of interest of this paper. Fourth chapter presents empirical model and statistical tests that are applied within the paper. VAR description as a model and estimation ways, interpretation tools for the VAR model are obtained by this chapter. Related tests are also explained theoretically in this chapter. Fifth is about the data description. Macroeconomic variables employed, KASE index; their sources, data transformations and description of statistical properties are represented in this part of the paper. Sixth chapter includes methodology and empirical results; information obtained from implemented tests and model presented in here. Chapter seven gives conclusion and some further analysis concluded from the results.

References are followed by Appendix including additional Tables and Figures.

2. LITERATURE REVIEW

Macroeconomic factors and stock market analysis cannot be considered as something novel within econometric topics. A lot of work has been done so far and various outcomes obtained during numerous researches. Some works will be overviewed in this part, concentrating on those which hypothesis is the existence of impact of macroeconomic factors on stock market returns. The literature is not divided according to empirical results, because there is no evidence where the all variables showed the same significance level; results differ from country to country.

Humpe and Macmillan (2007) compare US and Japanese stock markets' reaction to the changes in such macroeconomic factors as industrial production, inflation and long interest rate. Although there are some differences in market responses to the same variables, the evidence shows that in both samples there exists cointegrating vector between stock market returns and economic evidence. (ex.; money supply is insignificant in US, but significant for Japan)

Mohammed and Shaheen (2004) analyzed long term equilibrium relationship between Karachi Stock Exchange index and macroeconomic variables presented by the industrial production index, the consumer price index, M1, and the value of an investment earning the money market rate. VECM was used as an empirical tool and cointegration was observed among those variables. Industrial production was determined as the largest positive, while inflation the largest negative influence on stock market. Another research is done on the same market again in 2009. Its results are slightly different from previous one, especially about the influence of industrial production on stock returns. Mohammad et al. (2009) used quarterly data on macroeconomic factors as foreign exchange rate, foreign exchange reserve, gross fixed capital formation, M2, call money rate (interest rate proxy), Industrial production index and whole sales price index (proxy of inflation) and analyzed their relationship with Karachi stock market. The result was different for applied factors; exchange rate and exchange reserve influenced market, however industrial production changes does not affect stock prices. M2 and IR concluded to be significant in explanation of stock market returns.

Tvaronavičienė et al. (2006), implemented empirical analysis on Lithuanian stock market, using the following macroeconomic variables: foreign direct investment, state budget revenue, state budget expenditure, gross domestic product, price index of consumer goods and

services, money supply, average profitability of governmental bonds and inflation. The results showed that the OMX Vilnius Stock Index is significantly explained by 4 of 8 variables.

Maysami and Koh (2000) detected that Singapore market is influenced more by exchange rate and interest rate, which shows its sensitiveness to external factors, however; internal factors as money supply and inflation insignificantly affect the market. It is explained by small size and high global integration of Singapore market. Paper uses M2 for money supply and CPI as a proxy of inflation. Later Maysami et al.(2004) made research on Singapore All-S indexes which represented various sector indexes and used macroeconomic variables to test sectoral response to the macroeconomic changes. Results differ from sector to sector, giving additional questions to explore.

Nasseh and Strauss (2000) examined six countries consisting of Germany, Italy, France, Netherlands and the UK in their long run relationship with external and internal economic changes. Evidence supports that the macroeconomic variables as CPI, production, interest rates and business expectations can be considered as influential sources of stock prices. However, implemented variance decomposition methods shows that the forecast power of local and international variables' changes between 37% and 82%, depending on which country is tested. That is important factor in interpretation of results. One more interesting point is that Nasseh and Strauss show that the results can also change by influence of the model is used. They conclude that the explanatory power of variables is higher in VECM models than in unrestricted VAR model.

Wongbangpo and Sharma (2002) applied cointegration tests to ASEAN 5 countries, whereas, Eurilton Araujo(2009) explored co movements using SVAR in Latin America countries. Results showed inequality among countries and sector responses. Rjoub et al. (2009) found the correlation between tested macrofactors and stock returns, however results showed weak explanatory power. Muhittin Kaplan found stock market economic activity causality direction that implies the importance of stock market information for policy makers in countries like Turkey.

Previous literature is not consistent in empirical results and macroeconomic factors employed. Local market conditions strongly influence the variable selection, hence conclusions obtained. **Table 1** gives summary of papers that used the variables included in this paper. Also some papers applied VAR models for investigation are presented.

Table 1. Examples of previous literature used the macroeconomic variables employed in this paper

Tested variables	Some previous papers
Money supply	Chen, Roll and Ross (1986), Fama (1981), Wongbangpo and Sharma (2002), Maysami and Koh (2000), Humpe and Macmillan (2007), Mohammad et al. (2009), Tvaronavičienė et al. (2006), Maysami et al.(2004), Rjoub et al. (2009)
Industrial Production	Fama (1981), Chen, Roll and Ross (1986), Maysami and Koh (2000), Humpe and Macmillan (2007), Mohammad et al. (2009), Maysami et al.(2004), Nasseh and Strauss (2000)
CPI	Wongbangpo and Sharma (2002), Humpe and Macmillan (2007), Tvaronavičienė et al. (2006), Nasseh and Strauss (2000), Muhittin Kaplan (2008)
Exchange rate	Chen, Roll and Ross (1986), Wongbangpo and Sharma (2002), Valentine (2000), Maysami and Koh (2000), Mohammad et al. (2009), Maysami et al.(2004), Rjoub et al. (2009)
VAR model is used in following papers as the main tool for investigation	Humpe and Macmillan (2007), Maysami and Koh (2000), Maysami et al.(2004), Nasseh and Strauss (2000), Muhittin Kaplan (2008)

3. KAZAKHSTAN ECONOMY OVERVIEW

3.1 General Economic Outlook

Kazakhstan is the largest economy in central Asia. As the end of 2008 the population is 15 million, and average population growth is 0,9%². Country can be classified as industrial with mainly mining industry. Country possesses rich mineral and fusel fuel resources; extraction of oil and natural gas is the main part of the economy.

Table 2. Structure of the economy

		1998	2007	2008
Total GDP				
Agriculture		9,1	6,1	5,7
Industry	As a % of GDP	31,2	40,6	43,3
<i>Manufacturing</i>		12,8	12,4	12,7
Services		59,7	53,3	51

After the Soviets collapse Kazakhstan experienced deep regression that resulted in sharp decline in its industrial production. Governmental reforms on fiscal and monetary policy, as well as privatization programs stabilized the macroeconomic conditions in the country. Beginning from 2000 Kazakhstan experienced stable and high economic growth expressed in average 10 % of GDP growth per year. However, the main disadvantage of the economy is its dependence on natural resources. 73% of exports and 39% of GDP consist of minerals, oil and gas.

Financial crisis of 2008 cost a lot Kazakhstan which implemented a large fiscal stimulus program that should be weakened during following years. In general economic growth in Central Asia as well as in Kazakhstan is expected to be slow.³

The following table represents trend in main macroeconomic variables during last decade.

² http://devdata.worldbank.org/AAG/kaz_aag.pdf

³ <http://www.worldbank.org.kz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/KAZAKHSTANEXTN/0,,contentMDK:20629270~menuPK:361877~pagePK:141137~piPK:141127~theSitePK:361869,00.html#econ>

Table 3. Main macroeconomic movements during research period

Macroeconomic trend (in %)				
	2003	2005	2008	2009
GDP growth	9.50	9.10	8.50	2.40
Industrial Production	10	10.6	7.2	2.4
Inflation	6.00	6.90	10.80	17.00
Unemployment	8.80	8.00	7.30	6.60

Source: <http://www.indexmundi.com/kazakhstan/>

The main decrease in GDP sourced from oil price breakdowns and bank industry destruction.

3.2 KASE

Kazakhstan Stock Exchange was established immediately after introduction of national currency- tenge in 1993, November 15 with the main purpose of development of the national currency. Periodically KASE diversified its functions and reformed into today's joint stock company.

KASE has the following market sectors which are; 1) direct and automatic repo with collateral in the form of government and corporate securities, 2) foreign currencies (US dollars, euros and Russian rubles), 3) government securities issued by the National Bank, Ministry of Finance and local executive agencies in Kazakhstan, 4) bonds of international finance institutions and foreign government securities, 5) bills of exchange, 6) stock and 7) corporate bonds.⁴

Table 4. Essential information about KASE operations

Traded financial instruments	Equities as of February 1, 2010	Number of issued shares	Number of shares placed*	Type of shares issued
Corporate serial securities	KZT 1,756,114 th.	5,000,000	459,888	Common
Government securities				
Repo market instruments				
Foreign currencies				
Futures contracts				

*as of March 1, 2010⁵

⁴ <http://www.visocap.com/about-kase.html>

⁵ http://www.kase.kz/ru/page/general_info

4. EMPIRICAL MODEL AND STATISTICAL TESTS

Empirical methodology is applied to the discussing purposes described in this part of the paper. As mentioned in introduction VAR is considered as a central model for research, so methodology includes all empirical tools used to get more precise results within given data. There are some prerequisites dealing with data before realizing VAR models that should be implemented. First, time series included in VAR have to be stationary. Therefore, the tests for the unit root and stationarity applied to the data. These tests include Augmented Dickey Fuller (ADF), Phillips-Perron (PP), and The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS), which are described in the following subtitles. Secondly, the appropriate lag length is determined and autocorrelation in variables is presented. VAR model description follows the procedure, after which some alternative tools presented to help for interpretation of empirical results. They consist of Granger causality test, Impulse Response and Variance Decompositions.

4.1 Unit Root and Stationarity Tests

The popular test for stationarity (or non-stationarity) is unit root test. As we know there are three types of time series in financial econometrics: stationary (I(0)), trend stationary and non-stationary (I(1)).

Stationarity is important for standard econometric theory. Based on definition stationary process is a process that has constant mean, a constant variance and a covariance independent of time; i.e. its statistical properties are constant over time.

The trend stationary variable yields the way of describing an economic time series which is increase at a constant rate.

Finally, the third type of time series is non-stationary process which its statistical properties depend on time. Most of the time series are non-stationary.

There are two used models of non-stationarity: the random walk model with drift

$$y_t = \mu + y_{t-1} + u_t \quad (1)$$

and the trend stationary process

$$y_t = \alpha + \beta t + u_t \quad (2)$$

where u_t is a white noise (Brooks 2008, pp.320-321).

Almost most of the business and economic time series are far from stationarity when they are presented in their original units of measurement. They usually possess trends, cycles, random walking, and non-stationary behaviour. Time series should have some characteristics for possibility to be stationarized; steady long-run trend, which reverts to its line after some interruptions. Taking logarithms or deflating the factors can modify them into stationary time series. If such time series become stationary after logging or deflating they are called *trend-stationary*. On the other hand there are some time series that can remain non-stationary even after logging (or deflating); the situation where taking differences between periods may solve the problem. Possibly, if time series initially have time varying mean, variance and covariance, will possess statistical characteristics that are constant between periods after detrending. Literature refers to such time series as *difference-stationary*.⁶

Stationarity is important for time series analysis for some statistical evidence:

1. Properties of time series are heavily affected by its stationarity; the shocks will not die over time.
2. Spurious correlations between completely unrelated variables can occur if regress them in their initial trending form.
3. Time series cannot be tested hypothetically if they are non stationary, because the assumptions about asymptotic behaviour and t-distribution are not hold under such conditions. (Brooks 2008, pp.318-319)

We use unit root test to test a time series variables for non-stationarity. The most common tests in econometrics are the ADF, PP, and KPSS. The ADF and PP tests use the subsistence of a unit root as the null hypothesis and distinct generally in how they treat serial correlation in the test regressions. However, KPSS takes stationarity as null hypothesis.

4.1.1 Augmented Dickey – Fuller Tests (ADF)

Augmented DF is more general form of Dickey Fuller, is used for larger and more complicated time series sample. Since simple DF can be applied only to the AR(1) process, this paper employs ADF in order to capture the p lags. So, the lag length selection is also important for

⁶ <http://www.duke.edu/~rnau/411diff.htm>

ADF. Some methods as information criteria (such as Akaike information criterion, Bayesian information criterion or the Hannan-Quinn information criterion) or cross-equation restrictions can be used for lag length selection. ADF test statistics gives negative results, and the null hypothesis rejected as more as the t statistics is increasing in negative direction.

The general equation for ADF is applied to the time series is a following model:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \dots + \delta_p \Delta y_{t-p} + \varepsilon_t \quad (3)$$

where α is a constant, β is the coefficient on a time trend and p is the lag order of the autoregressive process. This model can be implemented for the different values of p , therefore modified accordingly (for higher order autoregressive processes).

Unit root test is realized under the null hypothesis that $\gamma = 0$, and the alternative is $\gamma < 0$;

$$H_0: \gamma = 0$$

$$H_1: \gamma < 0$$

The test statistics is

$$DF_\tau = \frac{\hat{\gamma}}{SE(\hat{\gamma})} \quad (4)$$

The logic is the same with the basic DF test, and the rejection criterion for the hypothesis is that the t statistics should be smaller than the larger negative critical value. Critical values are formulated by Fuller (1976), and additional test statistics are provided by Dickey and Fuller (1981) in further papers.

4.1.2 Phillips-Perron Test (PP)

Phillips Perron (PP) test along with ADF is very popular test for financial time series. The main difference between these two tests is that the initial one does not consider any correlations while testing the regression.

PP uses the following equation as the test regression:

$$\Delta y_t = \beta D_t + \pi y_{t-1} + u_t \quad (5)$$

Where, u_t is I(0) and may be heteroskedastic.

PP tests usually give similar results with ADF tests, but the test statistics calculations are relatively complex. Interpretation of the results is almost the same. The main problem related with PP tests cannot distinguish between stationarity and nonstationarity if the sample size small and its root close to nonsatationary value.⁷

4.1.3 The Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) Test

KPSS tests can be considered as a complementary to the ADF, because with the help of this test we can distinguish whether the series contain enough information about their empirical properties (stationarity) or not. This is the addition information to the unit root tests.

Hypothesis employed in KPSS tests derived (exchanged) from the ADF tests. The main difference in hypothesis is that KPSS assumes time series as trend stationary.

$$X_t = c + \mu t + k \sum_{i=1}^t \xi_i + \eta_t \quad (6)$$

The null hypothesis is

$$H_0: k = 0 \quad \text{and} \quad H_1: k \neq 0$$

If $k=0$ then the process is trend stationary, if not $k \neq 0$ then it is integrated process. So, the hypothesis of KPSS is reverse to ADF. Test statisticks for KPSS is

$$KPSS_T = \frac{\sum_{t=1}^n S_t^2}{n^2 \hat{\omega}_T^2} \quad (7)$$

where S_t is the sum of $\hat{\eta}_t$.

Residuals were obtained from the regressing equation 6 by OLS ⁸, where,

$$\hat{\omega}_T^2 = \hat{\sigma}_{\eta}^2 + 2 \sum_{\tau=1}^T \left(1 - \frac{\tau}{T-1}\right) \hat{\gamma}_{\tau} \quad (8)$$

In order to be sure about results of the tests one can use both ADF and KPSS and then compare the results. If one of the tests accepts, and other rejects the null hypothesis, it means that they both have the same result about stationarity of the time series. If they both accept or reject the null hypothesis, the result is contradictory. (Brooks 2008)

⁷ <http://faculty.washington.edu/ezivot/econ584/notes/unitroot.pdf>

⁸ <http://fedc.wiwi.hu-berlin.de/xplore/ebooks/html/sfe/sfenode53.html>

4.2 Lag length selection

Several ways can be applied to determine proper lag length for VAR model. The main purpose is constructing the VAR model as much unrestricted as possible. Quote from Brooks (2008) says: “A VAR with different lag length for each equation could be viewed as restricted VAR”. So, it is not useful to use F-test for lag length selection, and two alternative ways can be explored; LR test and information criteria. LR test compares restricted model value to unrestricted and determines the lag where the difference is minimal. The main drawback is that it is pairwise procedure, and if your restrictions don't cover the optimal lag the LR result gives no information about lag length. The second drawback is that LR requires assumption for residuals, so that they are normally distributed (Brooks 2008). So the information criteria method is more relevant method to estimate the optimal number of lags for VAR model. This method does not require any distribution of residuals. Information criteria have two main frames to realize the test:

1. It adds additional lags to reduce the sum of squared residuals
2. While adding residuals the degree of freedom increases.

Hence, information criteria methods like Akaike's (1974) information criterion (AIC), Schwarz's Bayesian (1978) information criterion, and Hannan-Quinn information criterion (HQIC) show the optimal lag length where the information criterion is smallest. It is better to put wide limit of lag numbers and see the result, because if one choose very short lag it causes misspecification, and if it is too long the degree of freedom is lost. The best lag length is where AIC and SBC shows lowest values.⁹

4.3 Vector Autoregression Models (VARs)

The vector autoregression (VAR) model is one of the most popular models used for the multivariate time series analysis due to its flexibility and successful forecast capability.¹⁰ This model generalize univariate autoregressive model by capturing interdependencies between time series. All variables included in this model are tested both on own lags and the lags of other variables. So, it is a-theoretical alternative for the structural models.

VAR models were popularized in econometrics by Sims (1980), who advocated non-theoretical way of defining relationships between different time series.

⁹ <http://mimoza.marmara.edu.tr/~ainasel/Lecture6VAR08.pdf>

¹⁰ <http://faculty.washington.edu/ezivot/econ584/notes/varModels.pdf>

4.3.1 Estimation of VAR

This paper employs VAR model where all variables are considered endogenous. The general mathematical expression of VAR can be shown as;

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + \varepsilon_t \quad (9)$$

Where y_t is a k vector of endogenous variables, A_1, \dots, A_p are matrices of coefficients to be estimated, and ε_t is a vector of shocks. Components of ε_t are not correlated either with its own lags, or with the variables on the RHS.

The OLS coefficients for VAR are unbiased, because the RHS variables are lagged values and they are not correlated. Also, errors ε_t may be contemporaneously correlated, it does not violate the efficiency of obtained results. So, the OLS gives the same result as if GLS were applied.¹¹

Main issues related with VAR are to decide which variables should be included and what lag length is the best for implementation of the model. First question is usually solved based on general financial and economical theory. Lag length selection was discussed previously.

4.4 Granger Causality Test

Granger causality test is implemented to identify how much the one factor significant in forecasting the other one (Granger 1969). The results are not coefficients of the real dependence or indicators of the actual causality; rather it is just a sign of existing linear interdependency of one factor on another. The hypothesis is hold only if one factor follows other and initial is potential reason for the follower. However, there can be some exclusions, when theoretically one factor Granger causes the other, but in actual evidence the change driver is something else; exogenous.

4.5 Impulse Responses

Impulse response is the test for identification of the sign and duration of the effect of shock to the endogenous variables. This is the main difference and superiority of impulse responses to F-test, which is only able to identify if one variable in the system can influence significantly the others, while saying nothing about its sign and period (Brooks 2008 pp 298-299).

¹¹ EViews 7 User's Guide

To implement impulse responses the VAR model should be modified into VMA (vector moving average) model in order to see how the shocks die away after N periods. As the shock applied to the error for every single variable from equations and the effects are observed on all other variables, the overall number of noted impulse responses will be N^2 for N variables.

4.6 Variance Decompositions

Variance Decomposition is another way to analyze VAR model results. It distinguishes the part of the information that one variable contributes to others. The whole error term consists of the shock part of the information affected the variable's own lags and the information came from other variables' exogenous shocks, therefore in order to identify the proportion that comes from other variables variance decomposition is used.

5. DATA DESCRIPTION

5.1 Tested Variables

This research uses four macroeconomic factors and Kazakhstan Stock Exchange Index (KASE index) time series as sample data for testing. The macroeconomic factors are used include Consumer price index (CPI), money supply in terms of M2 aggregate, Industrial Production Index (IPI) and Real Exchange rate index (ER) for Kazakh tenge.

The data set covers ten years period from 2000 until 2009 on monthly basis. The more frequent the data the more accurate results can be obtained from model and tests. This was the motivation for taking monthly data. The most part of the data was obtained from DataStream; KASE index has been taken from KASE site.¹² The two conditions are examined with the help of these factors: economic conditions in terms of CPI, M2 and ER, and industrial conditions in terms of IPI.

All macroeconomic variables employed in this paper have been used previously in many papers and below we present short theoretical intuition why we have chosen these factors.

5.1.1 Consumer Price Index

Proxy of inflation

Inflation is one of the sources of macroeconomic uncertainty for stock market. Relationship between general price level and stock prices is negative in most of the cases. Theory also supports this evidence for some reasons. First, inflation increases cost, therefore decreases profits of firms, thus their share prices. DeFina (1991) shows that, costs of the firms increase immediately with inflation, however; the price reflection in output is more slow process (Humpe and Mcmillan 2007). Second, expectation of future inflation is the general source of uncertainty that reduces today's value of future cash flows (Humpe and Mcmillan 2007), thus the value of the firms. But, DeFina (1991) also argues that inflation can also affect share prices positively depending on type of contracts that companies mainly possess. If equities can be considered as hedge for inflation then the sign of relationship with inflation can be positive.

Wongbangpo and Sharma (2002, p.38) found negative relationship between stock prices and CPI in all (ASEAN 5) tested countries. Also works of Fama and Schwert (1977),

¹² http://www.kase.kz/en/index_kase

Chen, Roll and Ross (1986), Nelson (1976) and Jaffe and Mandelker (1976) are examples of researches that concluded negative relation between stock prices and inflation (Maysami 2004).

Consumer price index is chosen as a proxy of inflation in Kazakhstan. It was used in many of previous literature as a proxy of inflation; Wongbangpo and Sharma (2002), Humpe and Macmillan (2007), Tvaronavičienė et al. (2006), Nasseh and Strauss (2000), Muhittin Kaplan (2008) etc.. CPI is employed in this paper was calculated considering 1995 as base year (1995=100).¹³

5.1.2 Money supply

Proxy of monetary policy

Money supply can effects stock market price trends through different ways. Increase in money amount increases ability to invest more in financial securities, thus increase security prices (Maysami 2004). According to Günsel, Chukur 2007, money supply decreases real interest rates, what makes firms to reallocate their investments in order to realize higher return from higher stock prices. Money supply can also positively influence stock prices by motivating real economy growth (Humpe and Mcmillan 2007).

However, there is some argumentation that money supply affects negatively stock prices. First, money supply is the source of inflation which is considered to be in negative interaction (larger discount rate) with stock prices (Fama,1981). Maysami (2004) gives examples of opposite results obtained from previous literature: “Empirically, Hamburger and Kochin (1972) and Kraft and Kraft (1977) found a strong linkage between the two variables, while Cooper (1974) and Nozar and Taylor (1988) found no relation.”

5.1.3 Exchange rate index

Existence of significant relation between exchange rate and stock prices represents the level of openness of the stock market internationally. The direction of relation depends on dominance of import-export volumes in a country (Maysami 2004).

The more integrated economy the larger influence of exchange rates to its stock markets. Businesses of such markets are more sensitive to exchange rate fluctuations, which can significantly change the volume of their cash flows. Thus, exchange rate is considered as valuable macroeconomic factor to test; Chen, Roll and Ross (1986), Maysami and Koh (2000),

¹³ DataStream, notes on methodology

Wongbangpo and Sharma (2002), Mohammad et al. (2009), Maysami et al.(2004), Rjoub et al. (2009). However, in emerging and relatively close markets there is insignificant impact of international risk factors on local market. This paper tests Exchange rate index for Kazakh tenge not the exchange rate based on distinct foreign currency.

5.1.4 Industrial Production Index

Proxy of economic activity

Economic growth affects stock market positively. Economic growth in its turn is the sum of real economic activities that increase the volume of real assets. Industrial production is used as a proxy of economical activity in several researches as Trainer (1993), Fama (1981, 1990), Chen, Roll and Ross (1986), Maysami and Koh (2000), Maysami (2004) hypothesized positive relationship between industrial production and stock market returns.

Industrial production can be considered as a proxy of economic activity at least because of the role it has in general economic growth. Only the oil industry constitutes around 39% of overall GDP. Considering that the most of economic growth comes from oil/ gas industry and mining the industrial production index is a good indicator for real economic growth.

5.1.5 KASE index

KASE share index (the same as KASE index)¹⁴ represents stock market movements. According to methodology of KASE there are some criteria that should be followed while calculating the Index:

- Number of representative shares/stocks should not be less than 7.
- The share can be included in reference list only if it was the topic of not less than 10 contracts (in open trade, in amount of no less than 50 million Kazakh tenge) a months within last six months. No less than 10 members of the Exchange should participate in these contracts during these months.
- Shares can be excluded from the representative list if they stop their turnover. However, if risk committee can show liquidity of these shares it has a right to decide not to exclude them from the list.
- KASE index is calculated n everyday basis, on the basis of the daily representative list in order to reflect the market movements more precisely.

¹⁴ http://www.kase.kz/files/normative_base/indicators_met.pdf, p.3

Numerous papers use firms returns, or industry index to examine the interdependencies between stock market and real economy, however, others employ general market index as in this paper, e.g. Maysami (2004).

5.2 Statistical properties of data time series

Financial time series are usually assumed to be non stationary (Maysami 2004, Nasseh and Strauss 2000). Also macrovariables can follow different distributions, so all data are tested and analyzed initially. **Table 5** gives the summary picture of the main statistical properties of involved factors.

It is observable that all variables have kurtosis different than 3 so, the distributions are not normal. Also positive skewness is observed for all variables, except IPI which means that they are longer in right tail. IPI is longer in left tail. All variables are asymmetric. According to Jarque Bera test probabilities, the null hypothesis about normal distribution is rejected for all variables, except IPI. IPI is the only variable with smallest excess kurtosis and smallest skewness which makes it closer to normal distribution.

Table 5. Summary of time series statistics

	CPI	EXRATE	IPI	M2	KASE_INDEX
Mean	265,28	100,09	107,27	1876911	888,98
Median	247,91	99,29	108,32	1283456	232,53
Maximum	389,62	125,19	121,89	5108413	2875,86
Minimum	180,59	87,12	92,15	249941	98,16
Std. Dev.	64,32	7,64	5,04	1586645	961,45
Skewness	0,62	0,73	-0,38	0,63	0,82
Kurtosis	2,10	3,61	3,33	1,85	2,07
Jarque- Bera*	11,30	12,06	3,38	13,73	17,13
Probability	0,00351	0,002401	0,183981	0,001042	0,00019

*5% of significance level

5.3 Correlation matrix

Group statistics for 5 variables are implemented and correlation matrix results are shown in **Table 6**. Very weak correlation is observed among macrovariables, however; the correlation is not enough to make conclusion about interdependencies among variables, so the further empirical tests are realized in following chapters.

Table 6. Correlation matrix of time series

	DLOGCPI_SA	DLOGEXR_SA	DLOGIP_SA	DLOGKASE_SA	DLOGM2_SA
DLOGCPI_SA	1				
DLOGEXR_SA	0,10	1			
DLOGIP_SA	0,05	0,09	1		
DLOGKASE_SA	0,08	0,06	0,03	1	
DLOGM2_SA	-0,13	0,08	0,07	0,08	1

The small correlation rejects assumptions about multicollinearity of the variables; all of them can be included in VAR model as independent factors.

5.4 Data transformation

Time series observed on monthly or quarterly basis usually show cycling. Some data can have pick points in distinct months.¹⁵ That is why many statistics agencies uses different methods to adjust data seasonally, i.e. omit monthly trend of time series in order to observe fundamental changes over long period. E-views apply X12 method to exclude cyclical seasonal effect from data. Before testing variables all of them were seasonally adjusted, because the methodology used for macroeconomic data show no seasonal adjustment.¹⁶

KASE index was adjusted seasonally, because the average was taken to transform daily data into monthly, thus some information could be generalized.

Time series of macrovariables and KASE index were transformed in log values, and then differentiated. Taking logs and differences was important in order to obtain stationary time series. This excludes “permanent component of the data, and therefore avoids the complications associated with unit roots and spurious regressions” as explained in (Nasseh and Straus 2000). Stationarity condition is also important for implementation of joint significance tests and estimation of VAR model.

¹⁵ E views 6 Guidel.pdf p. 339

¹⁶ DataStream

6. METHODOLOGY AND EMPIRICAL RESULTS

This chapter contains methodology and discussions on previously described empirical tests and models representing results obtained after implementation. All related tests and VAR models are generated in EViews program.

6.1 Testing for unit root and stationarity.

Stationarity is unavoidable prerequisite for VAR model implementation. Thus, we tested all involved time series for unit root and stationarity. As mentioned before all data was seasonally adjusted and then tested for unit root. All five variables (CPI, Exchange rate, Industrial Production index, M2, and KASE index) showed non stationarity for all three tests; ADF, PP and KPSS in 1% and 5% significance level. Unit root and stationarity tests for initially given data are presented in **Table 7**.

Table 7 .Unit root and stationarity tests

Unit root & stationarity Tests	ADF(1%)	ADF(5%)	PP(1%)	PP(5%)	KPSS(1%)	KPSS(5%)
Variables /Critical values	-3.48	-2.88	-3.48	-2.88	0.73	0.46
CPI	1,42		2,05		1,18	
Exchange rate index	-1,50		-1,68		0,65	
Industrial Production index	-3,12		-3,08		0,97	
Money supply (M2)	3,17		2,47		1,16	
KASE index	-1,13		-1,08		0,82	

Null hypothesis for ADF cannot be rejected both in 1% and 5% significance level for CPI, Exchange rate and KASE index time series, however; for Industrial production index and M2 the null hypothesis is accepted in 1% significance level. PP null hypothesis is accepted for both significance levels for all variables except IP index. KPSS null hypothesis about stationarity of data is rejected for all variables at 1% significance level, however for 5% significance level cannot be rejected only for Exchange rate.

It is obvious that the time series of tested variables are not stationary, therefore need to be transformed. First, the log values of variables were taken in order to omit non stationarity,

but the data showed non stationarity again. So, differences were taken from all the variables. The unit root and stationarity tests for transformed data (dlog) are presented in **Table 8**.

Table 8. Unit root and stationarity tests for transformed data

Unit root & stationarity tests	ADF(1%)	ADF(5%)	PP(1%)	PP(5%)	KPSS(1%)	KPSS(5%)
Critical values/variables	-3.48	-2.88	-3.48	-2.88	0.73	0.46
CPI	-4.17		-3.93		0.25	
Exchange rate index	-10.31		-10.38		0.12	
Industrial Production index	-10.92		-15.57		0.27	
Money supply (M2)	-10.72		-11.04		0.17	
KASE index	-4.60		-4.77		0.12	

All data demonstrates stationarity for KPSS at both significance level, and rejects null hypothesis of having unit root for ADF and PP.

6.2 Lag length selection

As mentioned before in this paper, Information criteria method is the optimal way to identify the proper lag length for VAR model. **Table 9** demonstrates the information criteria tests results for transformed variables. We can rely on information criteria as all three tests (AIC, SC and HQ) get the minimal value at lag 1. LR test shows lag 9 as the optimal, but it is not sufficient according to previously discussed problems related with this test.

Table 9. Lag length

Lag	LogL	LR	AIC	SC	HQ
0	1127.761	NA	-22.68204	-22.55097	-22.62901
1	1212.300	158.8315	-23.88485*	-23.09845*	-23.56668*
2	1230.693	32.69817	-23.75137	-22.30964	-23.16805
3	1247.375	27.97245	-23.58334	-21.48627	-22.73486
4	1278.832	49.56819	-23.71378	-20.96138	-22.60015
5	1294.924	23.73168	-23.53382	-20.12609	-22.15505
6	1312.726	24.45494	-23.38840	-19.32534	-21.74448
7	1331.570	23.98376	-23.26405	-18.54565	-21.35497

8	1357.939	30.89613	-23.29169	-17.91795	-21.11747
9	1399.334	44.32295*	-23.62292	-17.59385	-21.18355
10	1420.731	20.74835	-23.55013	-16.86573	-20.84561

As all variables are considered to be endogenous in VAR model first lag is taken is zero. So, estimate VAR (1).

6.3 VAR Model

The VAR model is applied to transformed data. We use 5 variables so there is 5 equations in the model, where every variable is considered to be endogenous and depend both on its own and other variables' lags. The paper implements VAR(1) as mentioned before, as a result of previously applied tests. Every variable has a linear dependence on its own and all other variables lags. That is no simultaneous relationship is analyzed in such model. Equations obtained from Eviews application are represented in **Appendix Table 1**. From this table we see that the variables are dependent on one past lag, consistent with the previously lag length selection results. The error terms in all equations are assumed to be uncorrelated. Every equation then is estimated by OLS.¹⁷

Estimation output of the model is presented in **Table 10**.

Table 10. VAR Estimation output

Vector Autoregression Estimates					
Sample (adjusted): 2000M09 2009M12					
Included observations: 112 after adjustments					
Standard errors in () & t-statistics in []					
	DLOGCPI_ SA	DLOGEXR_ SA	DLOGIP_ SA	DLOGM2_ SA	DLOGKASE_ SA
DLOGCPI_SA(-1)	0.728161 (0.06831) [10.6603]	0.519051 (0.40771) [1.27309]	0.378652 (0.51804) [0.73093]	-1.082609 (0.66434) [-1.62960]	0.047751 (1.41389) [0.03377]
DLOGEXR_SA(-1)	-0.016201 (0.01624) [-0.99774]	-0.004966 (0.09692) [-0.05124]	-0.120845 (0.12315) [-0.98130]	0.169608 (0.15793) [1.07398]	-0.707286 (0.33611) [-2.10436]
DLOGIP_SA(-1)	-0.005423 (0.01228) [-0.44159]	0.008653 (0.07330) [0.11804]	-0.045376 (0.09314) [-0.48718]	-0.103689 (0.11944) [-0.86811]	-0.291119 (0.25420) [-1.14522]
DLOGM2_SA(-1)	-0.006065	0.081214	-0.030626	-0.051957	-0.008553

¹⁷ http://faculty.washington.edu/ezivot/econ584/stck_watson_var.pdf

	(0.00997)	(0.05952)	(0.07562)	(0.09698)	(0.20639)
	[-0.60830]	[1.36460]	[-0.40500]	[-0.53577]	[-0.04144]
DLOGKASE_SA(1)	-0.000288	-0.003929	0.080979	0.026644	0.689221
	(0.00339)	(0.02021)	(0.02567)	(0.03293)	(0.07007)
	[-0.08496]	[-0.19443]	[3.15409]	[0.80924]	[9.83579]
C	0.001989	-0.006025	-0.004010	0.034649	0.008011
	(0.00065)	(0.00390)	(0.00496)	(0.00636)	(0.01353)
	[3.04223]	[-1.54391]	[-0.80870]	[5.44912]	[0.59193]

The coefficients from the model are insignificant and only Exchange rate index can be considered as significant factor in 5% interval that has some impact on KASE index. Industrial production and the stock market also have some interactions that can be considered significant in larger significance levels.

6.4 Residuals Correlation

VAR(1) model implemented in this paper can be called “reduced form” model, because we identified interdependencies between one variable and others lag values, and not the simultaneous relationship (Juselius 2006). **Table 11** gives results of residual correlation matrix from tested variables. The correlations coefficients are presented in the table are calculated in traditional form;

$$\hat{\rho}_{ij} = \frac{\hat{\sigma}_{ij}}{\sqrt{\hat{\sigma}_{ii}\hat{\sigma}_{jj}}} \quad (10)$$

Table 11. Residuals’ correlation (from VAR model)

	DLOGCPI_SA	DLOGEXR_SA	DLOGIP_SA	DLOGM2_SA	DLOGKASE_SA
DLOGCPI_SA	1				
DLOGEXR_SA	0.05	1			
DLOGIP_SA	-0.01	0.10	1		
DLOGM2_SA	-0.04	0.11	0.08	1	
DLOGKASE_SA	0.10	0.09	-0.26	0.06	1

Residuals correlation analysis can be helpful before implementing impulse responses and variance decomposition because, more residuals from the model are correlated, more the influence of the ordering on the results of tests (Brooks 2008). The table shows week correlation among residuals so we rely on economical and financial theory to order the

variables. Paper examines two ordering types, but no drastic difference between results are observed. This will be clear in following parts about impulse response and variance decomposition test.

The first test is implemented for the alternative analyze of the interactions is Granger causality test.

6.5 Granger Causality Test

Granger (1969) argued that if time series X Granger causes Y, then X can be used to forecast Y (Sundaram 2009). In this case X can be considered as just linear predictor; some variable which gives additional information about some future value of Y. Granger Causality is not real causality as one can imagine, so it is difficult to interpret such a relationship. This kind of causality is only reasonable if X comes before Y, however in reality both factors can be caused by some third factor even if we see a Granger causality between them.¹⁸ Usually the mutual causality is observed which is also difficult to interpret.

As the transformed data is stationary I(0), Granger causality test is performed in following equations:

$$X_t = \alpha_1 + \beta_{11}X_{t-1} + \beta_{12}X_{t-2} + \dots + \beta_{1n}X_{t-n} + \gamma_{11}Y_{t-1} + \dots + \gamma_{1n}Y_{t-n} + \varepsilon_{1,t} \quad (11)$$

$$Y_t = \alpha_2 + \beta_{21}Y_{t-1} + \beta_{22}Y_{t-2} + \dots + \beta_{2n}Y_{t-n} + \gamma_{21}X_{t-1} + \dots + \gamma_{2n}X_{t-n} + \varepsilon_{2,t} \quad (12)$$

Implementation of Granger causality test for lag length 1 shows that there is very few number of Granger causes at 5% of significance level. **Table 12** Gives the results of the test estimated by eviews.

Table 12. Granger Causality test based on VAR model

Dpendent variable	Excluded variable: F-statistics				
	<i>KASE_Index</i>	<i>CPI</i>	<i>EXR</i>	<i>M2</i>	<i>IP</i>
<i>KASE_Index</i>	NA	0.001	4.42*	0.001	1.31
<i>CPI</i>	0.007	NA	NA	NA	NA
<i>EXR</i>	0.03	NA	NA	NA	NA
<i>M2</i>	0.65	NA	NA	NA	NA
<i>IP</i>	9.94*	NA	NA	NA	NA

Note: (*) means that null hypothesis no causality is rejected at 5% of significance level.

¹⁸ http://www.uh.edu/~bsorense/gra_caus.pdf

The only factor which Granger causes KASE index at 5% of significance level is Exchange rate index.

6.6 Impulse Responses

In this paper impulse response is considered as a function which identifies the influence of introduced innovations to macrovariables on stock market prices. If the time series are stationary the shock effect will die after some periods, i.e. become zero.

Impulse responses is implemented in e-views, where we chose the format of output (table or graph), method of deriving the error terms which represent the innovations that influence its own variable and others as well. Also, we determine the number of periods we are interested to test, where we chose 10 periods ahead. The default form of test in Eviews suggests Cholesky method, which defines ordering for variables and the whole effect obtained from common components goes to the variable one puts first.¹⁹ We chose to put KASE index first as it is our prior interest to identify response loading on stock market. Some papers as Naka and Tufte (1997), Wongbangpo and Sharma (2002) are based on the same logic. The results from Impulse response are presented in **Table 13a** and **13b**.

Table 13a. Impulse response analysis:

<i>Responses of stock market index to innovations in macrovariables:</i>					
<i>Periods</i>	<i>DLOGKASE_SA</i>	<i>DLOGCPI_SA</i>	<i>DLOGEXR_SA</i>	<i>DLOGIP_SA</i>	<i>DLOGM2_SA</i>
1	0,067	0,0076	0,0059	-0,0195	0,0047
5	0,0131	-0,0005	-0,0028	-0,0058	-0,0001
10	0,0016	-0,0005	-0,0002	-0,0007	0

Table 13b. Impulse response analysis:

<i>Responses of macrovariables to stock market innovations:</i>				
<i>Periods</i>	<i>DLOGCPI_SA</i>	<i>DLOGEXR_SA</i>	<i>DLOGIP_SA</i>	<i>DLOGM2_SA</i>
1	0	0	0	0
5	-7,59E-05	-5,85E-05	0,0014	0,0003
10	-3,03E-05	-1,94E-05	0,0001	7,11E-05

As it was in Granger causality analysis, here we demonstrate only the responses of KASE index to macrovariables and *vice versa*. The interactions among macrovariables themselves are not the topic of interest.

¹⁹ http://coin.wne.uw.edu.pl/pwojcik/macroeconometrics/03/3_var.pdf

Tables show that KASE index responses positively to innovations in its own lags and in some first periods of influence to the shocks in Exchange rate and CPI, however; changes in negative response after some periods. Economical explanation to this evidence can be as following; when tenge (national currency in Kazakhstan) deflates the exports are motivated and the Kazakh industry is mainly mining export which is also motivated, consequently the expectations of future cash flows of such companies' increases which in its turn push up the share prices. Considering that the KASE index is used in this paper is calculated on the basis of mainly traded company shares (representative list)²⁰ and these companies are usually large mining companies and banks, the result is understandable for the given conditions.

The story with CPI is different. Positive response at first periods to CPI innovations is probably reasoned by the high cash flows related with price increases, however; rise of CPI in the future increases the expectation of inflation which influence the share prices negatively. Inflation is the prediction of lower real cash flows that pushes down the share prices.

The impulse responses of KASE index to the shock in Industrial Production (IP) is negative. This can be subject to the expectations. Expectations are the main factor formulating the share and bond prices in market. If the real economic activity exceeds the expectations the bond prices go down, as well as share prices can fall.²¹ The irrational expectations can be reasoned by information asymmetry and market inefficiency in Kazakhstan.

Mutual interactions between KASE index and M2 are very weak.

All impulse responses are dying away after some periods due to the stationarity of all time series included in analysis.

6.7 Variance Decomposition

The same order is applied to realize variance decomposition test. The ordering is important for variance decomposition and impulse responses and the results change due to the order changes as much as residuals correlated (Brooks 2008). The **Appendix; Table 2a and 2b** comparing with below presented **Table 14a and 14b** demonstrates the result changes when we put the variables in inverse order. As the results does not change drastically, and based on our correlation tests, we refer this fact to the low correlation in residuals from VAR(1) model.

²⁰ http://www.kase.kz/ru/index_kase

²¹ http://www.schwab.com/public/schwab/research_strategies/market_insight/1/4/schwab_guide_to_economic_indicators_industrial_production_and_capacity_utilization.html

Variance decomposition results are consistent with impulse responses and causality tests; very small amount of variances in forecasted errors of KASE index can be explained by macrovariables. The relatively influential variables are considered to be EXR and IP, which are not themselves significant to explain stock prices within given case. However; as it was in impulse responses results, KASE index influence internal macrovariables to some extent. This can be explained as the main players in KASE market at the same time are the main actors of the domestic economy, but not influenced a lot by the internal conditions themselves. Again the resource dependent industry story is coming to the scene.

We can observe in **Table 14a** and **14b** that the impact of all variables on stock market is trivial; however we cannot argue the same about inverse influence.

Table 14a. Variance decomposition analysis

<i>Forecast error variance of stock market index</i>					
<i>Periods</i>	<i>DLOGKASE_SA</i>	<i>DLOGCPI_SA</i>	<i>DLOGEXR_SA</i>	<i>DLOGIP_SA</i>	<i>DLOGM2_SA</i>
1	100	0	0	0	0
5	94,77	0,13	3,96	0,90	0,22
10	94,62	0,21	4,02	0,91	0,22

Table 14b. Variance decomposition analysis

<i>Forecast error variance of macrovariables</i>				
<i>Periods</i>	<i>DLOGCPI_SA</i>	<i>DLOGEXR_SA</i>	<i>DLOGIP_SA</i>	<i>DLOGM2_SA</i>
1	1,11	0,94	6,87	0,45
5	0,82	0,92	13,84	0,97
10	0,79	0,92	14,05	0,97

Note: Cholesky Ordering: DLOGKASE_SA DLOGM2_SA DLOGCPI_SA DLOGEXR_SA DLOGIP_SA

7. CONCLUSION AND FURTHER ANALISYS

This paper as a contribution and a platform for further analysis examines the potential interactions among macroeconomic factors in terms of CPI, M2, IP, and EXR and stock market index (KASE Index) in Kazakhstan. Real economy influence on stock market is intuitively obvious evidence, because the main value drivers for companies are affected by macroeconomic variables. However, if market is not efficient enough it is difficult to observe the price reflection of macrovariables' impact on stock market.

Kazakhstan stock market prices, which are the object to testing, are weakly correlated to real economic factors as the empirical results show. From VAR model we conclude that the only variable that contains empirically significant information about stock prices in Kazakhstan is exchange rate. The Granger causality, impulse response and variance decomposition tests also support the same result, as a logical addition to the VAR model. Impulse responses and variance decomposition are sensitive to ordering, however; in our case ordering does not drastically influence the results. Such a weak explanatory power of variables can be explained by some reasons such as inefficiency of the market reflected in information asymmetry, irrationality of investors, and more powerful external influence to the market relatively to internal factors.

The insignificant relationship can be also due to the fact that the paper analyzed the total market index rather than industrial indexes or independent firm indexes. As mentioned before, KASE index is calculated on the basis of representative firms which are usually large oil/gas industry representatives or firms from banking sector. The oil industry itself is more related to the external economy than internal, so the only variable presented the external factors seems to be more significant in explanation of share prices of this firms, i.e. KASE index.

The affect of KASE index on IP is also an evidence of interest. KASE index lags have powerful influence in explanation of IP movements. The impulse responses of KASE to IP is negative in contrast with many papers mentioned before in this paper, and this can be explained by expectations; the higher growth in industry than expectations of growth can lower the stock prices.

For further analysis it would be interesting to test whether Kazakhstan separate firms has good interactions with real economy or not. This can help to distinguish the efficiency level of Kazakh stock market, as well as give some key signals for policy makers.

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APPENDIX

Table 1. Equations of VAR (1)

VAR Model

$$\text{DLOGCPI_SA} = C(1,1)*\text{DLOGCPI_SA}(-1) + C(1,2)*\text{DLOGEXR_SA}(-1) + C(1,3)*\text{DLOGIP_SA}(-1) \\ + C(1,4)*\text{DLOGM2_SA}(-1) + C(1,5)*\text{DLOGKASE_SA}(-1) + C(1,6)$$

$$\text{DLOGEXR_SA} = C(2,1)*\text{DLOGCPI_SA}(-1) + C(2,2)*\text{DLOGEXR_SA}(-1) + C(2,3)*\text{DLOGIP_SA}(-1) \\ + C(2,4)*\text{DLOGM2_SA}(-1) + C(2,5)*\text{DLOGKASE_SA}(-1) + C(2,6)$$

$$\text{DLOGIP_SA} = C(3,1)*\text{DLOGCPI_SA}(-1) + C(3,2)*\text{DLOGEXR_SA}(-1) + C(3,3)*\text{DLOGIP_SA}(-1) \\ + C(3,4)*\text{DLOGM2_SA}(-1) + C(3,5)*\text{DLOGKASE_SA}(-1) + C(3,6)$$

$$\text{DLOGM2_SA} = C(4,1)*\text{DLOGCPI_SA}(-1) + C(4,2)*\text{DLOGEXR_SA}(-1) + C(4,3)*\text{DLOGIP_SA}(-1) \\ + C(4,4)*\text{DLOGM2_SA}(-1) + C(4,5)*\text{DLOGKASE_SA}(-1) + C(4,6)$$

$$\text{DLOGKASE_SA} = C(5,1)*\text{DLOGCPI_SA}(-1) + C(5,2)*\text{DLOGEXR_SA}(-1) + C(5,3)*\text{DLOGIP_SA}(-1) \\ + C(5,4)*\text{DLOGM2_SA}(-1) + C(5,5)*\text{DLOGKASE_SA}(-1) + C(5,6)$$

Figure 1. Impulse Responses

Response to Cholesky One S.D. Innovations ± 2 S.E.

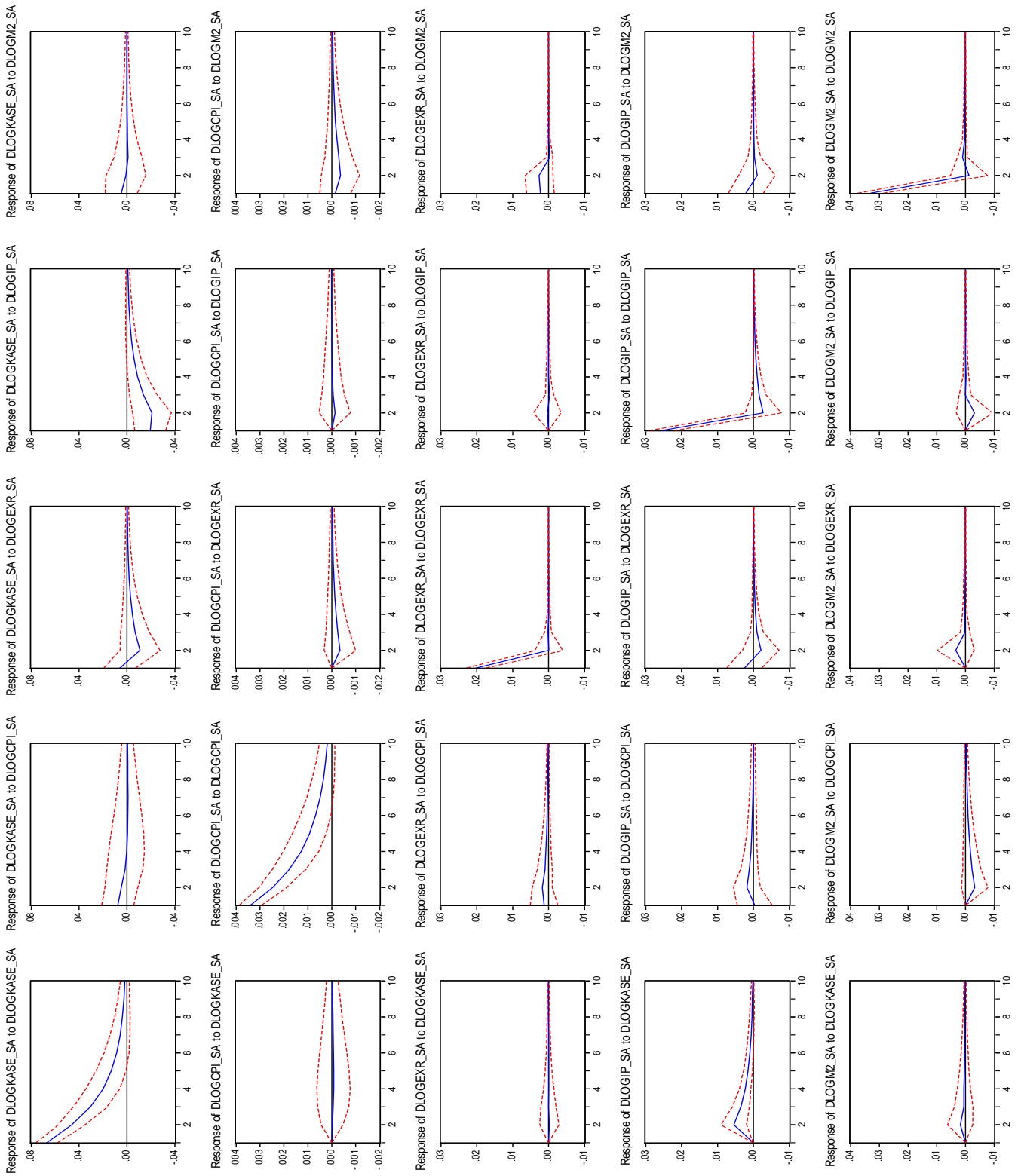


Figure 2. Variance Decomposition

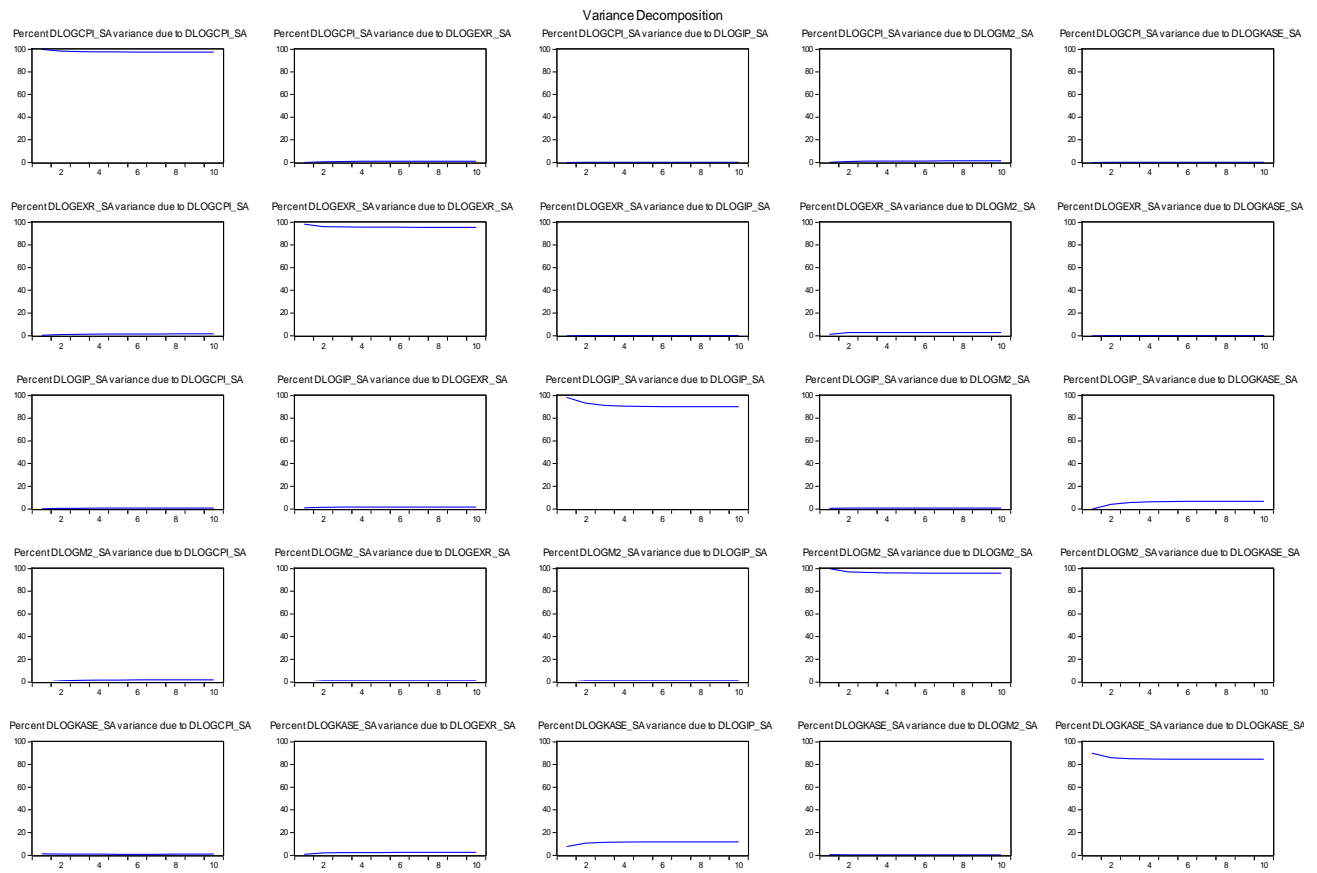


Table 2a. Forecast error decomposition of macroeconomic variables

<i>Forecast error variance of stock market index explained by innovations in macrovariables</i>					
<i>Periods</i>	<i>DLOGKASE_SA</i>	<i>DLOGCPI_SA</i>	<i>DLOGEXR_SA</i>	<i>DLOGIP_SA</i>	<i>DLOGM2_SA</i>
1	90,02484	1,182327	0,703491	7,630386	0,458955
5	84,74298	0,876584	2,416722	11,7059	0,257818
10	84,65543	0,891246	2,433147	11,76657	0,25361

Table 2b. Forecast error decomposition of KASE index

<i>Forecast error variance of macrovariables explained by KASE index</i>				
<i>Periods</i>	<i>DLOGCPI_SA</i>	<i>DLOGEXR_SA</i>	<i>DLOGIP_SA</i>	<i>DLOGM2_SA</i>
1	0	0	0	0
5	0,067173	0,018455	6,570306	0,33504
10	0,115556	0,01989	6,766251	0,34569

Note: Cholesky Ordering: DLOGM2_SA DLOGCPI_SA DLOGEXR_SA DLOGIP_SA DLOGKASE_SA

