



# Information response model of the national financial market in the conditions of transformation of the world monetary and financial systems

## Modelo de respuesta de información sobre el mercado financiero nacional en las condiciones de transformación del sistema monetario y financiero internacional

SOKOLOVA, Elizaveta S. [1](#); EGOROVA, Larisa I. [2](#) & KAZAKOVA, Nataliya A. [3](#)

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#### ABSTRACT:

The national financial system is deeply affected by a number of factors, information being one of the most influential of them. The mechanism of information spreading has changed a lot, involving more and more participants and leading to a point, when traditional evaluation models lack explanatory power. The authors have developed a model of estimation of external shocks and influence of media coverage on this response. The model is tested and proved to be adequate on the case of Brexit.

**Keywords:** financial market, world finance, econometrics, modeling

#### RESUMEN:

El sistema financiero nacional está profundamente afectado por una serie de factores, y la información es uno de los más influyentes. El mecanismo de difusión de información ha cambiado mucho, involucrando a más y más participantes y llevando a un punto en el que los modelos de evaluación tradicionales carecen de poder explicativo. Los autores han desarrollado un modelo de estimación de choques externos e influencia de la cobertura de los medios sobre este tipo de respuesta. El modelo está probado y se demostró que es adecuado en el caso de Brexit.

**Palabras clave:** mercado financiero, finanzas internacionales, econometría, simulación

## 1. Introduction

Effective strategies for developing the financial market in the modern economy rely not only on regulatory and organizational aspects, but also on econometric modeling. Econometric modeling allows giving a quantitative assessment of the degree of mutual influence of the financial market and the growth rates of the country's economy using integrated indicators. Integral indicators can be considered as a description of the patterns of mutual influences of

groups of indicators that describe the economic state of a particular sector of the national financial market, taking into account external and internal factors.

For example,

1. for the factors of the Russian foreign exchange market: the volume of the Russian foreign exchange market (exchange and over-the-counter segments), the share of currency transactions on the Moscow stock exchange, the share of SWAP operations in the structure of the foreign exchange market, the volume of international reserves, the volatility of the ruble exchange rate, the outflow of foreign exchange financial assets abroad;
2. for factors affecting the debt segment of the Russian financial sector: the underdevelopment of the domestic public debt market (dominance of bank loans), the use of potential additional sources of temporarily idle funds, the use of new debt instruments, the expansion of the range of possible bond issues for the issue, the liberalization of the Russian market state debt securities, complex external geopolitical and economic conditions, the integration of the Russian market for a long time securities in the global debt market (the presence of foreign investors in the domestic market), the activities of Russian borrowers in the international debt market, the disorderly legal framework regulating the activities of professional participants in the Russian debt securities market, the large costs of participants in the Russian bond market for finding and processing information related to the preparation of transactions in the Russian debt securities market, and accessibility of services of the settlement and accounting infrastructure of the Russian debt securities market (clearing companies, depositories, registrars and etc);
3. for banking sector factors: the amount of net lending to the rest of the world, the contribution of banks to the formation of a net international investment position, the difference in rates between the national and international money market, the availability of the international capital market, the level of sovereign risks, the share of foreign assets in the structure of bank assets, the share of foreign currency liabilities in the structure of the bank's liabilities, the size of the net foreign assets of banks, restrictive measures to attract foreign capital on the international market, the share of short-term and over short-term external debt in total borrowings, the level of interconnection of external assets and liabilities by maturity, the level of interconnection of external assets and liabilities by currencies.

## **1.1. Literature review**

A lot of papers tried to quantify the impact of information on financial markets: in one of them, Mark L. Mitchell and J. Harold Mulherin (1994) analyze the number of daily Dow Jones news and associate these to trading volume and stock market returns. Majority of the studies between 1970 and the early 2000s used rough and unprocessed proxies to quantify information, such as a simple count of the number of news. It was for the first time when Werner Antweiler and Murray Z. Frank (2004) attempted to programmatically quantify the content of information. They used the Yahoo! Finance and the Ragingbull.com online message boards. Lily Fang and Joel Peress (2009) use major US newspapers articles provided by the LexisNexis platform. Paul C. Tetlock, Maytal Saar-Tsechansky and Sofus Macskassy (2008) in their research used the Dow Jones Factiva database.

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## **2. Methodology**

To build an integrated model for the sectoral development of the national financial market, we used the following methods: expert assessments, consisting of expert ranking, expert ranking of alternative factors, expert forecasting; a priori methods that consist in determining the integral index and its value, as well as the signs and values of the coefficients for variables based on theoretical hypotheses about the essence of the economic phenomenon or process being studied; factor analysis, the application of which was associated with certain problems, in particular with the difficulties of accurately quantifying the majority of factors affecting the sectors of the national financial market (Cheong and Zurbruegg, 2016). The use of such diverse methods of constructing an integrated model has

created the need to develop a methodological concept for constructing an integral indicator. The essence of this concept is as follows:

1. Development of a system of indicators (a system of variables) describing the sectoral model of the national financial market.
2. Determining the comparability of the indicators included in the integral model.
3. Formal way of describing the dependence of variables, coefficients and random deviations.
4. Description of the system of the weight coefficients of variables for the estimation of the integral model. The model has applied practical importance, quantitatively characterizing the financial market of the country as a factor stimulating the development of the economy. The system of variables can be significantly expanded, which will provide an opportunity to obtain a more accurate assessment of the influence of segments of the national financial market on the growth of the country's economy. The model can be supplemented with coefficients that characterize the specific features of the development of each sector, as well as external and internal factors affecting the sectoral development of the financial market. The inclusion of indicators in a system describing the functioning of the sectors of the national financial market is carried out on the basis of theoretical criteria and practical results.

Theoretical criteria include the following:

1. the degree of the significance of the factor characterized by the indicator in the expert ranking system;
2. sufficient degree of formalization of the process under consideration in a certain sector of the national financial market;
3. the degree of use of the indicator in the national financial market.

Practical criteria include criteria that characterize the quality of information:

1. relevance, i.e. the significant impact of the indicator on the strategy development of the financial market sector through the evaluation of past, present and future events;
2. reliability, i.e. absence of significant errors and distortions;
3. timeliness and comparability in time.

The sectoral model of the national financial market is considered in terms of analysis of three sectors: banking, stock and currency. In this connection, the system of indicators describing the integral sectoral model of the national financial market consists of the following groups:

1. indicators characterizing the development of the banking sector of the financial market;
2. indicators characterizing the development of the stock sector;
3. indicators characterizing the development of the currency sector.

The model is developed on the basis of models that can include variables that describe the actual process of functioning of the financial market, which takes into account its sectoral structure (Gallemore and Labro, 2015). The basic model, which describes the development of financial market sectors, will be the model of Robert E. Lucas Jr (1988), modified to realize the purpose of this study.

The model describes the dependence of the growth rate of the country's economy  $X$  ( $Y$ ) on changes in the financial market (Equation 1):

$$X(Y) = F(A_i)^\delta F(D)^s, \quad (1)$$

Where  $A_i$  is the variable characterizing the level of development of the financial market sector;  $D$  is a variable that adversely affects the level of development of the financial market;  $\delta$  and  $s$  are coefficients of elasticity of the influence of variables on the financial market (Maiga, Nilsson and Ax, 2015).

The determining argument for the application of the model was the fact that it describes the dependence of one indicator on the system of indicators characterizing the degree of

development of individual sectors. At the same time, the model will allow considering how the influence of each segment of the financial market on the financial market as a whole, as well as the interrelations between the segments themselves.

The constructed model of the functioning of the financial market should quantitatively describe the changes in the level of development of the financial market and the economic development of the country as a whole (Roberts, 2015).

However, when using the theoretical model of Lucas (1988), there is a significant drawback: the model does not take into account the variables that characterize the specific features of the development of each segment of the financial market, which in future can lead to significant distortion of the results.

The general view of the model describing the influence of the development of the financial market sectors on the financial market is as follows (Equation 2):

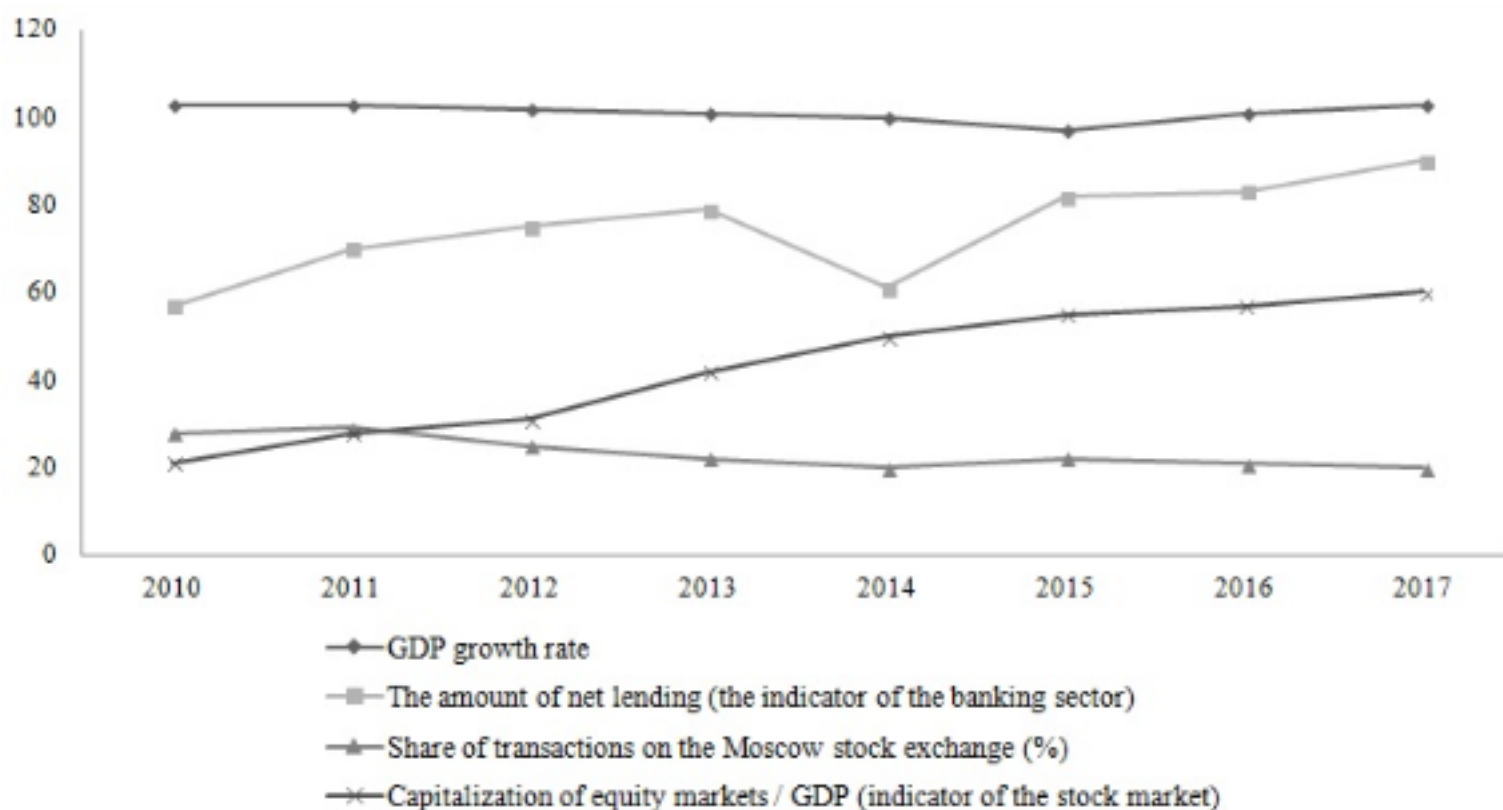
$$X(Y)_t = (B_i)^\alpha (F)^\beta (S)^\varphi \varepsilon_t, \quad (2)$$

where  $X(Y)_t$  is an indicator characterizing the growth rate of the volume of the financial market in year  $t$ ;  $B_i$ ,  $F_i$ , and  $S_i$  are the variables characterizing the development of the banking, stock and currency sectors of the financial market, respectively, at time  $t$ ;  $\alpha$ ,  $\beta$ , and  $\varphi$  are the elasticity coefficients of the relevant sector of the financial market;  $\varepsilon_t$  is a random error.

The empirical evaluation of the model on the example of indicators of the Russian financial market was carry out in several stages: the collection of data from various sources; data processing using an integrated model of sectoral development of the financial market; analysis of the results obtained (Crinò and Ogliari, 2017).

Information source of econometric analysis are data of the World Bank (2019); International Financial Statistics (IFS), Financial Soundness Indicators (FSIs) of the International Monetary Fund (2019a, 2019b). The period for which the data was evaluate covers the period 2010-2017. The results of the model evaluation indicate the existence of a nonlinear nature of the dependence of the change in the volume of the financial market on the volumes of the financial market sectors.

**Figure 1**  
Schedule of changes in the indicators of sectors of individual sectors of the financial market and GDP



Source: Authors' calculations

Analysis of the prospects for the development of the national financial market assumes the calculation of the forecast indicators, supplemented by the scenario component. For this, an

evolutionary-simulative model is used, which includes indicators characterizing the development of the sectors of the national financial market: banking, stock, currency, and debt taking into account the impact of the global financial system. Each indicator reflects the degree of influence of a particular sector on the financial market of the country as a whole. Its estimate is a weighted value, taking into account the impact of the entire complex of the most significant factors on the segment under study. The degree of influence of each factor is estimated by an expert, the values obtained are ranked by significance level.

### 3. Results

To construct our model, OLS estimation with extensions were used. To measure response in the financial market FTSE100 daily closing figures were used. Table 1 below gives descriptive statistics of the sample.

**Table 1**  
FTSE 100 Index Statistics

	<b>FTSE_100</b>
Mean	7101.771
Median	7217.586
Maximum	7877.446
Minimum	5923.530
Std. Dev.	361.872
Skewness	-0.190245
Kurtosis	1.779482

Source: Authors' calculations

Return function will be described as following (Equation 3).

$$Return_t = \ln \frac{Price_t}{Price_{t-1}} \quad (3)$$

Also, stationarity of return function is significantly important, using Augmented Dickey – Fuller test, return function was found to be stationary at 5% significance levels. For the analysis of media coverage machine algorithms were used. Automatic bot gathered daily news articles, online social media posts. Also, text analysis techniques were used to determine overall rhetoric of the article as positive, negative or neutral. By combining all parameters, we obtained following basic model (Equation 4).

$$Return_t = \alpha + \beta_1 Media_t + \beta_2 Rhetoric_t + \beta_3 Factors_t + \varepsilon_t, \quad (4)$$

Where  $Media_t$  is articles,  $Rhetoric_t$  is attitude towards news,  $Factors_t$  is all other conventional fundamental parameters affecting returns and  $\varepsilon_t$  is White standard error.

#### 3.1. Media

Various online news articles and social media posts were used to gather data on coverage. To exclude articles not related to the theme threshold for minimum usage of the word

“Brexit” were set, as 5 for the news articles and 1 for the social media platform. As social media platform twitter was chosen as it is mainly text platform and could be easily analyzed in terms of opinion or volume of readers. For every tweet data on followers and number of retweets were gathered. As for online news articles volume of their auditory were determined by the number of people who read the article, it may be not the most accurate criteria as some people may open article web page but do not read it, but it is still good enough proxy to estimate auditory. If data on the number of online page visits were not available, then this article was excluded from the sample.

### 3.2. Rhetoric

To determine article opinion on the matter words analysis technique were used. Each online article was assigned category as “positive”, “negative” or “neutral” depending on certain word usage. For twitter different algorithm were used to determine rhetoric, as twits are limited to only 140 characters, also some tweets were linked to retweets and replies to determine their opinion.

### 3.3. Model Extensions

Different models with various extensions to basic model were used. First simple autoregressive return model was estimated (Equation 5).

$$Return_t = \alpha + \beta_1 Return_{t-1} + \beta_2 TradingVolume_{t-1} + \beta_3 Residuals_{t-1} + \beta_4 Factors_t + \varepsilon_t \quad (5)$$

Where  $Return_t$  are daily returns,  $Return_{t-1}$  are lagged daily returns,  $TradingVolume_{t-1}$  is lagged trading volume, as it is not normalized we are referring to logarithmic values of trading volume,  $Residuals_{t-1}$  are squared residuals  $Factors_t$  is control factors and  $\varepsilon_t$  is White error. Previous model will be used as base of comparison with extended information response model.

Model with only volume coverage (Equation 6):

$$Return_t = \alpha + \beta_1 Return_{t-1} + \beta_2 TradingVolume_{t-1} + \beta_3 Residuals_{t-1} + \beta_4 Factors_t + \beta_5 Media_{t-1} + \varepsilon_t \quad (6)$$

Inclusion of  $Media_{t-1}$  parameter significantly increase explanatory power of the model which could be seen from increase of R-squared (from 0,087 to 0,107) but as inclusion of any parameter tend to increase R-squared to some degree, hence it could be insufficient to justify inclusion of new parameter. However, coefficient  $\beta_5$  was found to be significant at 5% level. And if we compare BIC criteria then model this model seems to outperform previous one.

Now let's include opinion parameter (Equation 7):

$$Return_t = \alpha + \beta_1 Return_{t-1} + \beta_2 TradingVolume_{t-1} + \beta_3 Residuals_{t-1} + \beta_4 Factors_t + \beta_5 Media_{t-1} + \beta_6 Rhetoric_{t-1} + \varepsilon_t \quad (7)$$

The parameter  $Rhetoric_{t-1}$  was found to be significant at 10% level but not on 5%. Also, it seems that overall negative feedback seems to decrease market returns which is expected result. Table 2 presents summary of results obtained from these models. It is important to notice that in both models Media and Rhetoric factors were found to be significant.

**Table 2**  
Analysis results

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Variable	Model 1	Model 2	Model 3
Return	0.12873	0.09384	0.08731
Residuals	7.91827	8.17285	8.67427
TradingVol	-0.00372	-0.00417	-0.00475
Factors(1)	-0.00001	-0.00002	-0.00002
Factors(2)	0.00012	0.00017	0.00019
Media		0.00271	0.00283
Rhetoric cons			0.00718
	0.07182	0.07827	0.08192
R-squared	0.087	0.107	0.112

Source: Authors' calculations (in the R environment)

## 4. Conclusions

The approach used in this study is fairly new and present practical applications. The main question of the study was to find link between media coverage and market response. Several different techniques were used to gather and analyses online resources such as text analysis and machine algorithms for data gathering. Focusing on the case of Brexit we found that media coverage and its rhetoric have significant impact on the stock returns. And even if this effect is limited it is still needs to be considered when making investment decisions, especially in current times when speed of information spreading is as high as never before.

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1. Doctor of Economics, professor, Department of World Economy and World Finance, Financial University under the government of the Russian Federation, Russia. Contact e-mail: [sokolovaes15@mail.ru](mailto:sokolovaes15@mail.ru)

2. PhD in Economics, associate professor, Department of World Economy and World Finance, Financial University under the government of the Russian Federation, Russia. Contact e-mail: [LIgorova@fa.ru](mailto:LIgorova@fa.ru)

3. Doctor of Economics, professor, Academic Department of Financial Management, Plekhanov Russian University of Economics, Russia. Contact e-mail: [Kazakova.NA@rea.ru](mailto:Kazakova.NA@rea.ru)

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