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THE INFLUENCE OF FINANCIAL STRESS ON ECONOMIC ACTIVITY AND MONETARY POLICY IN BELARUS

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This paper investigates the differences in macroeconomic dynamics that occurred during instabilities in the Belarusian financial market from 2004 to 2016. In this regard, I construct the Belarusian financial stress index (BFSI) as a proxy for financial stress, identify episodes of financial turmoil, assess consequences for the real economy, and examine its interaction with real economic activity and monetary policy using ARDL approach. The results show that during studied period Belarusian economy experienced two episodes of financial stress that coincided with a substantial and prolonged decline in the economic activity. Financial stress has large negative long-run effect on real economic activity. The findings also reveal that price stability is not a sufficient condition to support financial stability in the Belarusian economy.

Keywords: Financial Stress, Economic Activity, Monetary Policy, Recession, ARDL, Causality
JEL Classification: E52, E61, G01, G28, O11

1. INTRODUCTION

Schumpeter (1911) claims that entrepreneurs need credit to finance the implementation of new production technologies. Therefore, well-tuned and developed financial system serves as a key mechanism in the mobilization and utilization of savings, simplification of transactions and redistribution of resources towards productive usage allowing the real economy to prosper (Beck, 2014).

However, according to Minsky (1991) and his ‘financial instability hypothesis’, an economy naturally evolves from a system with a robust financial structure to a system with a fragile financial structure. Periods of economic growth contribute to risky economic behavior transforming economy to a boom phase encouraged by speculative economic activities, but on the other hand, negative real shocks may lead to financial instability and both may strengthen each other (Falahati, 2019).

Correspondingly, financial stress in the financial system is defined as a force that influences economic agents through uncertainty and changing expectations of loss in the financial markets and financial institutions. It arises from financial shocks, for example, banking or currency crises caused by the inability of economic agents to repay their debts (Illing and Ying, 2006). The increase in the financial expenses and the decrease in incomes altogether lead to the growth of bankruptcies resulting in economic recession.

The current level of the financial stress can be quantified by combining several key individual stress measures into a single composite indicator – the financial stress index. In world practices, such indices are widely used as an early warning signal of systematic risk in the financial system allowing regulators to maintain financial stability.[1] For example, Illing and Ying (2006) are among the first researchers who have developed a financial stress indicator for Canada combining data on equity, bond, foreign exchange and banking sector. Cardarelli et al. (2011) construct financial stress indices for a large number of developing and developed countries, Thompson et al. (2013) develop a financial conditions index for South Africa, Cambon and Estevez (2016) introduce a financial stress index for Spain, and He et al. (2019) construct a systematic financial risk index for China's economy. The European Central Bank (ECB, 2009) establish a financial stress index for the global economy.

These tradeoffs are also important for the existing theoretical debate on the realization of monetary policy instruments and objectives (Smets, 2014). The dominant agreement in the literature on central bank's monetary policy has indeed omitted the concern about financial instability, mainly attributing the objective of price stability and only indirectly the objective of financial stability (Clarida et al., 1999; Svensson, 1999; Hubrich and Tetlow, 2015; Dahlhaus, 2017; Fouejieu, 2017).

Moreover, current empirical studies are concentrated mainly on the analysis of developed economies, while few are focused on the investigation of the differences in macroeconomic dynamics during periods of financial instability in developing economies (Pitterle et al., 2015; Li and Tian, 2018; Batuo et al., 2018).

Therefore, the aim of this research is to fill this gap and to study the relationship between financial instability determined by the level of financial stress, economic activity and monetary policy in Belarus, where financial instability is a primary issue for the last decade. The estimated period consists of two parts, first, a stable period of 2004 till 2008 and, second, a highly volatile period of 2009 till 2016, which makes it possible to assess the effect of changing financial conditions on the economic activity and empirical relevance of the Belarusian monetary policy.

In this context, this paper attempts to give insight to several questions: first, what is the impact of financial stress on economic activity in Belarus? Second, does monetary policy respond in systematic manner to increases in financial stress? Finally, what are the directions of the causal relationships between financial stress, economic activity, and monetary policy in Belarus?

In this regard, I construct the Belarusian financial stress index (BFSI) as a proxy for

[1] In the financial context, systematic risk refers to the potential of a cascading failure in the financial sector, caused by interlinkages within the financial system, resulting in serious negative consequences for the real economy (Benoit et al., 2017).

financial stress, identify episodes of financial turmoil and assess consequences for the real economy. Further, the links between financial stress, economic activity (proxied by the index of composite leading indicators), and monetary policy are examined using two different methods. First, the research hypotheses are tested with autoregressive distributed lag (ARDL) models. Second, to confirm the conclusions obtained from the ARDL models the results of Toda Yamamoto causality tests on a selected set of indicators are reported.

The main findings of the paper show, first, that during 2004-2016 two episodes of financial stress were detected in the economy of Belarus. In both cases, there were large devaluations of the Belarusian currency, caused by the need to adjust its real exchange rate. Second, financial stress episodes have led to significant real output losses. The first episode has resulted in the contraction of GDP by 5.9 percent. The second one has pushed Belarusian economy into a severe recession, which lasted 52 months with cumulative output losses about 12.9 percent of GDP. Third, financial stress has large negative long-run effect on real economic activity. However, its effect on policy interest rate is small. Finally, the results of Toda Yamamoto causality analysis show that the growth in the financial stress does not Granger cause inflation and vice versa. From the theoretical point of view, this result signify that there is no evidence for the support of the conventional wisdom hypothesis for Belarusian economy. Therefore, price stability is not a sufficient condition to support financial stability in the country.

The rest of the paper is structured as follows. Section 2 presents the literature review. Section 3 describes the empirical methodologies and Section 4 describes the data. The empirical results of the research are presented in Section 5. Section 6 outlines main conclusions of the paper.

2. LITERATURE REVIEW

2.1. Theory

The influence of financial cycles on the real economy stays one the main questions both from academic and policy points of view. One part of the research studies the influence of the financial accelerator on the growth of the real economy, in particular, examines the effect of changes in the values of collateral on the willingness of the financial system to lend to the economy (Bernanke and Gertler, 1995; Kiyotaki and Moore, 1997). According to this view, the growth in the financial stress influences the solvency of borrowers increasing the fluctuations in output that can lead to a decrease in the business cycle.

For example, Paries et al. (2011) show that increase in money market spreads leads to decrease in bank lending, which subsequently reduces economic activity. In addition, Bloom (2009), Christiano et al. (2014), and Bonciani and Van Roye (2016) show that rise of uncertainty ultimately triggers economic contractions. Moreover, financial stress changes the behavior of private sector investment and consumption.

Another strand of research focuses on balance sheets of lenders and studies the so-called bank capital channel – the role of bank capital in influencing aggregate credit (Bernanke and Lown, 1991; Diamond and Rajan, 2000; Van den Heuvel, 2002). Their findings show that the decline in the capital of banks reduces lending to the economy and may force them to use the loans by themselves (in order to support their balance sheets) leading to sharper economic downturns.

Therefore, the relationship between financial stress and economic activity is an important question for the implementation of monetary policy, because most of the central banks tend to be responsible for financial stability. However, the number of empirical studies on this topic is scarce and mostly dominated by 'conventional wisdom hypothesis', which links monetary and financial stability, namely monetary regime that establishes aggregate price stability will in turn support financial stability (Schwartz, 1995).

Nevertheless, the significant amount of criticism is granted to conventional wisdom hypothesis. White (2006) and Leijonhufvud (2007) argue that stability of monetary system might lead to financial instability meaning that it allows for very low interest rates ('cheap money'), favoring high-risk projects. Furthermore, they also admit that inflationary pressures do not precede major economic and financial crises. This is so-called the 'paradox of credibility' according to which if the credibility in reducing inflation is granted to central banks, it will eventually lead to the growth of the vulnerability of the financial system and subsequently to financial instability.

2.2. Empirical Evidence

The problem of financial instability is studied since the mid-1990s suggesting that financial variables systematically influence the real economy and strongly interact with each other. For example, Frankel and Rose (1996) examine the determinants of currency crashes in 100 developing countries from 1971 to 1992 and show that in most cases currency crashes are caused by running out of foreign direct investment, low foreign exchange reserves, heightened domestic credit growth, significantly overvalued real exchange rate and constantly increasing interest rate.

Using the results of Frankel and Rose (1996), Kaminsky and Reinhart (1999) extend the analysis to broader types of crises, including banking and balance of payment crises of the 1990s. They discover that both types of crises are closely related to the outcomes of financial liberalization, which triggers boom/bust cycles with banking crises preceding a sharp depreciation of the national currency.

Further, Hakkio and Keeton (2009) show (on the example of the USA) that growth of financial instability leads to more prudent behavior of credit institutions, which in turn causes the reduction in total loans supplied and subsequently decreases economic activity. According to Cardarelli et al. (2011), periods of financial instability generated by problems in the banking sector are associated with deeper economic recessions than the periods of financial stress, which are largely determined by instability in the securities or foreign exchange markets. Claessens et al. (2012) empirically find that recessions associated with financial disruptions are often deeper and costlier. Aboura and Van Roye (2013) define that episodes of financial instability are related to a significant decline in French economic activity. In addition, Hubrich and Tetlow (2015) for the United States find that economic activity reacts to a greater extent to financial instability in periods of high stress than in low ones.

However, the empirical evidence on the response of central banks to financial instability is very scarce. In particular. Borio and Lowe (2004) assess the reaction of central banks in four countries (Australia, Germany, Japan, and the USA) to financial imbalances measured by the ratio of private-sector credit to GDP, inflation-adjusted equity prices, and using their composite measure. They find either negative or controversial evidence for all countries except the USA. Borio and Lowe (2004) come to the conclusion that the Fed responded to financial imbalances in an asymmetric and reactive way. First, when Fed encountered with the problem of increase in imbalances the federal funds' rate was unreasonably decreased, and, second, after the built up of imbalances the federal funds' rate was not increased beyond normal.

Cecchetti and Li (2008) calculate a Taylor rule for the USA, Japan and Germany taking into account a measure of banking stress, specifically the deviation of leverage ratios from their Hodrick–Prescott trend. Their results show that the Fed corrects the interest rate to respond to the procyclical impact of a banks' capital requirements, whereas the Bank of Japan and the Bundesbank do not.

Bulir et al. (2011) estimate the response of monetary policy to seven different indicators of the vulnerability of financial sector including measures of crisis probability, time to a crisis, distance to default in a panel of 28 countries. The results are twofold, first, in the panel setting they obtain the statistically significant negative response of monetary policy (that is policy easing) to measures of financial instability, whereas in the country-level regressions the response was statistically insignificant. Li and St-Amant (2010) discover that intensity of financial stress leads to different effects of monetary shocks on the economy.

Belke and Klose (2010) study factors that influenced the decisions of the European Central Bank (ECB) and the Fed to determine the interest rates during the 2008-2009 crisis. They find that the estimated policy rule for the Fed was significantly altered, whereas the ECB decided to preserve temporarily the level of interest rate with the aim of inflation stabilization but at the cost of some output losses. Baxa, Horvath, and Vasicek (2014) examine the response of central banks' policy of inflation targeting to financial stress. They find no reaction to financial stress in the normal situation, however, in periods of large and long financial stress the behavior of central banks changes.

3. METHODOLOGY

3.1. Construction of Financial Stress Index

The aggregation of variables into one composite measure has a number of advantages. First, it allows to assess the dynamics of financial stress that is caused by various factors and, therefore, is not limited to one specific type of instability. Second, the inclusion of additional variables in the index does not significantly affect the dynamics of the resulting indicator (Cardarelli et al., 2011). Third, by calculating composite indicator that evaluates different types of financial stress, the estimated index can be used as an early warning signal of systematic risk in the financial sector.

There are several specific indicators that can be used in order to construct the financial stress index for a particular developing country: the banking sector fragility index (BSF), the return on the stock market, the volatility of the stock market, the spread of sovereign debt and the exchange market pressure index – EMPI (Balakrishnan et al., 2011; Hollo et al., 2012; Lo Duca and Peltonen, 2011).

However, due to a low level of development of stock market in Belarus, the risk indicator arising from this financial sector is excluded from the construction of the BFSI. At the same time, additional problem exists in the financial system of Belarus namely external debt risk. Therefore, the constructed Belarusian financial stress index considers the risk of banking sector using the BSF, currency risk using the EMPI and the external debt risk using the growth of the external debt.

3.1.1. Risk of the Banking Sector

Financial intermediaries stimulate investment and increase output growth through borrowing and lending. Therefore, the stability of the banking sector is essential to overall financial stability in the economy. Consequently, the corresponding parameter for Belarus is constructed using the BSF index proposed by Kibritcioglu (2003).

The BSF index is constructed in the next way:

$$BSF_t = -\frac{\left[\left[\frac{\Delta DEP_t - \mu_{\Delta DEP}}{\sigma_{\Delta DEP}}\right] + \left[\frac{\Delta CPS_t - \mu_{\Delta CPS}}{\sigma_{\Delta CPS}}\right] + \left[\frac{\Delta FL_t - \mu_{\Delta FL}}{\sigma_{\Delta FL}}\right]\right]}{3}, \quad (1)$$

where Δ – difference operator – indicates changes in variables over a 12-month period; μ and σ – the mean and standard deviation of the corresponding variables; DEP – real deposits of banks; CPS – real claims on the domestic private sector; and FL – real foreign liabilities of banks.

The BSF index takes into account the assets and liabilities of the banking sector, therefore, this index can be used to assess the stability of the banking sector. It shows fluctuations in the domestic banking sector and the increase in the indicator means an increase in the fragility of the banking system, which may be due to reduction in bank deposits (caused by their withdrawals), growth of credit claims on the private sector (caused by the growth of overdue debt) and an increase in foreign liabilities (caused by the devaluation of the national currency). Moreover, Shen and Chen (2008) used the BSF index to determine a causal link between currency and banking crisis and find the presence of the bilateral causal relationship between the banking sector and exchange rate instability.

3.1.2. Currency Risk

Currency risk represents another essential part of the financial stress for developing countries. The first attempt to calculate such a measure was conducted by Girton and Roper (1977), who tried to assess the degree of pressure on the exchange rate using the EMPI calculated as a simple average of the exchange rate and international reserves changes.

In this paper the EMPI is calculated in a next way:

$$EMPI_t = \frac{\Delta e_t}{\sigma_{\Delta e}} - \frac{\Delta Res_t}{\sigma_{\Delta Res}} + \frac{\Delta i_t - \Delta i_{US,t}}{\sigma_{\Delta i} - \sigma_{\Delta i_{US}}}, \quad (2)$$

where Δe_t and ΔRes_t – 12-month percent changes in the exchange rate and total foreign international reserves minus gold of Belarus; i_t and $i_{US,t}$ – the overnight interest rate for Belarus and the US, respectively; $\sigma_{\Delta e_t}$, $\sigma_{\Delta Res_t}$, σ_{i_t} and $\sigma_{i_{US,t}}$ – the standard deviations of the corresponding variables.

According to Bussiere and Fratzscher (2006) taking into account changes in exchange rate allows identifying both successful and unsuccessful speculative attacks on national currencies. In turn, the main incentive for the accumulation of significant international reserves is an attempt to self-insure against a sudden stop in capital inflows and against the loss of possibility to borrow at the international capital market (Aizenman and Lee, 2007; Mendoza, 2010). Countries with high volumes of international reserves have both a possibility to decrease the losses from financial crises and make their occurrence less likely (Rodrik, 2006).

Finally, the increase in the spread between Belarusian overnight interest rate (which represents the average interest rate at which Belarusian banks lend unsecured short-term funds to other market participants) and US overnight interest rate (the benchmark for secured money market operations) reflects an increase in uncertainty in the money market and can be interpreted as a risk premium.

3.1.3. External Debt Risk

External debt plays an important role for the sustainability of economic growth in the developing countries. For example, a sharp increase of the short-term external debt was one of the main triggers of the Asian and Russian 1997-1998 crises. Therefore, external debt is considered as a potential indicator of financial stress in empirical studies of developing countries (Kaminsky et al., 1998; Bussiere and Fratzscher, 2006).

In this paper, I use the growth rate of total external debt as a component of the BFSI. However, in the empirical literature, there is no agreement on the influence of external debt on economic activity or economic growth for developing countries. From one hand, external debt plays an important role for maintaining sustainable growth and serves as an indicator of solvency of the debtor country. From another hand, its excessive amount has a considerable negative effect on future economic growth (Bellas et al., 2010).

Therefore, in this study, I assume that growth in total external debt has a positive effect on the Belarusian economy, which often lacks external financing. However, I also suppose that after a certain threshold level of external debt compared to GDP the increase in it may question its sustainability and subsequently negatively influence creditworthiness of Belarus as the debtor country.

3.1.4. Normalization of Variables

Before calculation a single aggregate index, all individual subcomponents are converted to a common scale (with a zero mean and unit variance) using statistical normalization procedure presented as follows:

$$Z_t = \frac{(X_t - \bar{X})}{\sigma_X}, \quad (3)$$

where Z_t is a normalized indicator; X_t is the value of indicator at time t; $\bar{X}$ and σ_X are the respective value of mean and standard deviation of indicator X evaluated in the period t.

The subtraction of mean value removes the problem of aggregation distortions possible due to differences in indicators' mean and subdivision by standard deviation is used to scale the indicators to a common base.

3.1.5. Principal Component Analysis

Next, the aggregation of standardized subcomponents into financial stress index is accomplished using principal component analysis (PCA). PCA is a statistical technique that determines the relationships in the data and converts variables into a smaller number of components, thus reducing the dimensionality of the data space. Under the assumption that each variable is sensitive to the financial stress, and if the financial stress is recognized as one of the main factors that influence the observed correlations among the variables, then it can be defined as a principal component. An advantage of principal component analysis is that it helps to separate variables with minimal loss of information.

Using the results of principal component analysis the BFSI is constructed on the basis of the first principal component as an average of three normalized subcomponents of the BFSI so that a positive value indicates deterioration in financial stability and a negative value indicates improvement in financial stability.

3.2. Construction of the Index of Composite Leading Indicators

As a measure of economic activity in Belarus, I will use the index of composite leading indicators (CLI) that includes growth in export of goods, growth in cargo turnover by motor vehicles, growth in industrial production, and growth in bank's credits. Using the same methodology as for the construction of the BFSI all data for the CLI is calculated as year-on-year growth rates, normalized in the same way as components of the BFSI and aggregated into a composite index using principal component analysis.

3.3. Unit Root Tests and ARDL Cointegration Analysis

In order to check the stationarity of the studied variables Augmented Dickey Fuller (ADF) (Dickey and Fuller, 1979), Phillips Perron (PP) (Phillips and Perron, 1988), Dickey Fuller-Generalized Least Squares (DF-GLS), and ERS point optimal unit root tests are applied. Further, the study employs the cointegration approach to investigate the long-run relationship between economic activity and financial stress and between monetary policy and financial stress in Belarus.[2]

Due to the constraints of the conventional approaches to cointegration namely the Engle and Granger (Engle and Granger, 1987) and Johansen and Juselius (Johansen and Juselius, 1990) cointegration methods,[3] this study uses the bounds testing approach to cointegration based on the autoregressive distributed lag modeling developed by Pesaran et al. (2001).

The ARDL approach has several advantages. First, it can be applied to study long-run associations either between variables that are integrated of order I(0), I(1) or both I(0) and I(1). Second, the evaluation of ARDL with proper lag structure can correct both autocorrelation and heterogeneity problem. Third, the ARDL performs better in small sample sizes providing unbiased and efficient estimates (Narayan, 2004).

The ARDL representations of relationships between economic activity and the BFSI, policy interest rate (PR) and the BFSI are next:

$$CLI_t = \lambda_0 + \lambda_1 CLI_{t-1} + \lambda_2 BFSI_{t-1} + \lambda_3 PR_{t-1} + \lambda_4 CPI_{t-1} + \sum_{i=1}^{m} \theta_{1i} \Delta CLI_{t-i} + \sum_{i=0}^{m} \theta_{2i} \Delta BFSI_{t-i} + \sum_{i=0}^{m} \theta_{3i} \Delta PR_{t-i} + \sum_{i=0}^{m} \theta_{4i} \Delta CPI_{t-i} + \varepsilon_t, \quad (4)$$

[2] The cointegration approach is used because in most macroeconomic and financial time series data the presence of unit roots are identified leading to spurious results of conventional regression analysis.

[3] These methods are applicable only if the underlying variables are integrated of the same order, that is, integrated of order one I(1).

$$PR_t = \beta_0 + \beta_1 PR_{t-1} + \beta_2 BFSI_{t-1} + \beta_3 CLI_{t-1} + \beta_4 CPI_{t-1} + \sum_{i=1}^{n} \gamma_{1i} \Delta PR_{t-i} + \sum_{i=0}^{n} \gamma_{2i} \Delta BFSI_{t-i} + \sum_{i=0}^{n} \gamma_{3i} \Delta CLI_{t-i} + \sum_{i=0}^{n} \gamma_{4i} \Delta CPI_{t-i} + \epsilon_t, \quad (5)$$

where Δ is first difference operator; θ_i and γ_i are short-run coefficients; $BFSI$ – financial stress index of Belarus; CLI – index of composite leading indicators of Belarus; CPI – 12-month changes in the consumer price index; PR – policy rate of Belarus, share; λ_i and β_i are long-run coefficients; and ε_i and ϵ_i are error terms.

The joint null hypothesis of no cointegration relationship in the Eqn. (4) is:

$H1_0$: $\lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$.

Alternative hypothesis of the presence of cointegration relationship is:

$H1_1$: $\lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq 0$.

The joint null hypothesis of no cointegration relationship in the Eqn. (5) is:

$H2_0$: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$.

Alternative hypothesis of the presence of cointegration relationship is:

$H2_1$: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$.

The first step of ARDL procedure is the conduction of the bounds test for the null hypothesis of no cointegration. The compound F-statistics of the lagged levels of the variables in the underlying ARDL model is compared with the upper critical values so-called upper critical bound (UCB) and lower critical values so-called lower critical bound (LCB) (Pesaran et al., 2001). The UCB supposes that all the series are I(1), and the LCB supposes that they are all I(0). The variables are supposed to be cointegrated if the estimated F-statistic lies above the UCB and not cointegrated if the calculated F-statistic is below the LCB, while if the estimated F-statistic is between UCB and LCB, the results will be inconclusive. If the long-run relationship is found among the variables then there is an error correction representation.

The error correction models of the series can be presented as follows:

$$\Delta CLI_t = \omega_0 + \sum_{i=1}^{k} \omega_{1i} \Delta CLI_{t-i} + \sum_{i=0}^{m} \omega_{2i} \Delta BFSI_{t-i} + \sum_{i=0}^{m} \omega_{3i} \Delta PR_{t-i} + \sum_{i=0}^{m} \omega_{4i} \Delta CPI_{t-i} + \sum_{i=0}^{m} \omega_{5i} \Delta EC_{t-i} + \omega_6 EC_{t-1} + \varphi_t, \quad (6)$$

$$\Delta PR_t = \pi_0 + \sum_{i=1}^{\tau} \pi_{1i} \Delta PR_{t-i} + \sum_{i=0}^{n} \pi_{2i} \Delta BFSI_{t-i} + \sum_{i=0}^{n} \pi_{3i} \Delta CLI_{t-i} + \sum_{i=0}^{n} \pi_{4i} \Delta CPI_{t-i} + \sum_{i=0}^{n} \pi_{5i} \Delta EC_{t-i} + \pi_6 EC_{t-1} + \phi_t. \quad (7)$$

The coefficients of lagged error correction terms are supposed to be negative and statistically significant in order to approve the presence of cointegration relationships. Finally, the goodness of the fit of the selected ARDL models will be studied using tests for serial correlation, normality, heteroscedasticity and functional form.

3.4. Causality Analysis

Causality between economic activity, financial stress, monetary policy and inflation are examined using Toda Yamamoto (TY) causality approach (Toda and Yamamoto, 1995). This technique has several advantages over traditional Granger causality approach. First, TY statistics follows a standard asymptotic distribution (Squalli, 2007). Second, this approach does not depend on the integration properties of underlying variables and cointegration properties of the estimated system.

According to TY method, vector auto-regression (VAR) with lag length equal to m+dmax (where m is the lag-length and dmax is the maximum order of integration of the underlying variables) is estimated in order to use the Modified Wald (MWALD) test (by applying linear restriction – adding dmax lags) on the parameters of VAR(m).

Following four-equation VAR model is used for assessment:

$$\begin{bmatrix}\Delta CLI_t\\ \Delta FSI_t\\ \Delta PR_t\\ \Delta CPI_t\end{bmatrix}=\begin{bmatrix}a_{10}\\ a_{20}\\ a_{30}\\ a_{40}\end{bmatrix}+\begin{bmatrix}a_{11}(l)\ a_{12}(l)\ a_{13}(l)\ a_{14}(l)\\ a_{21}(l)\ a_{22}(l)\ a_{23}(l)\ a_{24}(l)\\ a_{31}(l)\ a_{32}(l)\ a_{33}(l)\ a_{34}(l)\\ a_{41}(l)\ a_{42}(l)\ a_{43}(l)\ a_{44}(l)\end{bmatrix}\times\begin{bmatrix}\Delta CLI_{t-m}\\ \Delta FSI_{t-m}\\ \Delta PR_{t-m}\\ \Delta CPI_{t-m}\end{bmatrix}+\begin{bmatrix}u_{1t}\\ u_{2t}\\ u_{3t}\\ u_{4t}\end{bmatrix}, \qquad (8)$$

where m is the optimal number of lags; parameters a_{i0} and b_{i0} represent intercept terms; parameters $a_{ij}(l)$ and $b_{ij}(l)$ are the polynomials in the lag operator l; u_{it} and ϑ_{it} are white noise error terms.

In TY causality test, optimal lag length is selected by minimizing the value of the Akaike information criterion (AIC). For example, if a VAR model with a lag length of two is used to estimate Eqn. (8), then a particular variable does not Granger-cause other variable if and only if all the coefficients of $a_{ij}(l)$ are equal to zero. In the opposite case, second variable does not Granger-cause the first variable if and only if all the coefficients of $a_{ji}(l)$ are equal to zero.

Thus, in the four-equation model (see Eqn. (8)), the hypotheses can be tested as next:

H_0: $a_{1j}(1)$=$a_{1j}(2)$=$a_{1j}(3)$=$a_{1j}(4) = 0$,

H_1: $a_{j1}(1)$=$a_{j1}(2)$=$a_{j1}(3)$=$a_{j1}(4) = 0$,

where $a_{1j}(i)$ are the coefficients of the given variables in the first equation and $a_{j1}(i)$ are the coefficients of the given variables in the jth equation in the VAR model of Eqn. (8).

4. DATA

To assess the level of financial stress in Belarus the paper uses monthly and quarterly data from, National Bank of Belarus (NBB), Belstat, World Bank database and IMF-IFS[4] database for January 2004 until September 2016. In order to obtain monthly values from quarterly series the method of cubic splines is applied. Prior to the estimation of the BFSI and index of composite leading indicators the data was seasonally adjusted using Census X-13 technique, real values were calculated applying consumer price index (CPI) and using 2000 as the base year. The full description of the variables used in this study is shown in Table 1.

Table 1. Description of Variables

Variable	Source	Description
Inflation	National Bank	Consumer price index, by month (percent change)
	Elements of Financial Stress Index	
Liabilities (FL)	IMF-IFS	Foreign liabilities of banks, by month (current prices, mln. US dollars)
Deposits (DEP)	IMF-IFS	Transferable and other deposits included in broad money, by month (current prices, bn. BYN)
Claims (CPS)	IMF-IFS	Claims on the domestic private sector, by month (current prices, bn. BYN)
Policy rate (PR)	National Bank	Policy rate of the NBB, by month (percent per annum)
OvernightBLR (iBLR)	National Bank	Overnight interest rate for Belarus, by month (percent per annum)
OvernightUSA (iUS)	IMF-IFS	Overnight interest rate for USA, by month (percent per annum)
Exchange rate (e)	National Bank	Average exchange rate of BYN to USD, by month (BYN)
Reserves (Res)	IMF-IFS	Total foreign international reserves minus gold, by month (current prices, mln. US dollars)
External debt	World Bank	Total external debt, by month (current prices, mln. US dollars)
	Composite Leading Indicators	
Investments	Belstat	Investment in fixed capital, by month (current prices, bn. BYN)
Banks' credits	National Bank	Banks' credits, by month (current prices, bn. BYN)
Cargo turnover	Belstat	Cargo turnover of motor vehicles, by month (mln. tonnes per kilometer)
Industrial production	Belstat	Industrial production, by month (current prices, bn. BYN)

Note: Descriptive statistics are shown in Table 2.

Table 2. Descriptive Statistics

Series	Obs.	Mean	Std. dev.	Min	Max
Liabilities	153	4129.350	2576.929	362.640	8383.650
Deposits	153	90426.440	96440.510	5057.630	316504.300
Claims	153	81575.740	70645.850	4268.120	231283.000
Policy rate	153	0.185	0.083	0.100	0.450
OvernightBLR	153	0.281	0.128	0.160	0.700
OvernightUSA	153	0.014	0.018	0.001	0.053
Exchange rate	153	6321.430	5507.098	2111.000	21482.000
Reserves	153	3145.769	1723.120	550.912	6354.740
External debt	153	22755.610	13622.22	4187.913	40919.460
Inflation	153	0.014	0.020	-0.007	0.136
Investments	153	7829.880	7128.765	347.000	29265.600
Banks' credits	153	14922.740	12886.370	1070.200	45879.300
Cargo turnover	153	1162.410	726.640	123.800	2888.700
Industrial production	153	27843.030	23464.930	3225.700	70314.000

[4] IFS – International Financial Statistics.

5. EMPIRICAL RESULTS

5.1. Aggregation of the BFSI and CLI Components

The PCA results for the BFSI are presented in Table 3. The coefficient of each variable denotes the effect on the financial stress index of a one-standard deviation change in the corresponding variable. According to the signs of the coefficients, growth of the BSF and EMPI increases financial stress in the Belarusian economy, while increase in the external debt decreases it. The last row in Table 3 indicates that 44 percent of the total variation in all three variables over the sample period is explained by the BFSI. Taking into account that this variation captures the tendency of these variables to move together, a higher number suggests that financial stress is a core element in the comovements of the variables.

Table 3. Principal Component Analysis Results for the BFSI

Variables	First principal component
BSF	0.406
EMPI	0.490
External debt	-0.771
Total variance explained (percent)	44

Table 4 represents results of the PCA for the CLI index of composite leading indicators of Belarus. The positive signs of all variables indicate that they positively influence economic activity. The main influence comes from industrial production, the least important factor remains cargo turnover with the quantitatively smaller effect on CLI.

Table 4. Principal Component Analysis Results for the CLI

Variables	First principal component
Exports	0.535
Banks' credits	0.446
Industrial production	0.657
Cargo turnover	0.287
Total variance explained (percent)	51

Finally, 51 percent of the total variation in the four variables is explained by the index of composite leading indicators. Moreover, this large number indicates that CLI serves as a key element in the comovements of these variables.

5.2. Identifying Financial Stress Episodes and Recessions in Belarus

Using the subcomponents described in the previous section, the BFSI and CLI values are calculated (see Figure 1). Financial stress episodes are determined as the periods when the BFSI is more than one standard deviation above its trend, which is captured by the Hodrick–Prescott (HP) filter.[5] These episodes show that one or more of the BFSI's subcomponents has changed abruptly. A recession occurs if there was a serious contraction in the economic activity during six months or more.

During 2004-2016, two financial stress episodes were detected in the economy of Belarus (see Figure 1). In both cases, there were large devaluations of the Belarusian currency, caused by the need to adjust its real exchange rate.

The first episode began in December 2008 and ended in May 2009. This episode was mainly a consequence of the global economic and financial crisis that caused a deep recession in Russia, reducing Russia's demand for import products from Belarus, further loss of competitiveness due to the sharp depreciation of the Russian ruble, deterioration of the current account balance and the depletion of foreign exchange reserves. This episode of financial stress led to a persistent decline in economic activity for 12 months.

The second episode of the financial stress began in December 2011 and ended in May 2012. It was caused by the renewed unbalanced macroeconomic policy aimed primarily at boosting aggregate demand by increasing government spending and accelerating economic growth, and monetary policy aimed at targeting the exchange rate. All these led to problems in the foreign exchange market that eventually encompassed issues in the banking sector and caused a sharp reduction in foreign exchange reserves. This financial stress episode pushed Belarusian economy into a severe recession, which lasted 52 months.

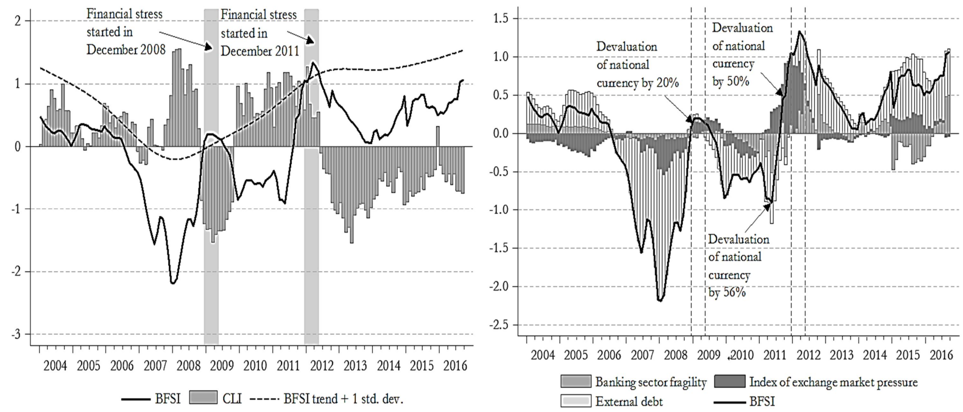

Figure 1. Episodes of Financial Stress in Belarusian Economy during 2004-2016

[5] The Hodrick–Prescott (HP) filter determines a time-varying trend needed to capture the notion that the financial system develops over time.

The main characteristics of the Figure 1 is that the currency stress is the prevailing factor in two identified stress episodes. However, while the origins of the second episode were in currency market, by the early 2012 the stress had become much more broad based – the banking stress and the external debt stress contributed further to the BFSI growth.

Next, two recessions were identified using constructed CLI index (see Figure 2). In the first case (October 2008 – October 2009), it started earlier than financial stress episode. In the second case (June 2012 – September 2016) the recession started with a lag of six months between the onset of the financial stress and the slowdown, but lasted substantially longer.

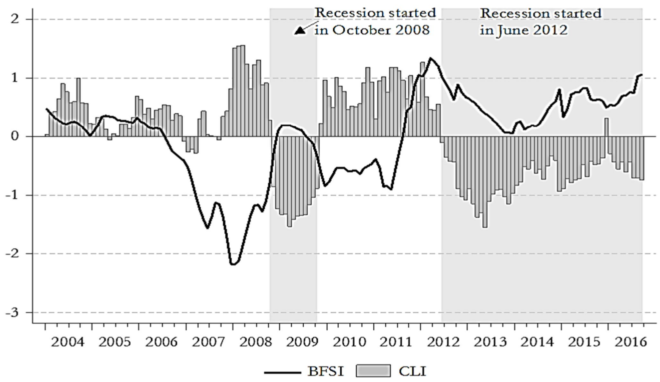

Figure 2. Recessions in Belarusian Economy during 2004-2016

Finally, the descriptive statistics of two financial stress episodes and recessions are presented in Table 5. The cumulative output losses (relative to trend) amounted to 5.85 percent of GDP for the first recession and 12.89 percent of GDP for the second recession. Another interesting result is the difference in the increase of the BFSI prior to start of the recessions. In the second case, the increase was 2.4 times higher than in the first case, indicating that the magnitude of shock may also be a trigger of the substantial longevity of the following recession.

Table 5. Descriptive Statistics on Financial Stress and Recessions in Belarus

Episodes of financial stress	Duration (months)		Output loss[a] (percent of GDP)		Number of months after start of financial stress to recession	Increase in BFSI six months prior to financial stress (percent)
	Financial stress	Recession	Cumulative[b]	Average[b]		
Dec 08–May 09	6	12	-5.85	-0.53	0	82.47
Dec 11–May 12	6	52	-12.89	-0.52	6	198.34

Note: a output is loss measured as GDP below trend during recession. b output loss is calculated on yearly base.

Thus, taking into account the above results the BFSI may be considered as a comprehensive indicator that successfully determines the main episodes of financial stress in Belarus during the studied period and can afford the basis to study their macroeconomic consequences.

5.3. Estimation Results of the ARDL Models

A preliminary step before conducting cointegration and causality analyses is to examine the integrated properties of the studied variables (CLI, BFSI, PR, and CPI). Four unit root tests are used: ADF, PP, ERS DF-GLS and ERS point optimal. The last two tests are developed by Elliott et al. (1996) and have better power properties and lower size distortions in comparison to the standard ADF unit root tests. The results at level and first differences are shown in Table 6, indicating that variables are all stationary at first differences,[6] but inconclusively stationary at level. Correspondingly, there is a possibility that BFSI and CLI may suffer from endogenous structural breaks since they comprise of monthly data of almost thirteen years. Therefore, the ARDL methodology to cointegration (with dummy variables capturing structural breaks in the series) is suitable here, because can handle the possibility of different types of stationarity in the data.

Table 6. Results of Unit Root Tests

Null Hypothesis	At level		At 1st difference	
	intercept	intercept and trend	intercept	intercept and trend
ADF unit root test				
BFSI	-1.972	-2.512	-7.096***	-7.125***
CLI	-2.253	-2.729	-11.538***	-11.499***
PR	-2.188	-2.799	-6.037***	-6.0144***
CPI	-4.205***	-4.287***	-5.600***	-5.587***
PP unit root test				
BFSI	-1.663	-2.196	-6.957***	-7.046***
CLI	-2.615*	-3.151*	-11.543***	-11.505***
PR	-2.034	-2.728	-6.110***	-6.091***
CPI	-2.387	-2.416	-4.842***	-4.829***
ERS DF-GLS unit root test				
BFSI	-1.859*	-1.995	-6.469***	-7.085***
CLI	-2.262**	-2.534	-3.009***	-9.674***
PR	-1.683	-1.919	-3.034***	-5.278***
CPI	-4.207***	-4.227***	-5.618***	-5.629***
ERS point optimal unit root test				
BFSI	3.469*	12.053	0.537***	1.608***
CLI	2.620**	7.912	0.777***	1.571***
PR	4.825	14.299	1.327***	2.549***
CPI	0.419***	1.436***	0.012***	0.047***

Note: *** – significance at 1 percent level, ** – significance at 5 percent level.

[6] Integrated of order one – I(1).

Table 7 presents the computed F-values for testing the existence of long-run relationships presented in Eqns. (4) and (5) during studied period under the null hypothesis of no relationship between the regressors. The F-statistic in Table 7 is compared with the critical bounds presented in Pesaran et al. (2001). The outcome of the bounds test is conditioned by the choice of the lag order, p. Therefore, the conditional models (see Eqns. (4) and (5)) are estimated by imposing optimal lag length selection using Akaike information criterion (AIC).

Estimated results of the bound F-test show that with CLI as the dependent variable, the computed F-statistic exceeds the upper critical bound of 1 percent. Therefore, the null hypothesis ($H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = 0$) that no long-run relationship (no cointegration) between economic activity, financial stress, policy rate and inflation in Eqn. (4) is rejected. The same holds for the model with PR as a dependent variable (see Eqn. (5)) – the computed F-statistic exceeds the upper critical bound of 1 percent rejecting the null hypothesis (H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$) that no cointegration exists between underlying variables.

Table 7. ARDL Bounds Test Results for the Existence of a Long-run Relationship

Model	Calculated F-statistic	Optimal lag order	Significance level	Critical bounds F-statistic*	
				I(0)	I(1)
$F_{CLI}(CLI \mid BFSI,\ PR,\ CPI)$	8.39[a]	(12, 1, 2, 0)	1 percent	3.65	4.66
			5 percent	2.79	3.67
			10 percent	2.37	3.20
$F_{PR}(PR \mid CPI,\ BFSI,\ CLI)$	13.07[a]	(5, 7, 5, 6)	1 percent	4.30	5.23
			5 percent	3.38	4.23
			10 percent	2.97	3.74

Note: The superscripts a and b indicate that the statistic lies above or below the upper or lower bound, correspondingly. * - critical values from Pesaran et al. (2001).

The serial correlation-free residuals were obtained under the optimal lag order of twelve (p=12) for the CLI model in the Eqn. (4) and lag order of five (p=5) for the PR model in the Eqn. (5), as suggested by AIC. Additionally, several diagnostic tests such as Breusch-Godfrey serial correlation LM test, Jacque-Bera normality test, Breusch-Pagan-Godfrey heteroscedasticity test and Ramsey RESET specification tests are applied to check the stability of the ARDL models (see Tables 8 and 10). All the tests indicate that the models have correct functional form, residuals are normally distributed (except for model in Eqn. (5)), serially uncorrelated and homoscedastic.

Next, since the bound tests confirm the presence of cointegration between economic activity, financial stress, policy rate and inflation in Belarus, the short-run and long-run coefficients for both models may be calculated (see Tables (8)-(11)).

Table 8 shows the long-run coefficients of the CLI model. The coefficient of the financial stress index is negative and significant. An increase in the BFSI by 1 standard deviation (or approximately by 0.75 points) ceteris paribus, will decrease economic activity in Belarus by 0.5 s.d. (0.35 points). This shows that high level of financial instability causes the substantial downturn in economic activity in Belarus, which is in line with statement that underdeveloped financial systems[7] are not supportive to the economic activity and usually associate with financial instability (Li et al., 2015).

Table 8. Long-run Estimation Results of the ARDL Model for Economic Activity – CLI Model

Variable	ARDLCLI(12, 1, 2, 0)	t-values
Long-run coefficients		
BFSI	-0.463**	-2.451
PR	-6.265***	-3.472
CPI	1.804**	2.422
DummyBFSI_2006	-0.640**	-2.178
DummyBFSI_2011	0.988*	1.668
DummyCLI_2008	-1.357***	-2.943
Constant	-0.463***	-2.451
Diagnostic test statistics		
χ^2 LM	1.140 [0.337]	
χ^2 BPG	0.922 [0.564]	
χ^2 RESET	1.628 [0.205]	
χ^2 NORMALITY	1.183 [0.553]	

Note: F-statistics in the parentheses. *** – significance at 1 percent level, ** – significance at 5 percent level, * – significance at 10 percent level. $Dummy_{BFSI_{2006}}$ – structural break occurred in the BFSI in 2006, $Dummy_{BFSI_{2011}}$ – structural break occurred in the BFSI in 2011, $Dummy_{CLI_{2008}}$ – structural break occurred in the CLI in 2008.

Next, the influence of the policy rate is also negative and significant. An increase in policy rate by 10 percentage point ceteris paribus, will decrease economic activity by 0.63 points. An increase in inflation by 10 percentage points increases economic activity in Belarus by 0.18 points, ceteris paribus. Finally, the influence of structural breaks on economic activity occurred in the BFSI in 2006 and in the CLI index in 2008 is negative and significant, while structural break in financial stress occurred in 2011 caused statistically significant positive changes in economic activity.

The results of short-run error correction estimates for Eqn. (4) are presented in Table 9. The significant and smaller than unity lagged error correction term (ECM_{t-1}) indicates the existence of long-run cointegration between CLI, BFSI, PR, and CPI. These results also confirm the existence of long-run relationship among economic activity and financial stress in Belarus calculated using bound F-test (see Table 7). More importantly, the negative sign of error correction term shows that 32 percent of long-run

[7] For example, lacking the developed and effectively functioning stock market.

disequilibrium in economic activity caused by other three variables will be corrected in each short-run period (month). The value of R^2, which measures the overall goodness of fit of the model, indicates that it is well defined.

Table 9. Short-run Estimation Results of the ARDL Model for Economic Activity – CLI Model

Variable	$ARDL_{CLI}$(12, 1, 2, 0)	t-values
Short-run coefficients		
ΔCLI_{t-1}	0.092	1.281
ΔCLI_{t-2}	-0.070	-0.999
ΔCLI_{t-3}	0.087	1.250
ΔCLI_{t-4}	0.122*	1.763
ΔCLI_{t-5}	-0.035	-0.498
ΔCLI_{t-6}	0.237***	3.187
ΔCLI_{t-7}	0.070	0.973
ΔCLI_{t-8}	0.147**	2.039
ΔCLI_{t-9}	0.113	1.510
ΔCLI_{t-10}	0.067	0.910
ΔCLI_{t-11}	0.247***	3.336
$\Delta BFSI_t$	-0.798***	-5.456
ΔPR_t	-5.410***	-2.652
ΔPR_{t-1}	4.679**	2.404
ΔCPI_t	0.357	0.497
$\Delta Dummy_{BFSI_{2006,t}}$	-0.137	-0.797
$\Delta Dummy_{BFSI_{2011,t}}$	0.276	1.505
$\Delta Dummy_{CLI_{2008,t}}$	-0.219	-1.201
ECM_{t-1}	-0.323***	-6.529
Diagnostic test statistics		
R^2	0.925	
DW	1.945	

Note: F-statistics in the parentheses. *** – significance at 1 percent level, ** – significance at 5 percent level, * – significance at 10 percent level. $Dummy_{BFSI_{2006}}$ – structural break occurred in the BFSI in 2006, $Dummy_{BFSI_{2011}}$ – structural break occurred in the BFSI in 2011, $Dummy_{CLI_{2008}}$ – structural break occurred in the CLI in 2008.

Table 10 shows the results of long-run coefficients of the PR model presented in Eqn. (5). The coefficient of the BFSI is positive and significant. An increase in financial stress by 1 standard deviation (or approximately by 0.75 points) ceteris paribus, will increase policy rate only by 1.9 percentage points. The CPI influence is also positive and significant, that is an increase in inflation by 1 percentage point ceteris paribus, will increase policy rate by 0.69 percentage points. The increase in economic activity does not have statistically significant effect on policy rate in Belarus. Finally, the influence of structural breaks on policy rate occurred in the BFSI in 2011 and in the CLI index in 2012 is negative and significant.

Table 10. Long-run Estimation Results of the ARDL Model for Policy rate – PR Model

Variable	$ARDL_{PR}(5, 7, 5, 6)$	t-values
	Long-run coefficients	
CPI	0.693***	6.103
$BFSI$	0.025***	2.277
CLI	0.0003	0.032
$\Delta Dummy_{BFSI_{2011}}$	-0.153***	-2.944
$\Delta Dummy_{CLI_{2012}}$	-0.154***	-2.908
$Trend$	0.001***	4.326
	Diagnostic test statistics	
χ^2_{LM}	1.266 [0.284]	
χ^2_{BPG}	1.016 [0.455]	
χ^2_{RESET}	0.242 [0.809]	
$\chi^2_{NORMALITY}$	221.716 [0.000]	

Note: F-statistics in the parentheses. *** – significance at 1 percent level, ** – significance at 5 percent level, * – significance at 10 percent level $\Delta Dummy_{BFSI_{2011}}$ – structural break occurred in the BFSI in 2011, $\Delta Dummy_{CLI_{2012}}$ – structural break occurred in the CLI in 2012.

Table 11. Short-run Estimation Results of the ARDL Model for Policy Rate – PR Model

Variable	$ARDL_{PR}(5, 7, 5, 6)$	t-values
	Short-run coefficients	
ΔPR_t	0.245***	3.347
ΔPR_{t-1}	0.040	1.157
ΔPR_{t-2}	0.214***	3.169
ΔPR_{t-3}	-0.159**	-2.156
ΔCPI_t	0.222***	7.399
ΔCPI_{t-1}	0.030	0.805
ΔCPI_{t-2}	0.041	0.257
ΔCPI_{t-3}	-0.033	-0.978
ΔCPI_{t-4}	-0.063*	-1.889
ΔCPI_{t-5}	-0.125***	-3.930
ΔCPI_{t-6}	-0.092**	-2.634
$\Delta BFSI_t$	-0.018***	-3.473
$\Delta BFSI_{t-1}$	0.003	0.518
$\Delta BFSI_{t-2}$	-0.002	-0.325
$\Delta BFSI_{t-3}$	0.008	1.359
$\Delta BFSI_{t-4}$	-0.021***	-3.894
ΔCLI_t	-0.004**	-2.147
ΔCLI_{t-1}	-0.0004	0.159
ΔCLI_{t-2}	-0.002	-1.057
ΔCLI_{t-3}	0.001	0.271
ΔCLI_{t-4}	0.005*	1.938
ΔCLI_{t-5}	-0.005**	-2.193
$\Delta Dummy_{BFSI_{2011,t}}$	-0.025***	-4.000
$\Delta Dummy_{CLI_{2012,t}}$	-0.001	-0.109
$Constant$	0.004***	4.822
ECM_{t-1}	-0.144***	-7.923
	Diagnostic test statistics	
R^2	0.993	
DW	2.132	

Note: *** – significance at 1 percent level, ** – significance at 5 percent level, * – significance at 10 percent level. $Dummy_{BFSI_{2011}}$ – structural break occurred in the BFSI in 2011, $Dummy_{CLI_{2012}}$ – structural break occurred in the CLI in 2012.

The results of short-run error correction estimates for Eqn. (5) are presented in Table 11. The significant and smaller than unity lagged error correction term (ECM_{t-1}) indicates the existence of long-run cointegration between CLI, $BFSI$, PR and CPI in estimated Eqn. (5). These results also confirm the existence of long-run relationship among policy rate and financial stress in Belarus calculated using bound F-test (see Table 7). Moreover, the negative sign of error correction term shows that 14 percent of long-run disequilibrium in policy rate caused by other three variables will be corrected in each short-run period (month as in present paper) in Belarus. The value of R^2, which measures the overall goodness of the fit of the model, indicates that it is well defined.

Stability of the estimated ARDL models' parameters is necessary for the empirical findings to be valid over the sample period. To test for parameters' stability the CUSUM and CUSUMSQ test statistics are calculated to the recursive residuals of the models. Plots of the CUSUM and CUSUMSQ test statistics are presented in Figure 3 and 4 revealing no evidence of parameter instability in the selected ARDL models at 5 percent critical level.[8] Therefore, the stability of the estimated parameters indicates that the ARDL models can be considered stable enough for proper policy analysis.

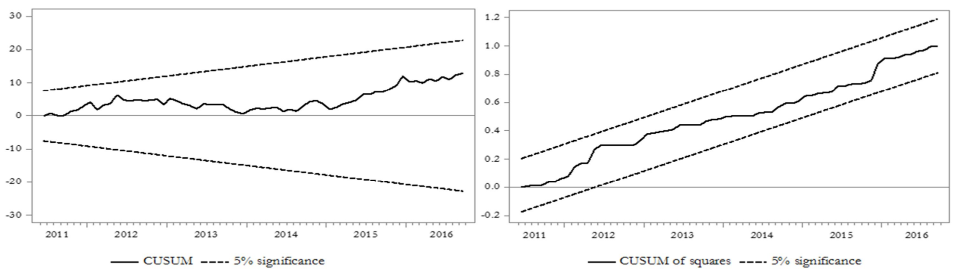

Figure 3. Stability Tests for CLI Model

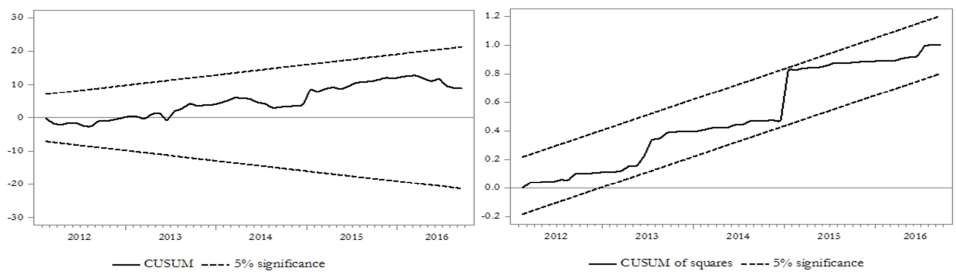

Figure 4. Stability Tests for PR Model

[8] The cumulative sum of the recursive residuals and the cumulative sum of squares of the recursive residuals within 5 percent significance lines suggest that the residual variance is stable.

5.4. Toda-Yamamoto Causality Analysis

Table 12 shows the results of Toda-Yamamoto causality analysis for $BFSI$, CLI, PR, and CPI indicating presence of the next causality relationships:

$BFSI \rightarrow CLI \rightarrow CPI \leftrightarrow PR.$

The findings show that $BFSI$ Granger causes economic activity. In turn, economic activity Granger causes inflation. Finally, there is a bidirectional causality running from inflation to monetary policy (through policy rate) and from monetary policy to inflation.

These results suggest that higher financial stress in Belarus leads to lower economic activity that causes higher inflation, which in turn leads to higher policy interest rate (tight monetary policy) introduced to ensure stable prices. However, in case of financial stress episode a sharp increase in the interest rate decreases investment levels in response to shrinkage of credit in the banking system, which leads to recession in Belarusian economy.

From the theoretical point of view, these findings also signify that there is no evidence for the support of the conventional wisdom hypothesis in Belarus since 2004. The $BFSI$ does not Granger causes CPI and vice versa.

Table 12. Toda-Yamamoto Causality Tests Results

Null Hypothesis	Chi-Sq. test	P-value	Inference
$BFSI \rightarrow CLI$	18.963*	0.089	Yes
$BFSI \rightarrow PR$	11.423	0.493	No
$BFSI \rightarrow CPI$	17.613	0.128	No
$CLI \rightarrow BFSI$	10.920	0.536	No
$CLI \rightarrow PR$	11.828	0.460	No
$CLI \rightarrow CPI$	19.426*	0.078	Yes
$PR \rightarrow BFSI$	10.158	0.602	No
$PR \rightarrow CPI$	22.291**	0.034	Yes
$PR \rightarrow CLI$	17.315	0.138	No
$CPI \rightarrow BFSI$	10.704	0.555	No
$CPI \rightarrow CLI$	6.720	0.876	No
$CPI \rightarrow PR$	30.950***	0.002	Yes

Note: *** – significance at 1 percent level, ** – significance at 5 percent level, * – significance at 10 percent level.

6. CONCLUSION

This paper constructs a financial stress index for Belarus (BFSI) based on the principal component analysis and incorporating distinctive indicators for the banking sector, exchange market and external debt risks. It identifies episodes of financial turmoil in the Belarusian economy using BFSI, assesses the consequences for the real economy, and examines the long-run relationship between financial stress, economic activity and monetary policy in the country applying the ARDL approach.

The results indicate that the aforementioned subcomponents of the BFSI capture main features of financial stress in Belarus as the BFSI tops at identified financial stress episodes during studied period. The first one led to a persistent decline in economic activity for 12 months and resulted in the contraction of GDP by 5.9 percent. The second one pushed Belarusian economy into a severe recession, which lasted 52 months with cumulative output losses about 12.9 percent of GDP.

The findings of the estimated ARDL models show, first, that financial stress has large negative long-run effect on real economic activity, second, its effect on policy interest rate is small, and, third, the increase in economic activity does not have statistically significant effect on policy interest rate in Belarus.

Furthermore, the Toda Yamamoto causality analysis provide additional evidence for a causal relationship between level of financial stress, economic activity and monetary policy in the country. In particular, economic activity is Granger caused by BFSI. Economic activity Granger causes inflation. Finally, there is a bidirectional causality between inflation and policy rate. However, as for the monetary policy, the analysis finds no significant evidence of a causal relationship between policy rate and level of financial stress in the economy.

Therefore, the results from the ARDL models and TY causality analysis may indicate that policy rate established by the Belarusian monetary authority does not fully absorb the market information on increasing financial imbalances in the economy. As a result, policy rate is sharply increased in the aftermath of the financial stress episode, which subsequently decreases investment levels as a response to shrinkage of credit in the banking system leading to recession in the Belarusian economy.

The results of Toda Yamamoto causality analysis also show that the growth in the financial stress does not Granger cause inflation and vice versa. From the theoretical point of view, this signifies that there is no evidence for the support of the conventional wisdom hypothesis for Belarusian economy. Price stability is not a sufficient condition to support financial stability in the country.

Finally, the paper has three policy implications. First, the BFSI may be considered as a comprehensive indicator that successfully determines the main episodes of financial stress in Belarusian economy and can be used to study their macroeconomic consequences. Second, the BFSI identifies the most salient stress factors for Belarus, thereby showing which financial sectors need to be monitored carefully by national regulator to avoid a critical buildup of risks in the financial system. Third, efforts to confine financial stress will support the country's economic activity in the long-run, which may include intervention in the foreign exchange market and build up of investor confidence in the economy.

This paper has its limitations. First, due to relatively short range of data it is unavailable to check the robustness of the constructed financial stress index on other episodes of financial instability in the Belarusian economy. Second, the findings should also be considered in the broad context of the economy subject to complex interlinked economic and financial processes with neighboring countries.

The results of this study suggest that it is of great importance for further studies to consider how to take into account the financial stress measure in the estimated monetary-policy rule and study how this may influence macroeconomic and financial stability in the developing countries.

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