

МАКРОЭКОНОМИЧЕСКИЕ РАСЧЕТЫ

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FINANCIAL CYCLES IN THE EURASIAN ECONOMIC UNION

1. Introduction

The crisis of 2007–2009 has demonstrated vulnerability of all types of economies to the availability of finance. This crisis has also reminded that in the modern world countries are highly connected in terms of finance and trade, implying that financial problems of one large economy (or a group of economies) threaten the stability and development of the world economy as a whole. Indeed, one of the outcomes of the post-crisis research in the field of financial system development was to demonstrate that the ratio of credit to private sector to GDP over 100% is detrimental to economic growth (Berkes, Panizza, Arcand, 2012).

The evidence suggests that the financial system is even more important for developing and emerging markets, since it has been shown that high external credit exposure is responsible for the phenomenon of so-called «sudden stops» — cases of sudden reversals of current account positions followed by recessions in emerging economies (Mendoza, 2006). The role of finance, especially that of external financing, has been also well-documented for resource-dependent countries due to the propensity of both governments and private sector to borrow abroad in times of high resource prices (see e.g. Gavin et al., 1996; Kaminsky, Reinhart, Vegh, 2005; Mendoza, Terrones, 2008; Reinhart, Reinhart, 2009; Frankel, 2010).

It has been also shown empirically and grounded theoretically that credit developments and subsequent instability are contagious due to a number of reasons. Kaminsky et al. (2003) group all explanations into three major themes: *herding behaviour* (related to information constraints, observed behaviour and costs of being out of surrounding network — see e.g. Calvo, Mendoza 2000), *trade linkages* (extensive trade linkages create sensitivity to the economic stance and economic policy decisions of major trading partners, such as devaluation — see e.g. Charemza et al., 2009), and *financial linkages* (external credit, openness of capital flows, potential for speculative attacks (see e.g. Kaminsky, Reinhart 2000). The last two reasons — trade and financial linkages — are especially relevant for countries that form economic union of any sort, since it is in trade and finance that first and closest ties usually develop.

The issue of interdependence is highly relevant for the recently created Eurasian Economic Union (EAEU), a successor to the Common Economic Area. The current members of the EAEU include Russia, Kazakhstan, Belarus, Kyrgyzstan and Armenia. The EAEU has ambitious goals, including, among others, those of creating a common market for goods, services, capital and labour, development of unified economic policies such as tax, monetary, exchange rate, financial, trade, custom and tariff. It is known that a development of economic integration of this sort has to be gradual and take into

account interconnections and spillover effects between participating countries (Frankel, Rose, 1998; Crucini et al., 2011).

The three major countries of the EAEU demonstrate a high level of existing economic interdependence in terms of business cycles synchronization (see e.g. Vymyatnina, Antonova, 2014a) that might negatively affect the stability prospects of the union, though representing potential for deepening economic integration. The two largest countries of the EAEU — Russia and Kazakhstan — are examples of resource-dependent economies, and this provides further potential for destabilizing economic growth in the EAEU as a whole. In this regard a deeper analysis of financial interrelations between the EAEU countries is both logical and desirable.

Our paper contributes to the literature in the following ways: first, we consider a group of the three largest countries belonging to the EAEU aiming at contributing the literature on this integration project; secondly, we account for specific features of these countries, and emerging economies more generally, in our definition of financial cycles. The paper is structured as follows: at the beginning we provide a brief literature review on financial cycles and relevant EAEU studies, next we describe data and methodology, following by presentation of results and conclusions.

2. Financial cycles literature

The importance of financial side of the economy for macroeconomic dynamics has been known for some time — the now famous Minsky's financial instability hypothesis was formulated in 1950s (Minsky, 1957), the importance of credit for the economic dynamics was explored in a seminal paper by Stiglitz and Weiss (1981), and the issue of credit influence on economic indicators was developed, for example, in a paper from the Federal Reserve System (Thornton, 1994). More recent, but pre-crisis works paying attention to the financial system include, for instance, (Borio, Lowe, 2002), and (Stiglitz, Greenwald, 2003).

Financial crisis led to a body of research that explicitly addressed the issues of financial cycles and their relation to business cycles as well as relevant policy implications. A good overview of this strand of research and of the main issues that remain to be solved is provided by Borio (2014). There is no clear and unified definition of financial cycle nor a universal measure of it. A general consensus is that financial cycle covers the idea of credit expansion and contraction and associated changes in spending and investment decisions, risk attitude, mode of expectations etc. (Borio, 2014, p. 183). Accordingly, most measures of financial cycle include some sort of credit indicators and measures of investment activities and risk attitude. There is also a consensus that financial cycles are in general longer than business cycles, at least for developed countries, so the emphasis is on the medium-term (Borio, 2014).

Some authors pay attention only to the cycles of credit (e.g. Mendoza, Terrones, 2012; Schularik, Taylor, 2012). Drehmann et al. (2012) suggest that the most parsimonious definition of financial cycle includes credit indicators and property prices since the latter is considered as capturing investors' expectations. These authors consider equity prices as being a distraction due to higher volatility. Other authors consider equity prices as having relevant information and add market indexes into their definitions of financial cycles, on top of credit and property prices (see e.g. Claessens et al., 2011a; Claessens et al., 2011b). Still others add further variables. For example, Stremmel (2015) considers seven indicators: property prices to disposable income, credit to GDP ratio, annual growth rates of credit and house prices, as well as a set of banking sector ratios, including funding to total assets, net income to total assets, and loans to total assets. Giordani et al.

(2017) form an early warning indicator of financial cycle developments, including credit to GDP ratio, house prices and a ratio of unstable to stable funding in the banking sector. They suggest that there are other potential candidates to be included in the future in their measure of financial cycle, namely, commercial property prices, volatility of credit, credit quality and foreign business of banks. They found that indicators of non-performing loans and leverage ratio were not adding any substantial information. Kongsamut et al. (2017) consider the following six categories for their financial cycle indicator: interest rates, spread of risk premiums, equity market returns, credit standards, credit quantities and exchange rates.

These are just some examples of the work on financial cycles, and it is clear that the core consensus is that indicators of credit and property prices are considered by almost all authors, while other variables are added depending on the purpose of the study and a group of countries studied. The latter moment deserves a closer look. While for credit cycles there are several papers that include emerging economies and developing countries (e.g. Mendoza, Terrones, 2012; Schularik, Taylor, 2012; Deryugina, Ponomarenko, 2017), there has been not so much attention paid to financial cycles in emerging economies. One exception is the paper by Claessens et al. (2011b) in which they compare a group of emerging markets with advanced economies.

Both (Schularik, Taylor, 2012) and (Mendoza, Terrones, 2012) have concluded that for emerging market economies credit booms provoke financial crisis (followed by economic crisis), though for advanced economies this is not necessarily true. These differences can be explained by the fact that there are less crises in advanced economies to make the causality clear, or that their financial systems are much more developed, and hence the overall level of credit the financial system can support is much higher than in emerging economies. Deryugina and Ponomarenko (2017) find that credit gap is a good early warning indicator of credit cycle developments for emerging markets, though suggest that other indicators, like GDP growth rates and share of financial sector in GDP would further improve their early warning indicator.

Claessens et al. (2011b) find less recessions episodes in emerging economies in comparison with advanced countries, explaining this by a shorter sample period for the former group. They also find that recessions and downsides of financial cycles are deeper and more pronounced in emerging economies, and synchronization between business and financial cycles is higher in the group of advanced economies, which can be explained by more developed financial markets. Therefore, first studies of financial cycles in emerging economies suggest that there are differences between how advanced and emerging economies react to financial disruptions. These studies also mention the problem with data for emerging economies — for example, property prices indicators are often not available or available only for short periods of time.

The issue of financial cycles in economic unions (of various nature) to the best of our knowledge has not yet been researched, and even the ECB working paper on financial cycles in Europe concentrates on 11 ‘old’ EU members disregarding the newcomers. This aspect has not been yet properly researched for the EAEU countries either. Several studies have looked at the various aspects of financial systems interaction between these countries: potential for the introduction of the common currency (e.g. Schegoleva, Balashov 2010), legal aspects of financial development within the EAEU (e.g. Kozyrin, 2013), the role of Russia as a dominant country and provider of financial resources (e.g. Golovnin, 2016; Nersesov, 2011), potential gains from financial market liberalization for Belarus (Demidenko et al., 2016). One study has discussed credit cycles of Russia, Kazakhstan and Belarus, concluding that credit cycles of Russia and Kazakhstan are closely correlated, which can be explained by the similarity of the two economies rather

than by close ties between them, and the credit cycle for Belarus is practically unrelated to those of the other two countries (Vymyatnina, Antonova, 2014b).

There are also several papers focusing on related issues for Russia. As early as 2006 it has been shown that credit developments in Russia have an influence on its GDP (Vymyatnina, 2006). Lately several studies under the auspices of the Bank of Russia have addressed the links between macroeconomic and financial indicators and the issue of early warning indicators with results also applied to Russia (Deruigina, Ponomarenko, 2017; Mamonov et al., 2017; Ponomarenko et al., 2017). Mamonov et al. (2017) reinforce the notion of the 100% of credit to GDP ratio threshold from Berkes et al. (2012) as being an upper limit of optimal credit expansion in the economy and suggest that further deepening of financial system in Russia in the sectors of private credit and corporate bonds is desirable. However, the specific group of EAEU countries has not been covered by the previous studies of financial cycles.

3. Data and methodology

The Eurasian Economic Union (EAEU) came into being as a successor to the Customs Union (CU) created in 2010. Most available studies on the EAEU do not cover Kyrgyzstan and Armenia, since they have joined the union only recently. In our analysis we also focus on Russia, Kazakhstan and Belarus for several reasons. First of all, some data for Kyrgyzstan and Armenia are either missing (property prices) or time series are short (credit indicators), making analysis less meaningful. Secondly, existing previous studies allow us to make explicit hypotheses about behaviour and correlations of financial cycles in the three largest countries. As some previous studies (Vymyatnina, Antonova, 2014a; Vymyatnina, Antonova, 2014b) demonstrate that Russia and Kazakhstan have similar business and credit cycles and similar reactions to shocks, we anticipate that the same will be true for financial cycles, and that Belarus again will be least correlated with the other two countries. Thirdly, relative importance of Armenia and Kyrgyzstan in the EAEU is very low as is confirmed by their joint share of the customs fees of 3% within the EAEU and their indices of financial development, especially for Kyrgyzstan, are low compared to the other three countries (World Bank Group, 2018). This allows us to assume that Armenia and Kyrgyzstan are not in a position to influence financial stability of other union members, and we concentrate on the three biggest economies of the EAEU.

After analyzing various indicators that are included in the definitions of financial cycles, we decided to opt for the parsimonious definition of (Drehmann et al., 2012) and to include credit and property prices indicators. We exclude equity markets since compared to advanced countries financial markets in the countries we consider are shallow and highly volatile. However, this most simple definition does not allow for all specificities of the countries in question. We have to bear in mind that two of the three countries are resource-dependent (Russia and Kazakhstan), and that all three countries can be characterized as state-dominated economies though to a varying degrees (arguably, Belarus has the largest government presence in the economy, and Kazakhstan — the lowest).

Resource-dependence means importance of commodity (oil) prices for the general macroeconomic stance, including, among other things, export-import balance and credit dynamics. Because of that we decided to include current account balance as one of the financial cycle indicators. This is in line with the findings by (Ponomarenko, 2013) suggesting that addition of capital flows to the system of early warning indicators for emerging economies is important. In our opinion, CA balance is a better indicator

since it accounts for the capital flows, Central bank interventions in the foreign exchange market, changes in commodity prices and the propensity to consume imports. Another difference — capturing domination of the government in the economy — is that we consider two types of credit indicators: to compare our results with previous studies we use credit to private sector and its ratio to GDP, and to account for the government factor we also use separately government credit and total credit (private plus government) and their ratio to GDP.

The detailed list of data and their sources is provided in Appendix 1. Data are quarterly and cover slightly different periods for different countries: 2000q4 to 2019q1 for Russia, 2002q1–2019q2 for Belarus, 2001q4–2019q1 for Kazakhstan. Most data are from official statistical offices and Central banks. Data were seasonally adjusted where appropriate using Census X-12 procedure and deflated using CPI index. For combining data into financial cycles all relevant time series were taken in logarithms. CA balance time series were adjusted by an arbitrarily large number in order to the make the series non-negative.

There are two approaches in the literature on financial cycles on how the cycles are determined. The first one uses methods from the vast literature on business cycles and relies on data filtering (see e.g. Drehmann et al., 2012; Borio, 2014; Stremmel, 2015). This approach allows not only to study cycles of individual series representing part of financial cycles (credit, credit to GDP ratio, property prices etc.), but also of an aggregate indicator that combines several series into one. The second approach works with the data as they are using the turning points algorithm determining local maxima and minima of series within a given time frame (see e.g. Claessens et al., 2011a; 2011b). In fact, this is the method that NBER uses for determining recessions, and it was developed in (Bry, Boschan, 1971) and (Harding, Pagan, 2006). In our work we concentrate on the first method since, following (Drehmann et al. 2012) and (Stremmel, 2015), we believe that the composite measure of financial cycle is needed to capture developments in various sectors of financial system, and filtering time series at single frequency makes the series additive (Stremmel, 2015, p. 8).

The choice of a specific filter depends on the task at hand. The most widely used Hodrick-Prescott filter (HP) allows to use all data available that makes it very attractive for work with short data series. At the same time HP-filter is subject to serious critical comments, most important of which include: producing spurious dynamic relations, different results of filtering in the middle and at the ends of the sample, arbitrary choice of the smoothing parameter (Hamilton, 2017) or the fact that this filter does not allow for proper extraction of cycles since it filters off stochastic trend as well (Harding, Pagan, 2002).

An alternative is to use band-pass filters such as Baxter-King (BK) or Christiano-Fitzgerald (CF). In most cases it does not matter which frequency filter (BK or CF) is used, but for our data when we opt for medium-term cycles results between the two filters are different. We chose to rely on CF filter since its results are more in line with the HP filter. Therefore, for robustness check we compare results for HP and CF filters. Another argument against BK filter is that it shortens sample symmetrically thus reducing sample size more substantially, which is undesirable for our relatively short samples.

Usually the length of financial cycle for the band-pass filters is chosen to be between 32 and 120 quarters (Drehmann et al., 2012, p. 4; Stremmel, 2015, p. 9). We use a shorter time span, between 16 and 40 quarters for our data since we have shorter samples than are available for advanced countries, and it is known that for emerging markets the length of business cycles is considerably shorter than in advanced

economies (Aguilar, Gopinath, 2007), making plausible the hypothesis that financial cycles are also shorter for these countries. This evidence is corroborated by Claessens et al. (2011b) who confirm that for emerging economies the length of both business and financial cycles is lower than for advanced economies. This accounts for the choice of lower bound for CF filter of 16 quarters. The upper bound of 40 quarters has been chosen for the stability of results it produces, and also with the idea of allowing for shorter duration of financial cycles in the countries we consider in comparison with advanced economies.

Once the series are filtered, thresholds (of statistical nature) can be applied to determine the start and end dates of the boom and bust stages of the series, denoting cyclical variation higher than average (Mendoza, Terrones; 2012). More precisely, if l_{it} is the deviation of some time series from its long-term trend, and if $\sigma(l_i)$ is the standard deviation of cyclical component of this time series, then if on one or more particular sequential dates it is true that $l_{it} \geq \varphi\sigma(l_i)$ (φ is the *threshold*), we can claim that on this date(s) a boom was observed in this time series. The sign of the inequality changes for the busts. We pay more attention to the booms, since they potentially precede financial and economic crises. To check for robustness, alternative values of φ were used (1.75 and 1.5 as suggested in (Mendoza, Terrones, 2012)). The peak date of boom of some time series is the date when the difference between l_{it} and $\varphi\sigma(l_i)$ is the largest for a set of continuous dates. The date preceding the peak with the smallest absolute difference between l_{it} and $\varphi\sigma(l_i)$ is the start date, and the date following the peak date with the smallest absolute difference between l_{it} and $\varphi\sigma(l_i)$ is the end date, where φ_s and φ_e we assume equal to 1 as in Mendoza and Terrones (2012). We also consider smaller values of φ_s and φ_e , with no substantial difference in results¹. In this way we have several robustness checks: using different filters, and different values of φ_s and φ_e .

We first analyse (in de-trended form and in logs) eight separate indicators of financial cycles for each country: credit to private sector, its ratio to GDP, credit to the government sector and its ratio to GDP, total credit and its ratio to GDP, property prices, and current account balance. We consider the periods of booms and busts for these series, as well as their correlations between each other and with the business cycle for each country. At the next stage we combine these individual indicators (in logs) into several alternative composite measures of the financial cycle for each country (9 in total). They are combined in threes and include a credit measure (private, government or total) and its ratio to GDP as the most parsimonious definition, then we add property prices, and then — CA balance to GDP ratio. Details of how various measures of financial cycles are defined are provided in Appendix 3. These composite measures are then analyzed for separate countries, and at the following step the cross-country relations between financial cycles are considered in the framework of a simple VAR model.

4. Results and discussion

Tables 1–3 in Appendix 2 present results of applying threshold method to define the periods of booms and busts (with peaks and troughs) for individual indicators of financial cycle and to the business cycle of each country. Analyzing performance of different filters, we consider results produced by CF filter as more robust compared to those by HP filter since it produces series with lower amplitude resulting in almost no cases of a boom/bust period lasting one quarter only or when the two booms are 2 quarters apart. All filters

¹ Details on results with other values of φ_s and φ_e are available from the authors upon request.

used are robust to the change of threshold with the only difference being the length of the boom/bust period determined. However, one might note that the HP-filter generally suggests more periods of booms/busts (and, correspondingly, more peaks/troughs). This leads to situations when with the increase in the threshold value there are more booms/busts and peaks/troughs since the phases in some cases become very short. This is an additional point in favour of the CF-filter.

It is noticeable that the booms of CA balance to GDP cycles are different from other financial cycle indicators. This suggests that this might not be the best option for inclusion into aggregate financial cycle indicators. The periods of booms and busts in CA balance to GDP ratio are closer for Russia and Kazakhstan, which might be attributed to common dynamics of oil prices and related GDP movements. In Belarus CA balance to GDP cycle's boom is in late 2011 and early 2012, closer to a boom of 2011 in other indicators (such as private credit and total credit and their ratio to GDP), and might be related to the event of Beltransgaz purchase by the Gazprom in late 2011 resulting in a substantial improvement of CA balance for Belarus.

Private credit, total credit and property prices for Russia and Kazakhstan are very much in line with each other and with GDP cycle in terms of booms and busts as well as in peaks and troughs. It is interesting to note that the cycle of government credit in these two countries seems to be rather counter-cyclical relative to GDP cycle and almost completely unrelated to other credit indicators. This suggests that in Russia and Kazakhstan government credit (comprising credit to government authorities of regional and municipal levels, as well as government-owned companies) acts as a sort of stabilizer for the economy, meaning that the government (and its companies) is most active in its spending during recessions. This is in line with findings by (Vymyatnina, 2006) that credit to state-controlled enterprises has important implications for the dynamics of money supply and inflation. In Belarus, however, private and total credit seems to lag behind the GDP cycle, and government credit does not have pronounced booms periods, while its bust periods precede somewhat the bust periods for private and total credit. This suggests that government credit in Belarus plays different role in the economy, compared to Russia and Belarus.

Considering correlations between individual indicators of financial cycles (see table 4 of Appendix 2), there are several interesting features. CA balance to GDP cycle in both countries is negatively correlated with private and total credit cycles (and their ratio to GDP), but positively with government credit cycles (though this correlation is not always statistically significant). This is in contrast with Belarus where CA balance to GDP is negatively related to all types of credit (and always significantly). This confirms the difference between Belarus and the other two countries in terms of dependence on commodity markets. For both Russia and Kazakhstan government credit is negatively correlated with private and total credit. This means that credit to the government in these countries plays more of a stabilizing role. This is again in contrast to Belarus where government credit is unrelated to private credit and is positively related to the total one. This can be explained by the different significance of government credit in Belarus and in the other two countries. In the latter case total credit is dominated by credit to the private sector, while in Belarus government credit plays a more prominent role in the total credit.

Interestingly, results for correlations for the CF filter for all countries suggest that GDP cycle is unrelated to all other cycles (in terms of contemporaneous correlations), while results for HP filter provide statistically significant correlations. This is reasonable since HP filter provides less smooth results. It also suggests that other indicators of financial cycles might be more in line with GDP cycle with some lag. Another interesting result about correlations between the cycles concerns

property prices. In both Russia and Kazakhstan their cycle is in line with private credit and total credit, and is inversely related to the cycle of government credit. In Belarus, however, the relation is completely different. This suggests that in Belarus the economy is much more government-oriented, and property prices move in line with the situation in government companies and agencies, and not so much so with what happens in the private sector.

These preliminary results suggest that in terms of composition of aggregate financial cycles for Russia and Kazakhstan more promising in terms of their relation to the GDP cycles will be financial cycles based on private or total credit and property prices, while for Belarus better results might be expected for financial cycles based on government credit. CA balance might be of less relevance, but we try them as well. The various compositions of aggregate financial cycles are described in Appendix 3, while tables 2–4 there provide results for booms and busts periods for different measures of financial cycles contrasted against GDP cycles booms and busts. Table 1 in Appendix 3 provide weights for individual components for the aggregate financial cycles. We rely on weights to be determined by factor loadings of the first principal component as opposed to equal weights as suggested in other studies (e.g. Drehmann et al., 2012 and Stremmel, 2015). The weights can be considered equal only for the most parsimonious definitions of aggregate financial cycles based on a credit aggregate and its ratio to GDP. In cases of wider definitions of financial cycles different components bear different weights, which is especially true for the CA balance to GDP ratio (negative in most cases) that has rather different dynamics as has been mentioned earlier.

While results for both CF and HP filters are quite similar, HP filter tends to suggest more short periods of booms and busts, and that might lead to more false alarms if an early warning indicator is constructed on its basis. In what follows we discuss mostly results based on the CF filter, since results for HP filter are qualitatively the same. Aggregate financial cycles for Russia based on CF filter are presented in figs 1 and 2, for Kazakhstan — on fig. 3, for Belarus — on fig. 4. An important implication of this exercise is that for all three countries all types of credit indicators are important — in some instances it was private credit, in others — government credit that were more closely related to the peaks and troughs of GDP. Moreover, both booms and busts of different credit indicators might be potential early warning indicators of a change of tendency of GDP cycle. In some cases, the troughs of FC based on government credit preceded the peaks of GDP cycle and vice versa. This is especially true for the cases of Russia and Kazakhstan. It seems that the FC definitions that include property prices are better candidates for being used to forecast GDP cycles than FC measures based on credit aggregates only or those including CA balance ratio to GDP. However, we would like to stress that we did not aim at forecasting GDP cycles in our paper here. The fact that no specific FC credit-based indicator is related to GDP cycle closer than others is confirmed by the analysis of cumulative correlations (both lagged and forward) between different measures of FC and GDP cycle — after a few years they all are not very different from zero. Therefore, one important implication of our analysis is that there is no one specific indicator of credit that should be taken into account, but that all of them should be monitored in countries we consider.

In order to study closer relation of financial cycles and between the countries that we consider, we employ another tool from analysis of business cycles literature related to synchronization of business cycles — that of VAR-analysis. On the basis of the previous discussion we have chosen to consider those measures of financial cycle that include CF-filter based cycles of credit indicator and its ratio to GDP as well as property prices (that is, FC2, FC5 and FC8 measures of financial cycle).

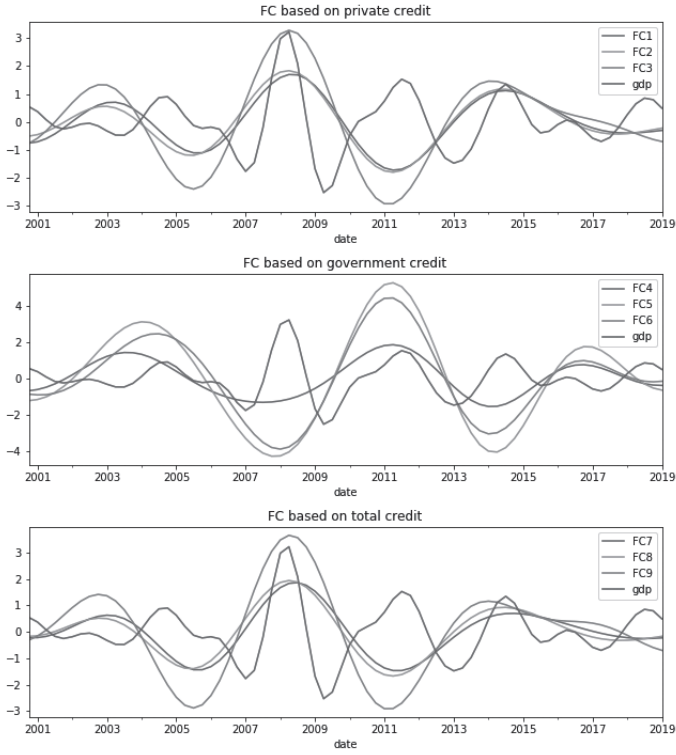


Fig. 1. Difference aggregate measures of financial cycles for Russia grouped by the type of credit

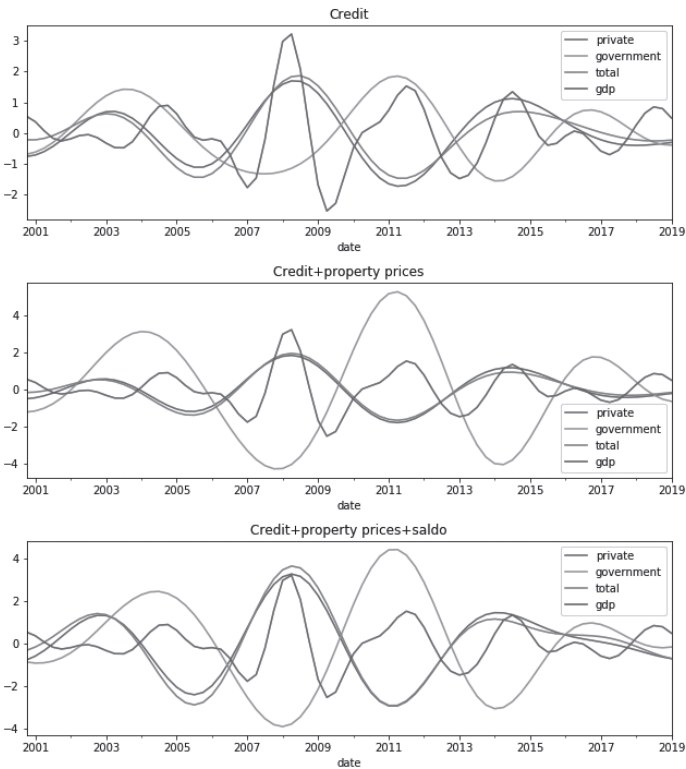


Fig. 2. Different measures of aggregate financial cycles for Russia grouped by the number of aggregates in the FC definition

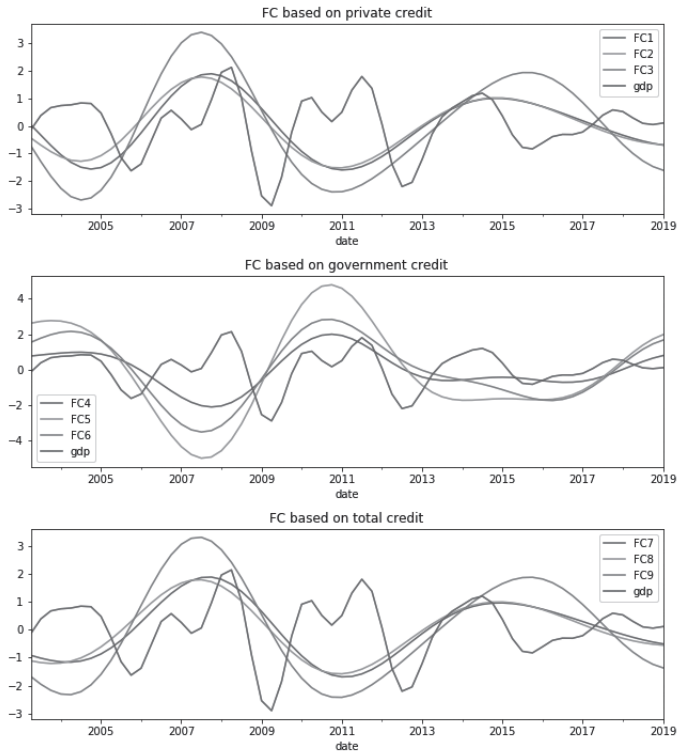


Fig. 3. Difference aggregate measures of financial cycles for Kazakhstan grouped by the type of credit

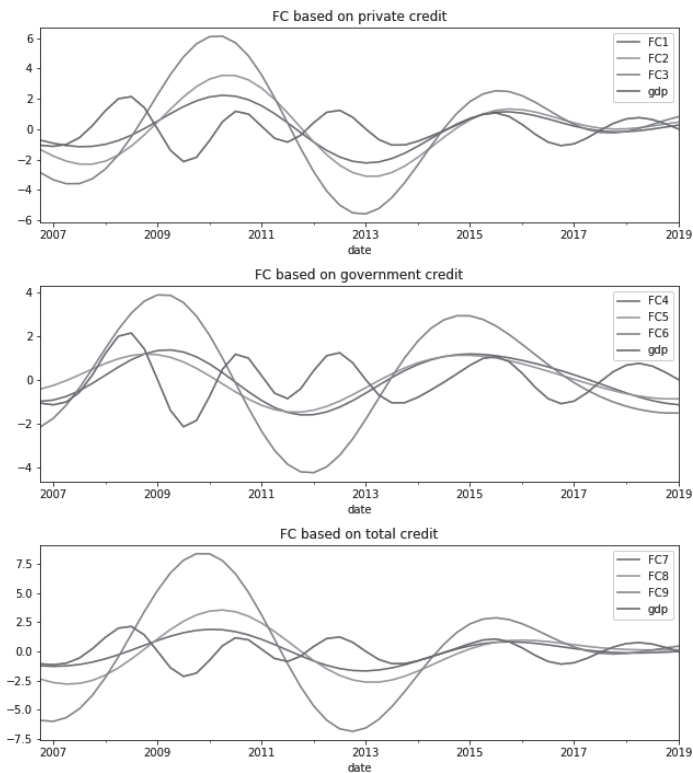


Fig. 4. Difference aggregate measures of financial cycles for Belarus grouped by the type of credit

We use impulse-response analysis to check how shock to the financial cycle measure in one country might affect a similar FC measure of other countries (see Appendix 4 for details). Experiments with the length of lags resulted in 2 lags as being sufficient in all our VAR models (based on Akaike and Schwartz information criteria and other indicators of VAR quality). The speed with which the effect of another country's shock influence disappears (measured as quarters it takes before influence of this shock becomes insignificant) compared between the three countries allows making additional insights on spillover effects between the countries.

It is interesting to note that in case of all three selected measures of FC, Russia's cycle does not explain any part of the Kazakhstan's or Belarus cycles in terms of variance decomposition. Cycles of credit to the private sector and to the government sector in Kazakhstan and Belarus also do not react in any significant way to changes in Russia's financial cycle. Only in terms of total credit there is significant effect from shocks to Russia's financial cycle in the other two countries — positive for Belarus (after 2.5 years) and negative for Kazakhstan (after slightly more than 1 year). At the same time for total credit both Russia and Kazakhstan do not react in any way to shocks in Belorussian cycle, but in all other cases shocks to Belarus's or Kazakhstan's financial cycle provokes statistically significant effect in the FCs of the other two countries. In terms of residual correlation matrix, the two least related countries are Kazakhstan and Russia, which suggests that despite of similarity of general macroeconomic conditions, internal specifics of the two countries results in very different patterns of credit. These results suggest that though Russia is the largest country of the EAEU, its influence on the situation in credit and property markets in the other two large economies of the EAEU is very limited and indirect. More elaborate studies of financial linkages between the studied countries are needed to explore in full financial connections and their importance for the financial cycles in these countries.

5. Conclusions

We have considered several individual and combined measures of financial cycles of the three largest countries of the Eurasian Economic Union — Russia, Belarus and Kazakhstan. In our analysis we used both conventional measures used by other authors and mostly for advanced countries and measures that could reflect better specific conditions of these countries, namely, resource dependence (proxied by the current account balance) and importance of the government-related credit as opposed to private credit.

We used two different filters (Christiano-Fitzgerald and Hodrick-Prescott) to construct financial and GDP cycles, and a number of measures for composite financial cycles. Results are robust for the two different filtering methods, suggesting that HP filter might be too noisy and result in shorter boom/bust periods. Therefore, for historical study of cycles CF filter is better suited. However, it should be remembered that one-sided HP filter can be used for defining financial cycle using the most recent information. This point was not developed further in this paper.

It is important to note that for the countries that we considered — Russia, Kazakhstan and Belarus — all types of credit are important (credit to the private sector, to the government sector and total credit), and a special attention should be paid to a potential change in the phase of the credit cycle (regardless of the type of credit) as there is no stable and sustained relation between any individual or composite measure of financial cycle and GDP cycle, as our analysis of cumulative correlations confirms.

In terms of composite measures of financial cycle, the most often used one, comprising a credit indicator, its ratio to GDP and property prices provides the most promising results in terms of potential for construction of an early warning indicator. However, our

study did not aim to construct such an indicator, and this suggestion has to be further studied. It is important to note that the CA balance does not improve significantly on the relation between the composite measures of financial cycles and GDP cycle, and one might conclude that any influence over financial developments that it has, is already accounted for in the credit indicators.

Taken on themselves the financial cycles of the three considered countries (on the basis of the most robust measure described earlier) are not closely related, and Russia's financial cycle hardly influences that of the other two countries. This suggests that financial linkages have to be studied in more details, and that macroeconomic situation of any country is more important than the influence of the largest country in the EAEU. Some other directions for further research include, for example, the question of high correlation between financial cycles of Belarus and Kazakhstan, connections between more specific types of credit (e.g. for investment purposes or consumer credit) with the dynamics of the corresponding GDP components (investments, consumption etc.), and the use of financial cycle measures as early warning indicators.

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Appendix 1

List of data and their sources

General comments to preliminary data adjustments:

- data series were first seasonally adjusted (including CPI index);
- seasonally adjusted data were deflated by CPI where appropriate (we tried GDP deflator as well with no substantial differences in the results);
- data on current account balance were first converted into national currency using official data on exchange rate as effects of CA balances changes on the economy and credit developments should be taken into account in local currency.

Data series	Period	Source
Russia		
Credit by the banking system to the economy, total Credit by the banking system to the private sector	2000Q4– 2019Q1	Bank of Russia https://www.cbr.ru/statistics/?PrtId=dkfs
Property prices, secondary market (for comparability with other countries)	2000Q1– 2019Q1	Unified Interdepartmental Information and Statistical System, Government Statistics https://www.fedstat.ru/indicator/31452
Current account balance	2000Q1– 2019Q1	Bank of Russia http://www.cbr.ru/statistics/Default.aspx?PrtId=dops_table&pid=svs&sid=itm_55060
Consumer price index	2000Q1– 2019Q2	State Statistical Committee (Rosstat) http://www.gks.ru/free_doc/new_site/prices/potr/tab-potr1.htm
Ruble — USD exchange rate	2000Q1– 2019Q1	Bank of Russia http://www.cbr.ru/statistics/macro_itm/svs/
GDP in current prices	2000Q1– 2019Q1	State Statistical Committee (Rosstat) http://www.gks.ru/free_doc/new_site/vvp/kv/tab5.htm
Belarus		
Credit by the banking system to the private sector	2000Q1– 2019Q2	National Bank of the Republic of Belarus http://www.nbrb.by/statistics/MonetaryStat/DepositoryCorporationsSurvey
Credit by the banking system to the economy, total	2006Q4– 2019Q2	National Bank of the Republic of Belarus http://www.nbrb.by/statistics/MonetaryStat/DepositoryCorporationsSurvey
Property prices, secondary market (for comparability with other countries), Minsk	2002Q1– 2019Q2	Real estate agency https://realt.by/statistics/dynamics/town/price_m2/usd/
Current account balance	2000Q1– 2019Q1	National Bank of the Republic of Belarus https://www.nbrb.by/statistics/BalPay/
Consumer price index	2000Q1– 2019Q2	National State Statistical Committee of the Republic of Belarus http://www.belstat.gov.by/ofitsialnaya-statistika/ssrd-mvf_2/natsionalnaya-stranitsa-svodnyh-dannyh/indeks-potrebitelskih-tsen/indeksy-potrebitelskih-tsen-1999-100/
Belorussian ruble — USD exchange rate	2000Q1– 2019Q2	National Bank of the Republic of Belarus https://www.nbrb.by/statistics/Rates/AvgRate/

The end of the table

Data series	Period	Source
GDP in current prices	2000Q1– 2019Q2	International Monetary Fund http://data.imf.org/regular.aspx?key=61545852 http://www.belstat.gov.by/ofitsialnaya-statistika/makroekonomika-i-okruzhayushchaya-sreda/natsionalnyescheta/operativnaya-informatsiya_5/o-vtoroi-otsenke/otvoroj-otsenke-valovogo-vnutrennego-produkta-za-ii-kvartal-2017-g/
Kazakhstan		
Credit by the banking system to the economy, total Credit by the banking system to the private sector	2000Q4– 2019Q2 2001Q4– 2019Q2	National Bank of the Kazakhstan Republic http://www.nationalbank.kz/?docid=288&switch=russian
Property prices, secondary market (for comparability with other countries)	2003Q2– 2019Q2	Ministry for national Economy of the Kazakhstan Republic. Statistical Committee https://stat.gov.kz/faces/wcnav_externalId/homeNumbersPrices?_adf.ctrl-state=lesn4e51g_465&_afLoop=786424858970375
Current account balance	2000Q1– 2019Q1	National Bank of the Kazakhstan Republic http://www.nationalbank.kz/?docid=343&switch=russian
Consumer price index	2000Q1– 2019Q2	National Bank of the Kazakhstan Republic http://nationalbank.kz/?docid=277&switch=russian
Tenge — USD exchange rate	2000Q1– 2019Q2	National Bank of the Kazakhstan Republic http://nationalbank.kz/?docid=763&switch=russian
GDP in current prices	2000Q1– 2019Q1	Ministry for national Economy of the Kazakhstan Republic. Statistical Committee https://stat.gov.kz/faces/wcnav_externalId/homeNationalAccountIntegrated?_adf.ctrl-state=o9keu87hb_85&_afLoop=1903421528141431#%40%3F_afLoop%3D1903421528141431%26_adf.ctrl-state%3Dvx3t6s4xn_4

Appendix 2

Boom periods and peaks for financial cycle individual indicators and real GDP by countries

General comment to tables 1–3: for real GDP CF filter had expected cycle length was 6–16 quarters instead of 16–40 quarters for financial cycle indicators

Table 1

Russia

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
Booms									
CF (1.5)	2007q3–2008q3 2008q4–2013q4 2014q1	2003q2–2004q1 2011q1–2012q1	2007q3–2008q4	2007q3–2008q4	2007q4–2008q3 2011q3	2005q2–2006q1	2008q2–2009q2	2010q2–2011q3	2008q2–2009q3
CF (1.75)	2007q4–2008q2	2011q2–2012q1	2007q4–2008q3	2007q3–2008q3	2008q1–2008q3	2005q3–2006q1	2008q3–2009q1	2010q3–2011q2	2008q3–2009q2
HP (1.5)	2007q3–2009q1	2003q1–2003q3 2011q3–2012q2	2007q3–2009q1	2007q1–2008q4	2007q4–2008q3	2015q1–2015q2 2018q3	2007q3–2009q1–2009q4	2003q1–2003q3 2011q3	2009q3–2009q4 2015q4
HP (1.75)	2007q3–2008q4	2011q3	2007q3–2008q4	2007q1–2008q3	2007q4–2008q2–2008q3	2015q1–2018q3	2009q3–2009q4	–	2009q3–2009q4
Peaks									
CF (1.5)	2008q1–2014q1	2003q3–2011q3	2008q1	2008q1	2008q2–2011q3	2005q4	2008q4	2011q1	2009q1

The end of the table

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
CF (1.75)	2008q1	2011q3	2008q1	2008q1	2008q2	2005q4	2008q4	2011q1	2009q1
HP (1.5)	2008q3	2003q1 2003q3 2011q3	2008q3	2008q3	2008q3	2015q1 2018q3	2007q3 2009q3	2003q1 2003q3 2011q3	2009q3 2015q4
HP (1.75)	2008q3	2011q3	2008q3	2007q2 2008q3	2007q4 2008q3	2015q1 2018q3	2009q3	–	2009q3
Busts									
CF (1.5)	2010q2– 2011q3	2014q2– 2014q3	2010q2– 2011q3	2010q4– 2011q4	2007q1 2009q1– 2009q3	2008q1– 2008q4	2005q4– 2006q1 2001q3– 2012q2	2007q2– 2007q3 2013q3– 2014q2	2005q3– 2006q2 2012q1– 2012q2
CF (1.75)	2010q2– 2011q2	–	2010q3– 2011q2	2011q1– 2011q3	2007q1 2009q2– 2009q3	2008q2– 2008q3	2011q4– 2012q1	–	2005q4– 2006q1
HP (1.5)	2010q3– 2011q2	2005q4– 2006q2 2008q2– 2009q2	2005q1– 2005q2 2006q1 2010q4– 2011q1	2005q2– 2005q4 2011q1– 2011q4	2009q1– 2010q2	2009q1– 2009q2 2013q2 2017q2– 2017q3	2005q1– 2005q2 2006q1 2011q1– 2011q2 2012q1	2008q2– 2008q4	2005q1– 2006q2
HP (1.75)	2011q1	2005q4 2008q4 2009q2	2011q1	2011q1– 2011q3	2009q1– 2009q4	2009q1 2013q2 2017q2– 2017q3	2006q1 2011q2	2008q2– 2008q4	2005q1– 2005q2 2005q4– 2006q2
Troughs									
CF (1.5)	2010q4	2014q2	2011q1	2011q2	2007q1 2009q2	2008q2	2005q4 2012q1	2007q3 2014q1	2006q1 2012q2
CF (1.75)	2010q4	–	2011q1	2011q2	2007q1 2009q2	2008q2	2012q1	–	2006q1

Table 2

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP (1.5)	2011q1	2005q4 2008q4	2005q1 2006q1 2011q1	2005q2 2011q1	2009q2	2009q1 2013q2 2017q3	2005q1 2006q1 2011q2 2012q1	2008q4	2006q1
HP (1.75)	2011q1	2005q4 2008q4 2009q2	2011q1	2011q1	2009q2	2009q1 2013q2 2017q3	2006q1 2011q2	2008q4	2005q1 2006q1

Kazakhstan

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
Booms									
CF (1.5)	2007q1– 2008q1	2010q2– 2011q3	2006q4– 2008q1	2006q2– 2007q3	2008q1– 2008q2 2011q3	2004q2– 2005q1	2007q2– 2008q3	2010q1– 2011q2	2007q2– 2008q3
CF (1.75)	2007q2– 2007q4	2010q3– 2011q2	2007q1– 2007q4	2006q3– 2007q2	2008q1– 2008q2 2011q3	2004q3– 2004q4	2007q3– 2008q2	2010q2– 2011q1	2007q4– 2008q2
HP (1.5)	2006q4– 2008q1	2010q1– 2010q4	2006q4– 2008q1	2006q4– 2007q4	2006q4 2007q2 2008q3	2000q4 2004q4 2008q1 2008q3 2011q2 2014q1	2007q1– 2008q1 2009q1– 2009q3	2010q1– 2010q4	2007q1– 2007q4 2009q3

The end of the table

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP (1.75)	2006q4– 2007q4	2010q1– 2010q4	2006q4– 2007q4	2007q1– 2007q4	2006q4 2008q3	2000q4 2004q4 2008q3 2011q2 2014q1	2007q1– 2007q4 2009q1	2010q1– 2010q4	2007q1– 2007q4 2009q3
Peaks									
CF (1.5)	2007q3	2010q4	2007q3	2007q1	2008q2 2011q3	2004q3	2008q1	2010q4	2008q1
CF (1.75)	2007q3	2010q4	2007q3	2007q1	2008q2 2011q3	2004q3	2008q1	2010q4	2008q1
HP (1.5)	2007q2	2010q1	2007q2	2007q2	2006q4 2007q2 2008q3	2000q4 2004q4 2008q1 2008q3 2011q2 2014q1	2007q2 2009q3	2010q1	2007q2 2009q3
HP (1.75)	2007q2	2010q1	2007q2	2007q2	2006q4 2008q3	2000q4 2004q4 2008q3 2011q2 2014q1	2007q2 2009q3	2010q1	2007q2 2009q3
Busts									
CF (1.5)	2004q2– 2005q1 2010q3– 2011q1	2007q2– 2008q3	2010q2– 2011q2	2003q2– 2003q3	2005q4 2009q1– 2009q3 2012q3– 2012q4	2007q1– 2007q4 2015q4– 2016q4	2010q4– 2011q4	2007q1– 2008q2	2011q1– 2012q1

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
CF (1.75)	–	2007q2– 2008q2	2010q3– 2011q1	–	2009q1– 2009q3 2012q3– 2012q4	2016q1– 2016q3	–	2007q2– 2008q2	–
HP (1.5)	–	2007q2– 2007q4 2009q2	–	2003q2– 2003q3	2008q4– 2009q2	2001q4 2007q1– 2007q3 2009q1– 2009q2	2011q1– 2011q3	2007q2– 2007q4 2009q2	2011q3
HP (1.75)	–	2007q3– 2007q4 2009q2	–	2003q2	2008q4– 2009q2	2007q3 2009q1– 2009q2	–	2007q2– 2007q4	–
Troughs									
CF (1.5)	2004q4 2010q4	2007q4	2010q4	2003q2	2005q4 2009q2 2012q3	2007q3 2016q2	2011q2	2007q4	2011q3
CF (1.75)	–	2007q4	2010q4	–	2009q2 2012q3	2016q2	–	2007q4	–
HP (1.5)	–	2007q3 2009q2	–	2003q2	2009q1	2001q4 2007q3 2009q2	2011q2	2007q3 2009q2	2011q3
HP (1.75)	–	2007q3 2009q2	–	2003q2	2009q1	2007q3 2009q2	–	2007q3	–

Table 3.

Belarus									
Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
Booms									
CF (1.5)	2009q3–2011q1	–	2009q3–2010q3	2007q2–2008q3	2000q4 2001q1–2001q2 2008q2–2008q3	2011q4–2012q4	2009q4–2011q1	–	2009q4–2010q3
CF (1.75)	2009q4–2010q4	–	2009q3–2010q2	2007q3–2008q2	2000q4 2001q1–2001q2 2008q2–2008q3	2011q4–2012q3	2009q4–2010q4	–	2010q1–2010q2
HP (1.5)	2010q3–2011q2	–	2010q3–2011q1	2007q1–2007q4	2000q4 2008q2–2008q3 2012q2	2005q1 2011q3 2012q1–2012q2	2010q1–2011q2	2009q3	2010q2–2011q1
HP (1.75)	2010q3–2011q2	–	2010q4–2011q1	2007q2–2007q4	2012q2	2005q1 2011q3 2012q1–2012q2	2010q3–2011q2	–	2010q3–2011q1
Peaks									
CF (1.5)	2010q2	–	2010q1	2007q4	2001q1 2008q3	2012q2	2010q2	–	2010q2
CF (1.75)	2010q2	–	2010q1	2007q4	2001q1 2008q3	2012q2	2010q2	–	2010q2
HP (1.5)	2011q1	–	2011q1	2007q3	2000q4 2008q3 2012q2	2005q1 2011q3 2012q1	2011q1	2009q3	2011q1

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP (1.75)	2011q1	–	2011q1	2007q3	2012q2	2005q1 2011q3 2012q1	2011q1	–	2011q1
Busts									
CF (1.5)	2012q2– 2012q3	2011q2– 2012q1	2012q4– 2013q1	2010q3– 2011q2	2000q1– 2000q2 2009q3– 2009q4	2008q4– 2010q1	2012q3– 2013q4	2012q1– 2012q3	2012q4– 2013q3
CF (1.75)	2012q3– 2013q3	2011q3– 2011q4	–	–	2000q1 2009q3– 2009q4	2008q4– 2010q1	2012q3– 2013q4	–	2013q1
HP (1.5)	2012q1– 2013q1	2011q2– 2011q4	2011q4– 2012q2	2010q4– 2011q1	2000q1 2009q2 2010q1 2011q3 2016q3– 2016q4	2004q4 2009q1 2010q2– 2011q1	2012q1– 2013q2	2011q2– 2011q4	2012q2 2012q4– 2013q1
HP (1.75)	2012q1– 2013q1	2011q3– 2011q4	–	–	2000q1 2010q1 2011q3	2004q4 2009q1 2010q4– 2011q1	2012q2– 2013q1	2011q3– 2011q4	–
Troughs									
CF (1.5)	2013q1	2011q3	2012q4	2010q4	2000q1 2009q3	2009q3	2013q2	2012q2	2013q1
CF (1.75)	2013q1	2011q3	–	–	2000q1 2009q3	2009q3	2013q2	–	2013q1

The end of the table

Filter and threshold values (in brackets)	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP (1.5)	2012q2	2011q3	2012q1	2011q1	2000q1 2009q2 2010q1 2011q1 2011q3 2016q4	2004q4 2009q1 2011q1	2013q1	2011q3	2012q2 2012q4
HP (1.75)	2012q2	2011q3	—	—	2000q1 2010q1 2011q3	2004q4 2009q1 2011q1	2013q1	2011q3	—

Table 4

Correlations between individual indicators of financial cycles by country

	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
Russia									
CF									
Private credit	—								
Government credit	-0.660***	—							
Total credit	0.978***	-0.666**	—						
Property prices	0.897***	-0.734**	0.949***	—					
GDP	0.019	0.027	0.027	0.008	—				
CA balance to GDP	-0.453**	0.051	-0.580**	-0.562**	0.082	—			
Private credit to GDP	0.511***	-0.302**	0.588***	0.701***	-0.008	-0.542**	—		
Government credit to GDP	-0.805**	0.879***	-0.762**	-0.701**	0.000	0.085	-0.071	—	
Total credit to GDP	0.284**	-0.179	0.412***	0.569***	-0.002	-0.587***	0.947***	0.123	—

	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP									
Private credit	–								
Government credit	–0.466***	–							
Total credit	0.963***	–0.306**	–						
Property prices	0.729***	–0.487**	0.710***	–					
GDP	0.439***	–0.090	0.405***	0.207	–				
CA balance to GDP	–0.151	0.029	–0.169	–0.139	0.324***	–			
Private credit to GDP	0.529***	–0.211*	0.519***	0.575***	–0.366***	–0.285***	–		
Government credit to GDP	–0.681**	0.888***	–0.551**	–0.523**	–0.462**	0.011	–0.040	–	
Total credit to GDP	0.358***	0.049	0.447***	0.462***	–0.467***	–0.291**	0.927***	0.212*	–
Kazakhstan									
CF									
Private credit	–								
Government credit	–0.825**	–							
Total credit	0.808***	–0.933**	–						
Property prices	0.794***	–0.786**	0.928***	–					
GDP	0.012	0.023	0.012	–0.058	–				
CA balance to GDP	–0.658**	0.665***	–0.535**	–0.548**	0.014	–			
Private credit to GDP	0.875***	–0.904***	0.809***	0.686***	–0.022	–0.767**	–		
Government credit to GDP	–0.792**	0.981***	–0.955**	–0.825**	0.017	0.589***	–0.820**	–	
Total credit to GDP	0.769***	–0.923***	0.863***	0.727***	–0.010	–0.731***	0.954***	–0.860***	–

The end of the table

	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP									
Private credit	–								
Government credit	–0.662**	–							
Total credit	0.986***	–0.546**	–						
Property prices	0.817***	–0.547**	0.807***	–					
GDP	0.269**	–0.038	0.305**	0.436***	–				
CA balance to GDP	–0.401**	0.357***	–0.353**	–0.256**	0.212**	–			
Private credit to GDP	0.882***	–0.624**	0.872***	0.650***	–0.037	–0.508**	–		
Government credit to GDP	–0.710**	0.969***	–0.609**	–0.619**	–0.193	0.298**	–0.586**	–	
Total credit to GDP	0.864***	–0.470***	0.869***	0.605***	–0.053	–0.477***	0.980***	–0.439***	–
Belarus									
CF									
Private credit	–								
Government credit	0.153	–							
Total credit	0.947***	0.349**	–						
Property prices	–0.403**	0.551***	–0.362**	–					
GDP _M	0.025	–0.012	–0.007	0.074	–				
CA balance to GDP	–0.600**	–0.791**	–0.777**	–0.219	–0.010	–			
Private credit to GDP	0.891***	0.039	0.915***	–0.478**	0.023	–0.468**	–		
Government credit to GDP	0.549***	0.736***	0.661***	0.236	–0.059	–0.779***	0.573***	–	
Total credit to GDP	0.948***	0.140	0.948***	–0.450***	–0.027	–0.602***	0.989***	0.645***	–

	Private credit	Government credit	Total credit	Property prices	GDP	CA balance to GDP	Private credit to GDP	Government credit to GDP	Total credit to GDP
HP									
Private credit	—								
Government credit	-0.244*	—							
Total credit	0.822***	0.216	—						
Property prices	0.001	0.136	-0.193	—					
GDP	-0.127**	0.237*	-0.310**	0.242**	—				
CA balance to GDP	-0.353**	-0.253*	-0.555**	0.051	0.151	—			
Private credit to GDP	0.952***	-0.323**	0.784***	-0.131	-0.348**	-0.314**	—		
Government credit to GDP	-0.130	0.888***	0.285**	-0.039	-0.087	-0.241*	-0.086	—	
Total credit to GDP	0.817***	0.026	0.902***	-0.327**	-0.564**	-0.447***	0.897***	0.289**	—

* denotes significance at 90% level, ** denotes significance at 95% level, *** denotes significance at 99% level.

Appendix 3

Boom and busts periods for composite measures of financial cycles for different countries

FC1 = private sector credit + private sector credit to GDP ratio.

FC2 = FC1 + property prices.

FC3 = FC2 + CA balance to GDP.

FC4 = government credit + government credit to GDP ratio.

FC5 = FC4 + property prices.

FC6 = FC5 + CA balance to GDP.

FC7 = total credit + total credit to GDP ratio.

FC8 = FC7 + property prices.

FC9 = FC8 + CA balance to GDP.

Table 1

Weights of individual indicators in the composite financial cycles measures

	FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9
Russia									
CF									
Private credit	0.500	0.335	0.455	–	–	–	–	–	–
Private credit to GDP	0.500	0.298	0.427	–	–	–	–	–	–
Government credit	–	–	–	0.500	0.961	0.717	–	–	–
Government credit to GDP	–	–	–	0.500	0.949	0.712	–	–	–
Total credit	–	–	–	–	–	–	0.500	0.352	0.504
Total credit to GDP	–	–	–	–	–	–	0.500	0.269	0.415
Property prices	–	0.367	0.511	–	–0.910	–0.753	–	0.379	0.535
CA balance to GDP	–	–	–0.393	–	–	0.324	–	–	–0.454
HP									
Private credit	0.500	0.340	0.395	–	–	–	–	–	–
Private credit to GDP	0.500	0.309	0.374	–	–	–	–	–	–
Government credit	–	–	–	0.500	0.828	0.762	–	–	–
Government credit to GDP	–	–	–	0.500	0.839	0.771	–	–	–
Total credit	–	–	–	–	–	–	0.500	0.350	0.417
Total credit to GDP	–	–	–	–	–	–	0.500	0.292	0.368
Property prices	–	0.351	0.409	–	–0.667	–0.621	–	0.358	0.424
CA balance to GDP	–	–	–0.178	–	–	0.088	–	–	–0.209
Kazakhstan									
CF									
Private credit	0.486	0.343	0.494	–	–	–	–	–	–

The end of the table

	FC1	FC2	FC3	FC4	FC5	FC6	FC7	FC8	FC9
Private credit to GDP	0.514	0.349	0.528	–	–	–	–	–	–
Government credit	–	–	–	0.502	0.904	0.510	–	–	–
Government credit to GDP	–	–	–	0.498	0.910	0.503	–	–	–
Total credit	–	–	–	–	–	–	0.498	0.350	0.491
Total credit to GDP	–	–	–	–	–	–	0.502	0.327	0.491
Property prices	–	0.308	0.440	–	–0.814	–0.444	–	0.323	0.450
CA balance to GDP	–	–	–0.462	–	–	0.431	–	–	–0.432
HP									
Private credit	0.494	0.352	0.433	–	–	–	–	–	–
Private credit to GDP	0.506	0.339	0.431	–	–	–	–	–	–
Government credit	–	–	–	0.503	0.809	0.584	–	–	–
Government credit to GDP	–	–	–	0.497	0.818	0.583	–	–	–
Total credit	–	–	–	–	–	–	0.500	0.358	0.439
Total credit to GDP	–	–	–	–	–	–	0.500	0.333	0.423
Property prices	–	0.309	0.372	–	–0.627	–0.449	–	0.309	0.374
CA balance to GDP	–	–	–0.236	–	–	0.282	–	–	–0.236
Belarus									
CF									
Private credit	0.495	0.673	1.044	–	–	–	–	–	–
Private credit to GDP	0.505	0.695	1.047	–	–	–	–	–	–
Government credit	–	–	–	0.506	0.383	0.741	–	–	–
Government credit to GDP	–	–	–	0.494	0.322	0.674	–	–	–
Total credit	–	–	–	–	–	–	0.500	0.753	1.468
Total credit to GDP	–	–	–	–	–	–	0.500	0.775	1.387
Property prices	–	–0.368	–0.404	–	0.295	0.398	–	–0.528	–0.486
CA balance to GDP	–	–	–0.687	–	–	–0.813	–	–	–1.369
HP									
Private credit	0.496	0.543	0.818	–	–	–	–	–	–
Private credit to GDP	0.504	0.558	0.825	–	–	–	–	–	–
Government credit	–	–	–	0.502	0.480	0.672	–	–	–
Government credit to GDP	–	–	–	0.498	0.472	0.663	–	–	–
Total credit	–	–	–	–	–	–	0.500	0.643	1.261
Total credit to GDP	–	–	–	–	–	–	0.500	0.664	1.243
Property prices	–	–0.101	–0.160	–	0.048	0.015	–	–0.307	–0.517
CA balance to GDP	–	–	–0.483	–	–	–0.350	–	–	–0.987

Table 2

Booms and busts of different composite financial cycles measures for Russia

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
Booms				
GDP	2007q4–2008q3 2011q3	2008q1–2008q3	2007q4–2008q3	2007q4 2008q2–2008q3
FC1	2007q4–2008q4	2008q1–2008q4	2007q3–2009q1	2007q3–2008q1 2008q3–2009q1
FC2	2007q4–2008q4	2007q4–2008q3	2007q2–2009q1	2007q3–2008q4
FC3	2007q4–2008q4	2007q4–2008q4		2007q3–2007q4 2008q3–2009q1
FC4	2010q4–2011q4	2011q1–2011q3	2003q1 2003q3 2011q3	2011q3
FC5	2010q3–2011q4	2010q4–2011q3	2011q1–2011q4	2011q1 2011q3
FC6	2010q3–2011q4	2010q4–2011q3	2011q1–2011q4	2011q1 2011q3
FC7	2007q4–2009q1	2008q1–2009q1	2007q3–2008q1 2008q3–2009q1	2007q3 2008q4–2009q1
FC8	2007q3–2009q1	2007q4–2008q4	2007q2–2009q1	2007q3–2008q4
FC9	2007q4–2009q1	2007q4–2008q4	2007q2–2009q1	2007q3 2008q3–2009q1
Peaks				
GDP	2008q2 2011q3	2008q2	2008q3	2007q4 2008q3
FC1	2008q2	2008q2	2007q3	2007q3 2008q4
FC2	2008q2	2008q2	2008q3	2008q3
FC3	2008q2	2008q2	2009q1	2007q3 2009q1
FC4	2011q2	2011q2	2003q1 2003q3 2011q3	2011q3
FC5	2011q2	2011q2	2011q3	2011q1 2011q3
FC6	2011q2	2011q2	2011q3	2011q1 2011q3
FC7	2008q3	2008q3	2007q3 2009q1	2007q3 2009q1
FC8	2008q2	2008q2	2008q3	2008q3
FC9	2008q2	2008q2	2009q1	2007q3 2009q1
Busts				
GDP	2007q1 2009q1–2009q3	2007q1 2009q2–2009q3	2009q1–2010q2	2009q1–2009q4

The end of the table

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
FC1	2010q4–2012q1	2011q1–2011q4	2005q1–2005q2 2006q1 2011q1–2011q2	2011q1–2011q2
FC2	2010q4–2011q4	2010q4–2011q3	2005q1–2005q3 2006q1 2011q1–2011q3	2005q2 2011q1–2011q2
FC3	2005q2–2005q4 2010q3–2011q4	2010q4–2011q3	2005q1–2005q3 2006q1 2011q1–2011q3	2005q2 2011q1–2011q2
FC4	2014q1–2014q2	–	2005q4–2006q1 2008q2–2008q4	2008q2–2008q4
FC5	2007q3–2008q2 2014q1–2014q2	–	2008q2–2008q4	2008q2–2008q4
FC6	2007q3–2008q3	2007q4–2008q2	2008q2–2009q1	2008q2–2008q4
FC7	2005q2–2006q1 2011q1–2011q4	–	2005q1–2006q2 2011q1–2011q2	2005q1–2006q2
FC8	2005q2–2005q3 2010q4–2011q4	2011q1–2011q3	2005q1–2006q1 2011q1–2011q2	2005q1–2006q1 2011q1–2011q2
FC9	2005q1–2005q4 2010q4–2011q3	2005q3 2011q1–2011q2	2005q1–2006q1 2011q1–2011q2	2005q1–2006q1 2011q1–2011q2
Troughs				
GDP	2007q1 2009q2	2007q1 2009q2	2009q2	2009q2
FC1	2011q2	2011q2	2005q1 2006q1 2011q1	2005q1 2006q1 2011q1
FC2	2011q2	2011q2	2005q2 2011q1	2005q2 2006q1 2011q1
FC3	2005q3 2011q2	2011q2	2005q2 2011q1	2005q2 2006q1 2011q1
FC4	2014q1	–	2005q4 2008q4	2005q4 2008q4
FC5	2007q4 2014q2	–	2007q1 2008q4	2008q4
FC6	2008q1	2008q1	2007q1 2008q4	2008q4
FC7	2005q4 2011q3	–	2006q1 2011q2	2006q1 2011q2
FC8	2005q3 2011q2	2011q2	2006q1 2011q2	2006q1 2011q2
FC9	2005q3 2011q1	2005q3 2011q1	2006q1 2011q2	2006q1 2011q2

Table 3

Booms and busts of different composite financial cycles measures for Kazakhstan

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
Booms				
GDP	2008q1–2008q2 2011q3	2008q1–2008q2 2011q3	2006q4 2007q2 2008q3	2006q4 2008q3
FC1	2007q2–2008q2	2007q3–2008q1	2006q4–2008q1	2007q1–2007q4
FC2	2007q1–2008q1	2007q2–2007q4	2006q4–2008q1	2007q1–2007q4
FC3	2007q1–2008q1	2007q2–2007q4	2006q4–2007q4	2007q1–2007q4
FC4	2010q2–2011q2	2010q3–2011q1	2010q1–2010q4	2010q1–2010q4
FC5	2010q2–2011q2	2010q3–2011q1	2010q1–2010q4	2010q1–2010q3
FC6	2010q3–2011q1	–	2010q1–2010q3	2010q1–2010q3
FC7	2007q1–2008q2	2007q2–2008q1	2006q4–2008q1	2007q1–2007q4
FC8	2006q4–2008q1	2007q2–2007q4	2006q4–2008q1	2007q1–2007q4
FC9	2006q4–2008q1	2007q1–2007q4	2006q4–2007q4	2007q1–2007q4
Peaks				
GDP	2008q2 2011q3	2008q2 2011q3	2006q4 2007q2 2008q3	2006q4 2008q3
FC1	2007q4	2007q4	2007q2	2007q2
FC2	2007q3	2007q3	2007q2	2007q2
FC3	2007q3	2007q3	2007q2	2007q2
FC4	2010q4	2010q4	2010q1	2010q1
FC5	2010q4	2010q4	2010q1	2010q1
FC6	2010q4	–	2010q1	2010q1
FC7	2007q4	2007q4	2007q2	2007q2
FC8	2007q3	2007q3	2007q2	2007q2
FC9	2007q3	2007q3	2007q2	2007q2
Busts				
GDP	2005q4 2009q1–2009q3 2012q3–2012q4	2009q1–2009q3 2012q3–2012q4	2008q4–2009q2	2008q4–2009q2
FC1	2004q4 2010q4–2011q2	–	–	–
FC2	2010q4–2011q2	–	–	–
FC3	2004q3	–	2011q2	–
FC4	2007q1–2008q2	2007q2–2008q2	2007q2–2007q4 2009q2	2007q2–2007q4 2009q2
FC5	2007q1–2008q2	2007q2–2008q1	2007q1–2007q4	2007q2–2007q4

The end of the table

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
FC6	2007q1–2008q2	2007q2–2008q1	2007q1–2007q4 2009q2	2007q2–2007q4
FC7	2010q4–2011q3	–	–	–
FC8	2010q3–2011q2	–	–	–
FC9	–	–	2011q2	–
Troughs				
GDP	2005q4 2009q2 2012q3	2009q2 2012q3	2009q1	2009q1
FC1	2004q4 2011q1	–	–	–
FC2	2011q1	–	–	–
FC3	2004q3	–	2011q2	–
FC4	2007q4	2007q4	2007q3 2008q2 2009q2	2007q3 2009q2
FC5	2007q3	2007q3	2007q3	2007q3
FC6	2007q3	2007q3	2007q3 2009q2	2007q3 2009q2
FC7	2011q1	–	2004q4 2001q1	–
FC8	2011q1	–	2003q4 2011q2	–
FC9	–	–	2004q4 2001q2	2011q2

Table 4

Booms and busts of different composite financial cycles measures for Belarus

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
Booms				
GDP	2000q4 2001q1–2001q2 2008q2–2008q3	2000q4 2001q1–2001q2 2008q2–2008q3	2000q4 2008q2–2008q3 2012q2	2012q2
FC1	2009q4–2010q4	2010q1–2010q3	2010q3–2011q2	2010q3–2011q2
FC2	2009q4–2010q4	2010q1–2010q4	2010q3–2011q2	2010q3–2011q2
FC3	2009q3–2010q4	2009q4–2010q3	2010q2–2011q2	2010q3–2011q1
FC4	–	–	–	–
FC5	–	–	2015q3	–
FC6	2008q4–2009q3	–	–	–
FC7	2009q3–2010q3	2009q4–2010q2	2010q3–2011q1	2010q3–2011q1
FC8	2009q4–2010q4	2010q1–2010q3	2010q3–2011q1	2010q3–2011q1

Continuation of the table

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
FC9	2009q2–2010q3	2009q3–2010q2	2010q2–2011q1	2010q3–2011q1
Peaks				
GDP	2001q1 2008q3	2001q1 2008q3	2000q4 2008q3 2012q2	2012q2
FC1	2010q2	2010q2	2011q1	2011q1
FC2	2010q2	2010q2	2011q1	2011q1
FC3	2010q2	2010q2	2011q1	2011q1
FC4	–	–	–	–
FC5	–	–	2015q3	–
FC6	2009q1	–	–	–
FC7	2010q1	2010q1	2011q1	2011q1
FC8	2010q2	2010q2	2011q1	2011q1
FC9	2009q4	2009q4	2011q1	2011q1
Busts				
GDP	2000q1–2000q2 2009q3–2009q4	2000q1 2009q3–2009q4	2000q1 2009q2 2010q1 2011q3 2016q3–2016q4	2000q1 2010q1 2011q3
FC1	2012q3–2013q3	2012q4–2013q2	2012q1–2013q1	2012q2–2012q3 2013q1
FC2	2012q4–2013q3	–	2012q1–2013q1	2012q2
FC3	2012q3–2013q2	2013q1	2012q1–2012q2 2012q4	2012q1–2012q2
FC4	2011q3–2012q2	–	2011q2–2011q4	2011q3–2011q4
FC5	2011q2–2012q1	2011q3–2011q4	2011q2–2011q4	2011q3–2011q4
FC6	2011q3–2012q2	2011q4–2012q1	2011q2–2011q4	2011q3–2011q4
FC7	2012q4–2013q2	–	2012q2	–
FC8	2007q2–2007q3	–	–	–
FC9	2012q3–2013q1	–	2012q1–2012q2	2012q1
Troughs				
GDP	2001q1 2009q3	2001q1 2009q3	2000q1 2009q2 2010q1 2011q3 2016q4	2000q1 2010q1 2011q3
FC1	2013q1	2013q1	2012q2	2012q2 2013q1
FC2	2013q1	–	2012q2	2012q2
FC3	2013q1	2013q1	2012q1 2012q4	2012q1

The end of the table

	CF (1.5)	CF (1.75)	HP (1.5)	HP (1.75)
FC4	2011q4	–	2011q3	2011q3
FC5	2011q4	2011q4	2011q3	2011q3
FC6	2012q1	2012q1	2011q3	2011q3
FC7	2013q1	–	2012q2	–
FC8	2007q2	–	–	–
FC9	2012q4	–	2012q1	2012q1

VAR, variance decomposition and impulse-response analysis of financial cycles

Table 1

Residual correlation matrix: unrestricted VAR, FC2

	FCB2	FCK2	FCR2
FCB2	1.000000	-0.692168	0.639499
FCK2	-0.692168	1.000000	0.112048
FCR2	0.639499	0.112048	1.000000

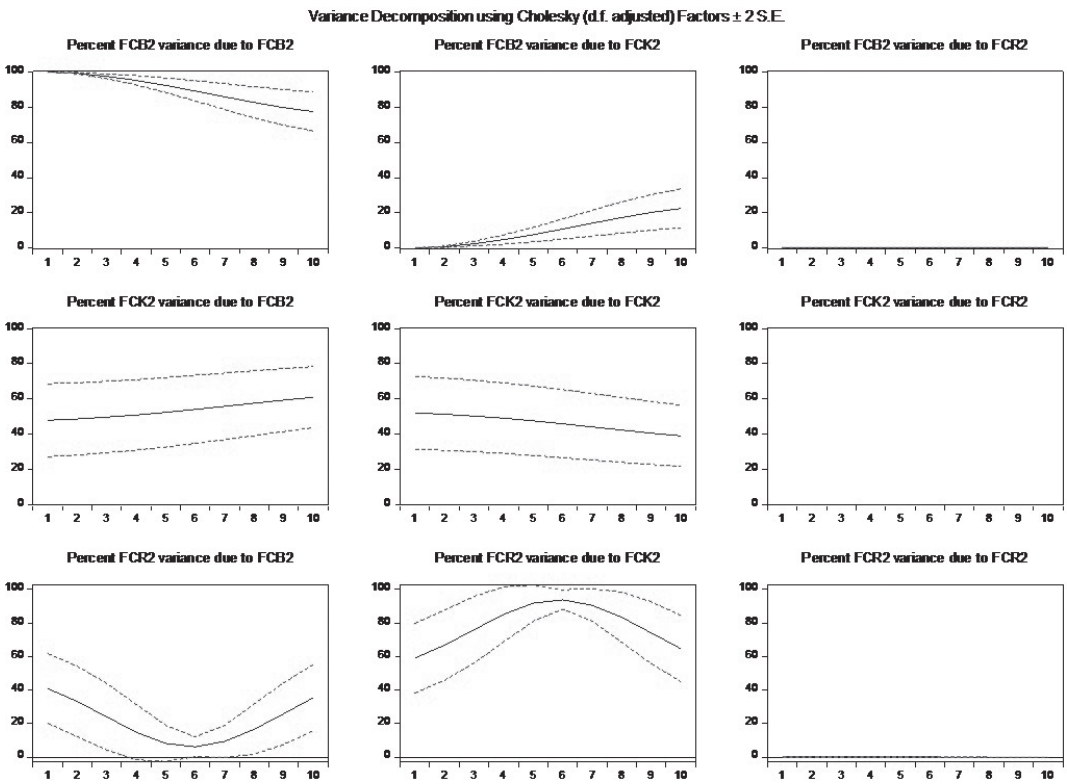


Fig. 1. Variance decomposition for unrestricted VAR, FC2

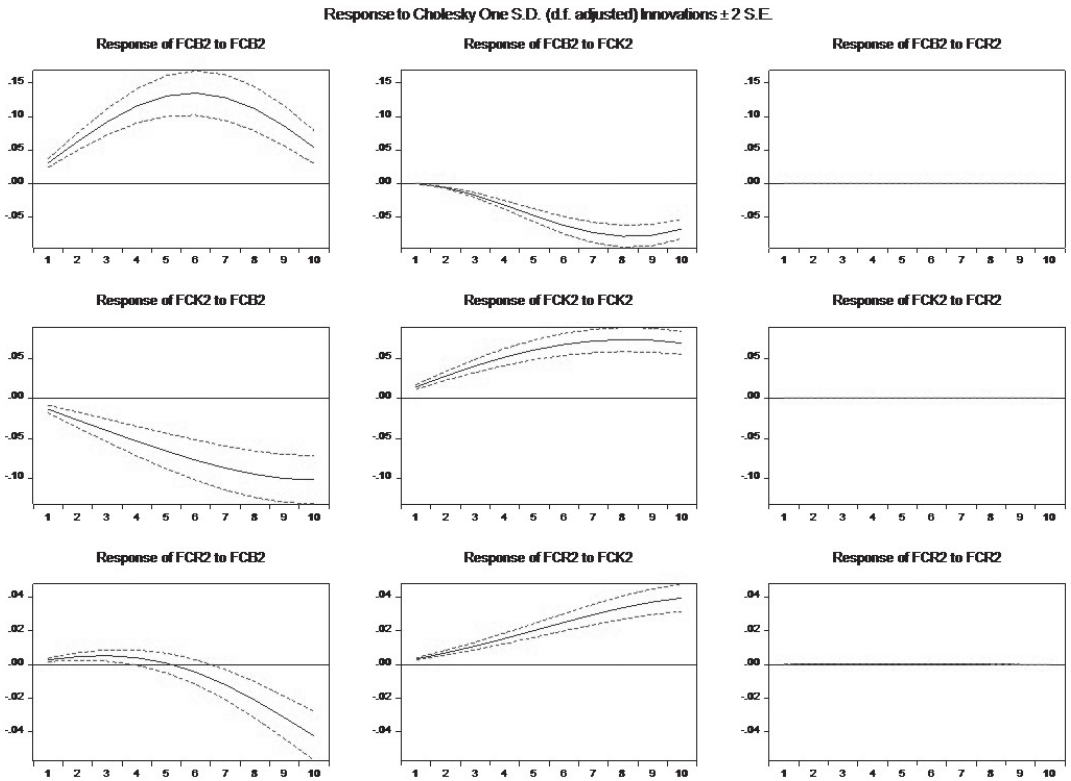


Fig. 2. Impulse-response analysis, unrestricted VAR, FC2

Table 2

Residual correlation matrix: unrestricted VAR, FC5

	FCB5	FCK5	FCR5
FCB5	1.000000	-0.571654	0.824038
FCK5	-0.571654	1.000000	-0.016464
FCR5	0.824038	-0.016464	1.000000

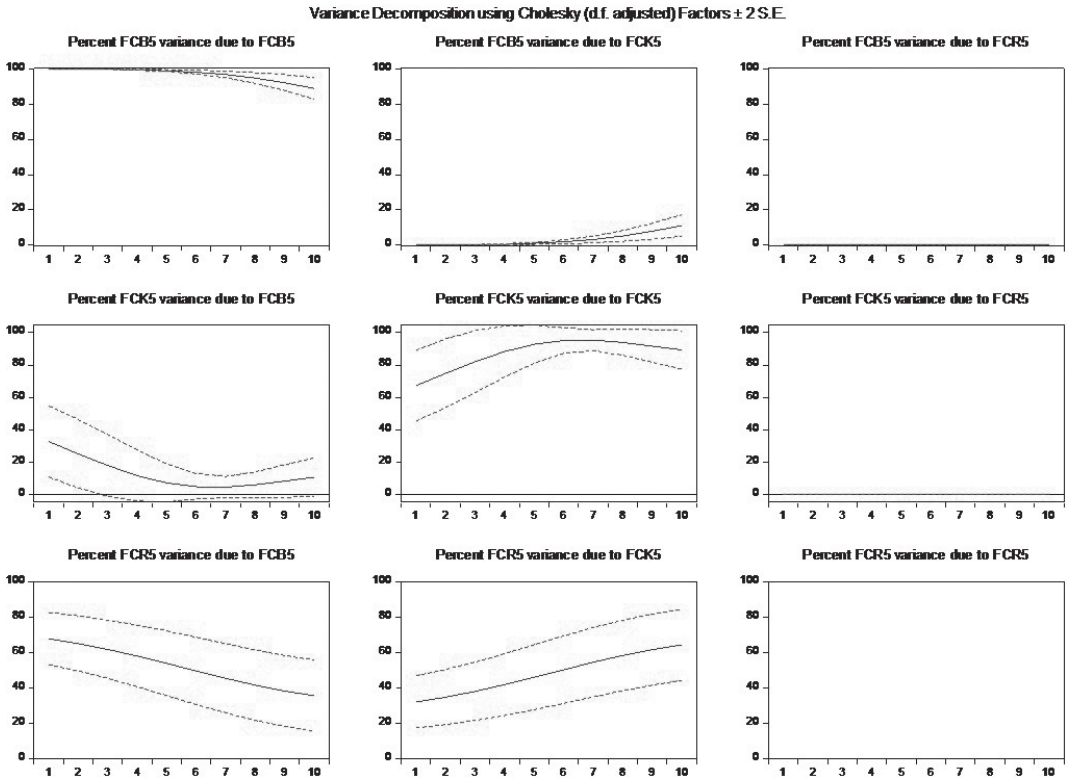


Fig. 3. Variance decomposition for unrestricted VAR, FC5

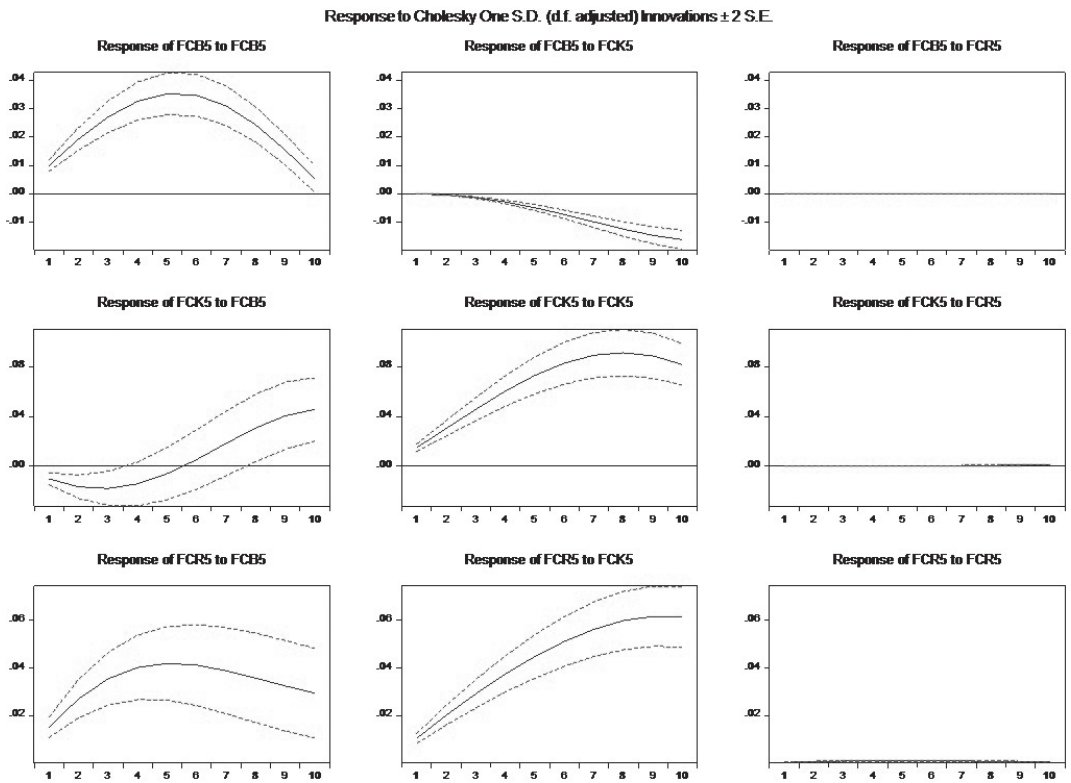


Fig. 4. Impulse-response analysis, unrestricted VAR, FC5

Table 3

Residual correlation matrix: unrestricted VAR, FC8

	FCB8	FCK8	FCR8
FCB8	1.000000	-0.318384	0.099229
FCK8	-0.318384	1.000000	-0.953809
FCR8	0.099229	-0.953809	1.000000

Variance Decomposition using Cholesky (d.f. adjusted) Factors ± 2 S.E.

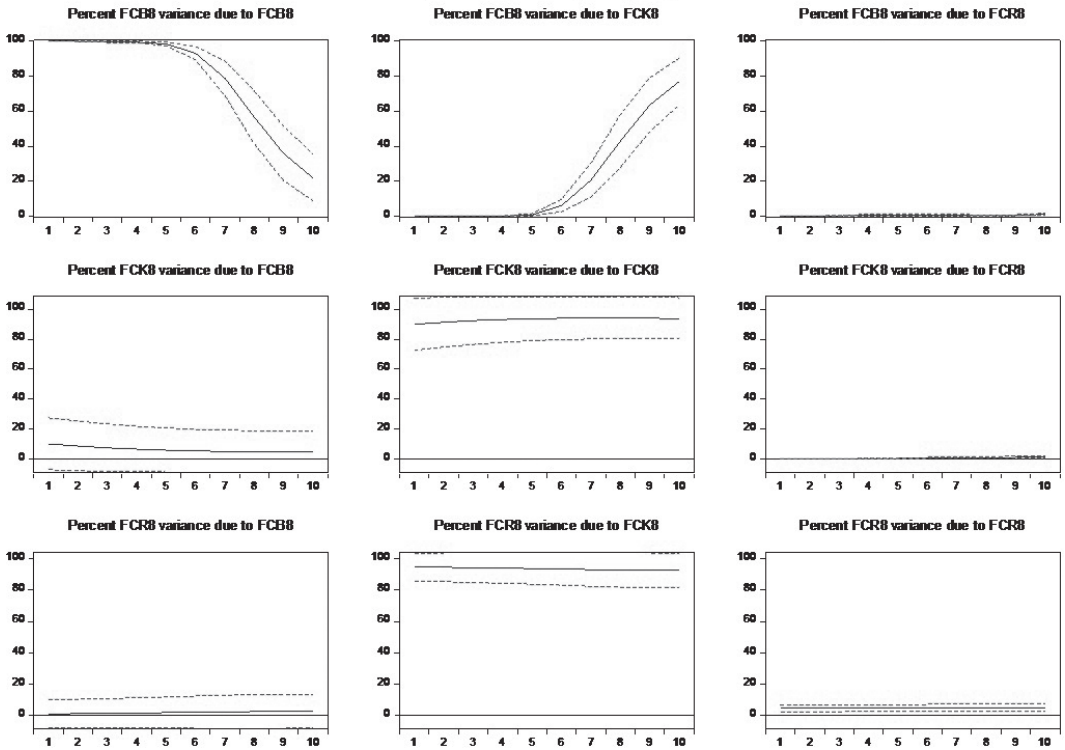


Fig. 5. Variance decomposition for unrestricted VAR, FC8

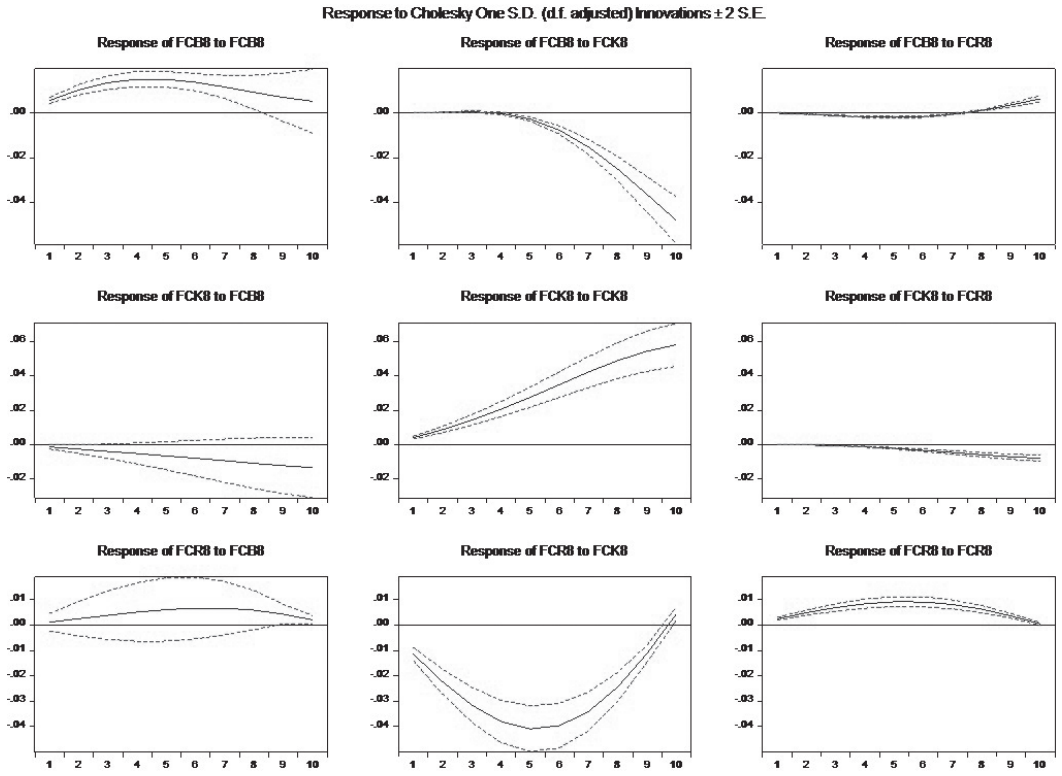


Fig. 6. Impulse-response analysis, unrestricted VAR, FC8