

Credit and Financial Cycles as Predictors of Business Cycles: Example of EAEU Countries

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Abstract

The paper studies credit and financial cycles of the three largest countries of the Eurasian Economic Union. We use both widely used in the literature measures of financial cycle and suggest our own measures accounting for the specificities of these countries (resource dependence and a large role of the government sector in the economy). To check results for robustness we use different filtering methods, different methods of locating peaks and troughs, consider individual indicators and their combinations with varying weights, as well as change sample size. We have established that the most widely used measure of financial cycle – combination of private sector credit, its ratio to GDP and property price index – delivers the most robust results and can be used for the countries in question. For Russia and Kazakhstan, where financial sector depends on oil prices, inclusion of current account balance in the measure of financial cycle produces a potential early warning indicator of the future financial cycle booms. For Belarus and Kazakhstan using private sector credit or total credit produces very much the same results, while for Russia these measures substantially differ suggesting that increasing importance of credit to government-related sector demands a different measure of financial cycle.

Keywords: financial cycles, Russia, Kazakhstan, Belarus, EAEU.

JEL-codes: E32, E44, F44

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 and 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 and following severe 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; and Frankel 2010).

It has been also well-documented 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 some economic union, 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 and Antonova, 2014(a)) 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: first we provide a brief literature review on financial cycles and relevant EAEU studies, next we describe data and methodology used, 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 influence of credit on the economic dynamics was mentioned 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 and Lowe (2002), and Stiglitz and 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 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 and Taylor (2012) and Mendoza and 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 and Antonova, 2014b).

There are also several papers focusing of 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 and Antonova, 2014a; Vymyatnina and Antonova, 2014b) demonstrate that Russia and Kazakhstan have similar business and credit cycles and similar reactions to shocks, we assume 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 Kyrgystan, 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 they 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 accounts for the capital flows, Central bank interventions in the foreign exchange market, changes in commodity prices and a 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 total credit (including credit to the government bodies) and its 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 2017q2 for Russia, 2002q1-2017q2 for Belarus, 2003q1-2017q2 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 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 and Boschan (1971) and Harding and 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 and 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 and an alternative to HP filtering procedure suggested by Hamilton (2017). Therefore, for robustness check we compare results for HP and CF filters and Hamilton filtering procedure. 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 120 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 (Aguiar and 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, and results are checked for robustness for lower bound of 20 quarters. The upper bound of 120 quarters has been chosen for the stability of results it produces, and also with the idea of allowing for longer financial cycles in our countries.

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 and 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 $\varphi_s\sigma(l_i)$ is the start date, and the date following the peak date with the smallest absolute difference between l_{it} and $\varphi_e\sigma(l_i)$ 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.

We also use the turning points algorithm, which is applicable both to raw and filtered data, to verify the results from the threshold method. Drehmann et al. (2012) describe the following procedure for the turning points method: local minima and maxima are found subject to several conditions, including a certain minimal length of the cycle and of each phase, and local maxima and minima should be strictly following one another. We assume that the minimal cycle length is 12 quarters (against 20 for advanced economies), and the minimal length of each phase (upward and downward) is 2 quarters (as in Drehmann et al., 2012).

Since both filtering methods and the threshold method are dependent on statistical properties of the time series that are change in time, we check if our results are robust to shortening the sample length. In this way we have several robustness checks: using different filters, different methods to determine the dates of booms (and busts), and different sample sizes.

We first analyse (in de-trended form) six separate indicators of financial cycles for each country: credit to private sector, 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: total credit and its relation to GDP, previous indicator plus property prices, previous indicator plus current account balance, private credit and its relation to GDP, previous indicator plus property prices, previous indicator plus current account balance. These composite measures are then analyzed for separate countries, and at the following step the cross-country correlations between financial cycles are considered.

4. Results and discussion

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

Tables 1-3 in Appendix 2 present results of applying threshold method and turning points method to locating boom periods² 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 and Hamilton procedure since it produces series with lower amplitude resulting in almost no cases of a boom/bust period lasting one quarter only and escaping results when the two booms are 2 quarters apart. All filters used are robust to the change of threshold with the only difference being the length of the boom/bust period determined. The turning points algorithm in most cases confirms results of booms periods though it also finds peak periods of lower amplitude. A larger difference is found for the results of HP filter and Hamilton procedure and of CF filter and turning points algorithm for GDP series. The first two filtering methods often produce a different picture compared to the latter two method, and results, especially for Kazakhstan, seem to be counterintuitive. This is additional argument in favour of using CF filter for our purposes, and in our further discussion of combined financial cycle measures we concentrate on results of CF filters mostly.

It is noticeable that the booms of CA balance cycles are different from other financial cycle indicators with the exception of Belarus. In both Kazakhstan and Russia CA balance cycles' boom periods are found around 2002 and 2015 suggesting that they capture a common factor of oil price dynamics. In Belarus CA balance cycle's boom is in early 2012 (detected only by HP-filter), closer to a boom of 2011 in other indicators, 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. In a sense, the boom periods of CA balance cycle in Russia and Kazakhstan might be seen as very early warning indicators of a future buildup of credit and financial cycle boom.

Other individual indicators of financial cycles for all three countries are more in line with each other and with the GDP cycles. For Belarus an important indicator preceding GDP boom is property price index with credit-related indicators booming simultaneously or soon after the boom in GDP. In Kazakhstan individual indicators of financial cycles peak simultaneously with GDP except for CF-filter results when they precede GDP boom by at least one quarter. For Russia it is noticeable that total credit and its ratio to GDP do not have boom periods (except for HP-filter), while private sector credit has a boom period in 2008 at the same time as GDP peaks. These results can be interpreted as the growing relative importance of credit to government-related sector in the total credit especially after 2008-2009 crisis. 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. It should be stressed that for Russia the boom periods of individual financial cycle indicators do not precede GDP boom periods but either coincide with it or follow it making these individual indicators' dynamics poor candidates for the early warning role. It is also important to stress that, unlike Russia, in Belarus and Kazakhstan private sector credit and total credit have largely similar dynamics.

Correlations between individual indicators of financial cycles are presented in table 4 of Appendix 2. Most of them are significant, with several exceptions for Russia. It is not surprising that private sector credit and total credit are correlated, but it is notable that for Russia this correlation is very low: 0.3 compared to almost 1 for Kazakhstan and 0.75 for Belarus. The ratio of total credit to

² Details on busts are similar (except that there are less busts detected than booms) in their general qualities and are available from the authors upon request.

GDP in Russia negatively correlates with private sector credit, its ratio to GDP, and property prices. This reinforces the idea that in Russia total credit has different dynamics and might be worth of tracking alongside private sector credit. Current account balance is almost in all cases negatively correlated with other individual indicators of financial cycle. This is not surprising since positive current account cannot be immediately translated into higher incomes, increasing domestic credit, and growth of investments, including those into real estate. On average correlations between individual indicators of financial cycle in Russia are lower compared to the other two countries suggesting that combining several indicators for Russia might produce more varying results.

Tables 1-3 in Appendix 3 describe booms and busts periods for 4 different combined measures of financial cycles with equal weights of individual indicators (following e.g. Drehmann et al., 2012 and Stremmel, 2015). We compare the most widely used in the literature combined indicator – private sector credit, its ratio to GDP and property price index (FC1 measure) – to a set of other combined indicators based on total credit and including current account balance. It is interesting to note that of the three countries considered in Russia combined indicators based on total credit (FC2, FC3 and FC4) produce the most diverging results for both booms and busts depending on the filtering method. The indicator that includes current account balance finds the boom period only in 2015, suggesting that in this period this indicator outweighs others.

For Kazakhstan results for financial cycle indicators based on private credit and total credit (FC1 and FC2) are almost identical confirming that the difference in dynamics of these two credit indicators is not very different for this country. Adding the current account balance to the financial cycle results in a change of the boom period of one quarter, while producing no reliable results for the busts. For both Kazakhstan and Russia most combined measures of financial cycle find the boom period around end of 2007 or mid-2008, very close to the peak in GDP. For Belarus financial cycle indicators report boom periods after GDP peaked in 2008 with the exception of financial cycle measure including current account balance. The measure based on total credit and its relation to GDP works worst of all. For Russia and Kazakhstan bust periods of early 2006 and 2015-2016 detected by some measures are likely to be related to the general trends in commodity prices.

To check for the robustness of results we also tried a number of different sets of weights. In table 4 of Appendix 3 we report results for the boom periods for the case where weights are inversely proportional to the difference between the maximum and minimum values of the time series. We also add for this case two other combined financial cycles indicators based on private credit, since this seems to work better for Russia. Graphically these financial cycles measures and GDP cycles are presented on figures 1 – 3 below.

For Russia (see Fig. 1) results are quite robust, and two additional combined measures based on private sector credit suggest that these measures consistently locate the boom period of 2008 that the measures based on total credit do not. We conclude that these results suggest that private credit was the driver of the financial cycle that has boomed in 2008, while the dynamics of total credit, especially combined with the current account balance, is an important indicator to monitor in the future as private sector credit in Russia slows down.

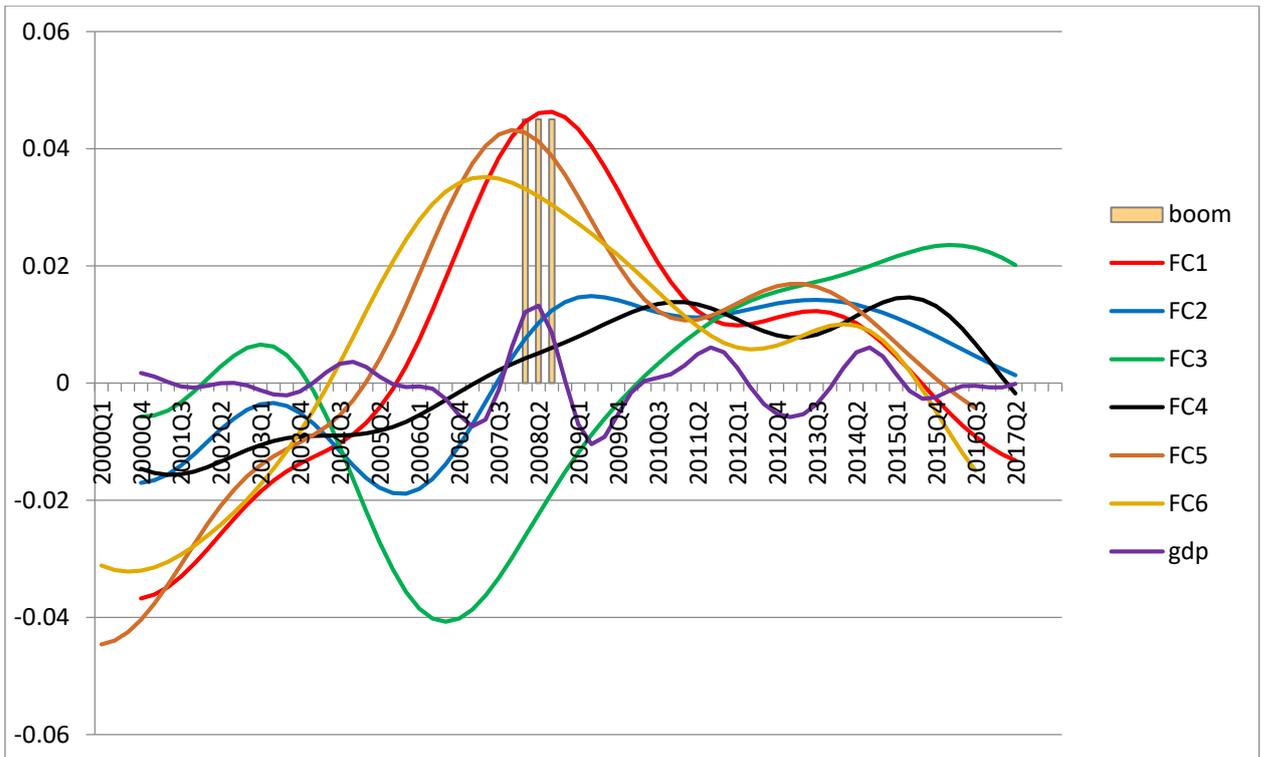


Figure 1. Financial cycles and GDP cycle in Russia. Booms denote GDP boom periods.

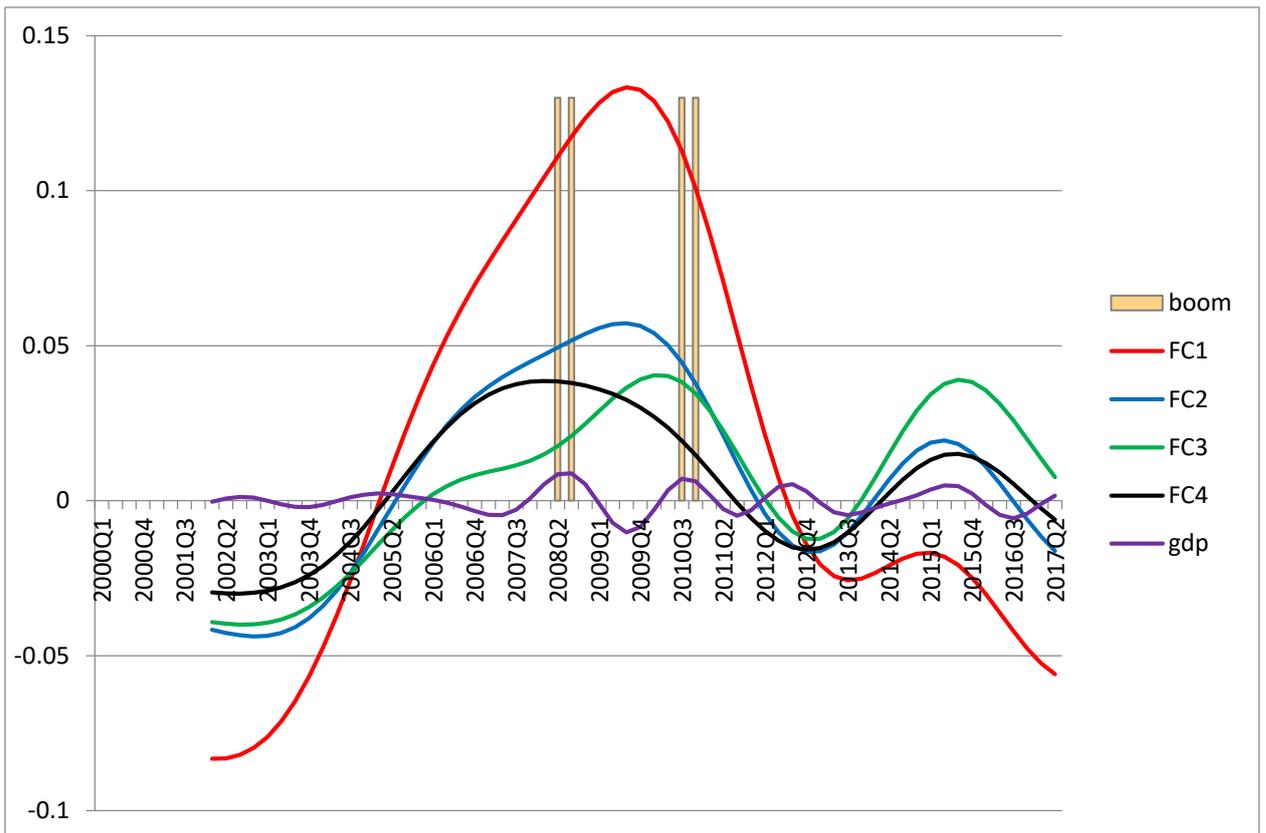


Figure 2. Financial cycles and GDP cycle in Belarus. Booms denote GDP boom periods.

For Belarus combined measures based on total or on private sector credit demonstrate very similar results (within one country) for different sets of weights, the exception being the measure that includes current account – weights inversely proportional to the amplitude of the series produce the only type of financial cycle that is in line with the GDP cycle boom (FC4 series on Fig. 2). For

Kazakhstan results are most robust for both types of credit indicators and in terms of including or excluding the current account balance (see Fig. 3).

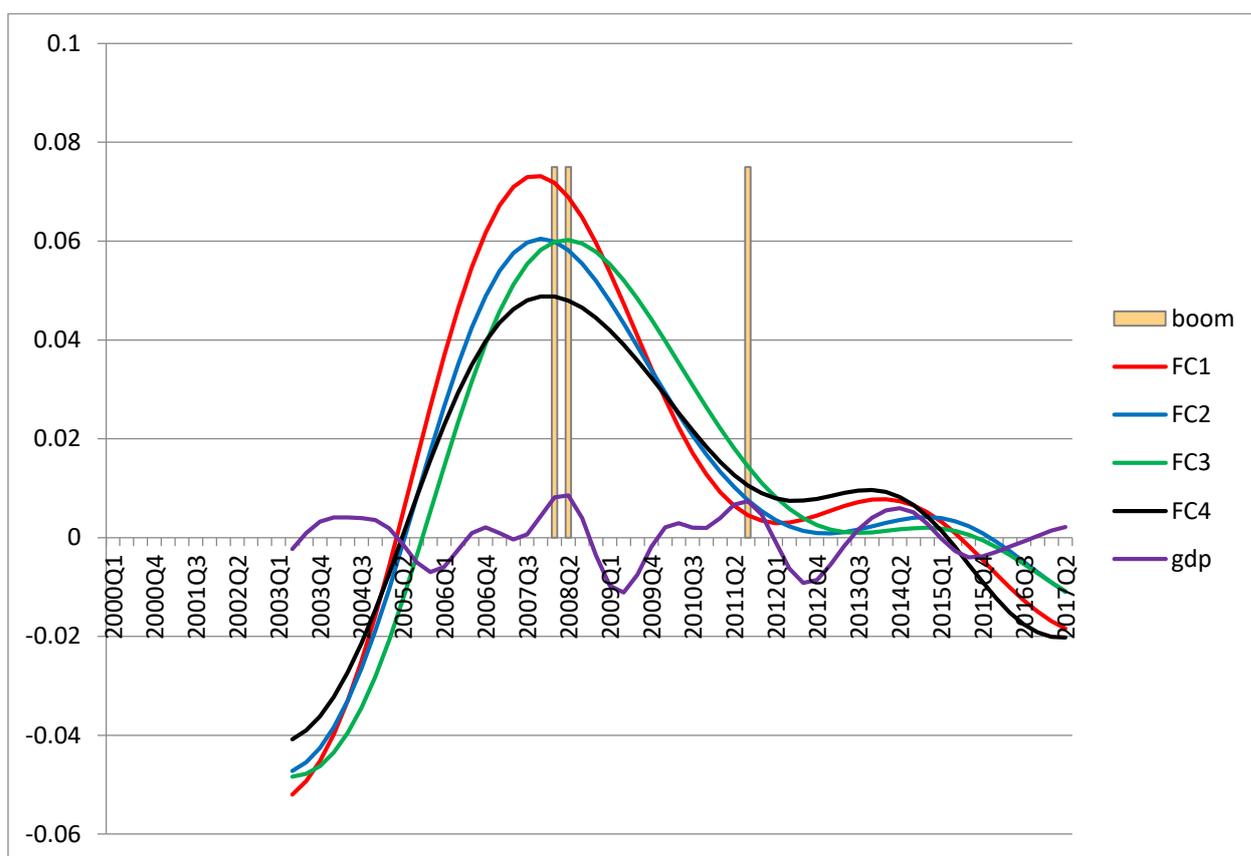


Figure 3. Financial cycles and GDP cycle in Kazakhstan. Booms denote GDP boom periods.

A further robustness check was made using shorter samples (see table 1 in Appendix 4). The most robust results are for Kazakhstan. All four combined measures of financial cycles work well and results do not depend on the length of the period. For Belarus results are less robust and depend on the choice of the period. The most robust results for all countries are related to the most conventional measure of the financial cycle that includes private sector credit, its ratio to GDP and property price index. For Kazakhstan an important indicator includes current account balance (FC4). For Russia most robust results are based again on private credit (with or without property price index), but the combination of total credit, its ratio to GDP and CA balance (FC4) suggests a boom around 2012 after which Russian GDP went into prolonged recession/stagnation. This corroborates the idea that total credit dynamics and current account balance might both become more important in Russia in the future.

In all three considered countries there was a boom period of the financial cycle around the crisis time of 2008, and it was detected by most of the financial cycle measures. Since our sample for all countries is relatively short, we cannot be sure that any of the countries did have a financial cycle bust during this time. This uncertainty might explain the fact that results for the busts periods of financial cycle are less robust to the choice of filtering method, though robust to the change of weights. Moreover, in terms of policy-making correct detection of boom periods as leading to potential trouble is more important than of busts periods.

Dynamic correlations' analysis of different financial cycles indicators and GDP cycle³ indicate that such correlations are significant only for short periods of time at the beginning of the sample. This suggests that the GDP cycle and constructed measures of financial cycles are indeed of different frequencies and that financial cycles are of different length compared to business cycles. Dynamic correlations of similar financial cycles' measures between different countries (Table 2, Appendix 4) are significant in many cases and suggest that in terms of the most conventional measures the three countries are most similar in terms of their financial cycles. For measures using total credit correlations between Russia and the other two countries are smaller, while for Kazakhstan and Belarus all aggregate measures of financial cycle are closely correlated. This is in contrast with our initial assumption that most close should be financial cycles for Kazakhstan and Russia.

In Russia financial cycle has the lowest amplitude for all combined measures, and measures based on private credit are of higher amplitude, allowing for easier boom periods detection. For Belarus the most conventional measure amplifies the magnitude of the financial cycle more than twice compared to a similar measure based on total credit, and for Kazakhstan all measures of financial cycle have closer amplitude though the most conventional one is still the largest. In general, our varying measures of financial cycles suggest all countries under consideration are in the downward phase of the financial cycle at present.

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 have conducted a number of robustness checks by using different filtering methods, different methods to locate the peaks and troughs (boom and bust periods), different weights for composite measures of financial cycle and different sample periods. The most conventional measure used in the literature so far – combined measure including private sector credit, its ratio to GDP and property price index – has demonstrated the most robust results across all countries. For Kazakhstan and Belarus results for combined measures of financial cycles using total credit and credit to private sector are very similar, while for Russia total credit indicator has a substantially different dynamics and we could not locate any boom periods in the sample.

For Kazakhstan we get the most robust results in general for different individual indicators (except for the CA balance), different composite measures and different sample periods. For Belarus results are less stable in relation to sample size, and there are no substantial differences for indicators based on private sector or total credit. For Russia combined financial cycle measures based on private credit locate the boom period close (and slightly ahead of) the business cycle period in mid-2008, however the results for total credit are completely different with no clear boom periods detected. Adding current account balance for Russia and Kazakhstan adds an additional

³ Results are available from the authors upon request. Lags of financial cycle measures were used up to 6 quarters.

boom period of the financial cycle in 2015-2016 that is likely to be connected to oil price dynamics. Since the previous boom of the CA balance as an individual indicator for these countries was around 2006, these results might suggest that a new period of financial instability in these countries is approaching.

Our conclusion is that the most widely used in the literature measure of financial cycle works well for the countries that we have considered, while for Belarus and Kazakhstan measures based on total credit produce very much the same results, and for Russia and Kazakhstan the measures including CA balance might add additional information and serve as leading indicators. The latter topic deserves an additional and more in-depth study. 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	2000Q4-2017Q3	Bank of Russia https://www.cbr.ru/statistics/?PrtId=dkfs
Property prices, secondary market (for comparability with other countries)	2000Q1-2017Q3	Unified Interdepartmental Information and Statistical System, Government Statistics https://www.fedstat.ru/indicator/31452
Current account balance	2000Q1-2017Q2	Bank of Russia http://www.cbr.ru/statistics/Default.aspx?PrtId=dops_table&pid=svs&sid=itm_55060
Consumer price index	2000Q1-2017Q3	State Statistical committee http://www.gks.ru/free_doc/new_site/prices/potr/tab-potr1.htm
Ruble-USD exchange rate	2000Q1-2017Q3	Bank of Russia http://www.cbr.ru/currency_base/dynamics.aspx?VAL_NM_RQ=R01235&date_req1=01.01.2000&date_req2=28.11.2017&rt=1&mode=1
GDP in current prices	2000Q1-2017Q2	State Statistical committee http://www.gks.ru/free_doc/new_site/vvp/kv/tab5.htm
Belarus		
Credit by the banking system to the private sector	2000Q1-2006Q3	National Bank of the Republic of Belarus http://www.nbrb.by/statistics/MonetaryStat/DepositaryCorporationsSurvey
Credit by the banking system to the economy, total	2006Q4-2017Q3	National Bank of the Republic of Belarus http://www.nbrb.by/statistics/MonetaryStat/DepositaryCorporationsSurvey
Property prices, secondary market (for comparability with other countries), Minsk	2002Q1-2017Q3	Real estate agency https://realt.by/statistics/dynamics/town/price_m2/usd/
Current account balance	2000Q1-2017Q2	National Bank of the Republic of Belarus https://www.nbrb.by/statistics/BalPay/
Consumer price index	2000Q1-2017Q3	National State Statistical Committee of the Republic of Belarus http://www.belstat.gov.by/ofitsialnaya-statistika/ssrd-mvf_2/natsionalnaya-stranitsa-svodnyh-dannyh/indeksy-potrebitelskih-tsen/indeksy-potrebitelskih-tsen-1999-100/

Belorussian ruble-USD exchange rate	2000Q1-2017Q3	National Bank of the Republic of Belarus https://www.nbrb.by/statistics/Rates/AvgRate/
GDP in current prices	2000Q1-2017Q2	International Monetary Fund http://data.imf.org/regular.aspx?key=61545852
Kazakhstan		
Credit by the banking system to the economy, total Credit by the banking system to the private sector	2000Q4-2017Q3	National Bank of the Kazakhstan Republic http://www.nationalbank.kz/?docid=288&switch=russian
Property prices, secondary market (for comparability with other countries)	2003Q2-2017Q3	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	2001Q1-2017Q2	National Bank of the Kazakhstan Republic http://www.nationalbank.kz/?docid=343&switch=russian
Consumer price index	2000Q1-2017Q3	National Bank of the Kazakhstan Republic http://nationalbank.kz/?docid=277&switch=russian
Tenge-USD exchange rate	2001Q1-2017Q2	National Bank of the Kazakhstan Republic http://nationalbank.kz/?docid=763&switch=russian
GDP in current prices	2000Q1-2017Q2	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 comments to the tables:

Italics denote situations when boom was detected only during one quarter by one of the filters. Bold font demotes the highest point of the boom.

*For real GDP CF filter had expected cycle length was 6-16 quarters instead of 16-120 quarters for financial cycle indicators, and 6-20 quarters instead of 20-120. BB procedure for real GDP assumed minimum cycle length of 6 quarters.

**For CF filter expected cycle length is given after the filter name.

***BB = Bry-Boschan procedure for the turning points method.

Table 1. Russia.

	Private sector credit	Total credit	Property prices	Current account balance	Private sector to GDP ratio	Total credit to GDP ratio	Real GDP*
Filter and threshold value (in brackets)	Threshold method						
HP (1.5)	2007q3-2009q1 2008q3	<i>2003q3</i> 2004q1-2004q2 2004q1	2007q1-2008q4 2008q3	2015q1-2015q2 2015q1 <i>2015q4</i>	2009q1-2009q4 2009q3	2003q3-2004q1 2003q3 2009q4-2010q2 2010q1	2008q1-2008q3 2008q2
HP (1.75)	2008q1-2008q4 2008q3	<i>2004q1</i>	2008q1-2008q3 2008q3	<i>2015q1</i>	<i>2009q1</i> 2009q3-2009q4 2009q3	<i>2003q3</i>	2008q1-2008q3 2008q2
Hamilton (1.5)	2007q1-2007q3 2007q2 2008q1-2008q2 2008q1	-	2006q4-2008q1 2007q2 2013q1-2013q2 2013q1	2015q1-2015q2 2015q1	2007q2-2008q1 2007q4	2010q1-2010q2 2010q2	<i>2011q1</i> 2011q4-2012q3 2011q4
Hamilton (1.75)	<i>2007q2</i> <i>2008q1</i>	-	2006q4-2008q1 2007q2 2013q1-2013q2 2013q1	<i>2015q1</i>	2007q2-2007q3 2007q2 <i>2007q4</i>	<i>2010q2</i>	<i>2011q4</i>
CF**, 16-120 (1.5)	2007q4-2008q4 2008q2	-	2007q2-2009q3 2008q2	2000q4-2002q4 2001q3 2014q1-2016q4 2015q3	2007q4-2009q4 2008q4	-	2008q1-2008q3 2008q2
CF, 16-120 (1.75)	-	-	2007q3-2009q2 2008q2	2000q4-2002q4 2001q3 2014q2-2016q3 2015q3	2008q1-2009q3 2008q4	-	2008q1-2008q3 2008q2

CF, 20-120 (1.5)	2008q1- 2008q4 2008q2	-	2007q2- 2009q3 2008q3	2000q4- 2003q3 2002q1 2013q3- 2016q3 2015q2	2007q4- 2009q4 2008q4	-	2007q4- 2008q3 2008q2
CF, 20-120 (1.75)	-	-	2007q2- 2009q3 2008q2	2001q1- 2003q2 2002q1 2013q4- 2016q3 2015q2	2008q1- 2009q3 2008q4	-	2007q4- 2008q3 2008q2
Turning points method							
BB***	2009q4 2014q4	--	2008q3 2012q4	2003q1 2008q3 2011q4 2015q1	2009q4 2016q1	2004q1 2010q4 2016q2	2008q3 2012q2 2014q2

Table 2. Kazakhstan.

	Private sector credit	Total credit	Property prices	Current account balance	Private sector to GDP ratio	Total credit to GDP ratio	Real GDP*
Filter and threshold value (in brackets)	Threshold method						
HP (1.5)	2006q4- 2007q4 2007q2	2006q4- 2007q4 2007q2	2007q1- 2007q4 2007q2	<i>2017q2</i>	2007q1- 2007q4 2007q2	2007q2- 2007q3 2007q2 2009q1- 2009q3 2009q3	<i>2006q4</i>
HP (1.75)	2006q4- 2008q1 2007q2	2006q4- 2007q4 2007q2	2007q1- 2007q4 2007q2	<i>2017q2</i>	2007q1- 2007q4 2007q2	2007q2- 2007q3 2007q2 2009q2- 2009q3 2009q3	<i>2006q4</i> <i>2007q2</i>
Hamilton (1.5)	2006q4- 2007q3 2007q3	2006q4- 2007q3 2007q3	2007q2- 2007q4 2007q2	-	2006q4- 2007q3 2007q2	2006q4- 2007q3 2007q3	<i>2011q3</i>
Hamilton (1.75)	2006q4- 2007q3 2007q3	2006q4- 2007q3 2007q3	2007q2- 2007q4 2007q2	-	2006q4- 2007q3 2007q2	2006q4- 2007q3 2007q3	2011q2- 2011q4 2011q3
CF**, 16- 120 (1.5)	2006q2- 2009q2 2007q4	2006q4- 2009q1 2007q4	2006q1- 2008q3 2007q1	2001q3- 2004q3 2002q4 2014q1- 2016q1 2015q2	2007q1- 2009q1 2008q1	2006q4- 2009q3 2008q1	2008q1- 2008q2 2008q2 2011q2- 2011q3 2011q3
CF, 16-120 (1.75)	2006q3- 2009q1 2007q4	2007q1- 2008q4 2007q4	2006q1- 2008q2 2007q1	2001q3- 2004q2 2002q4 2014q1- 2016q1 2015q2	2007q1- 2009q1 2008q1	2007q1- 2009q2 2008q1	2008q1- 2008q2 2008q2
CF, 20-120 (1.5)	2007q1- 2009q2 2008q1	2007q1- 2008q4 2008q1	2006q1- 2008q3 2007q2	2001q3- 2005q1 2003q2	2007q1- 2009q1 2008q1	2006q4- 2009q4 2008q1	2008q1- 2008q2 2008q1

				2013q2- 2016q1 2014q4			2011q1- 2011q4 2011q3
CF, 20-120 (1.75)	2007q1- 2008q4 2008q1	2007q2- 2008q4 2008q1	2006q1- 2008q2 2007q2	2002q1- 2004q4 2003q2 2013q3- 2015q4 2014q4	2007q1- 2009q1 2008q1	2007q2- 2009q2 2008q1	2011q2- 2011q3 2011q3
Turning points method							
BB***	2007q3 2014q1	--	2007q2 2015q3	2004q4 2008q3 2014q1	--	--	2001q3 2007q2 2008q3 2012q2 2015q2

Table 3. Belarus.

	Private sector credit	Total credit	Property prices	Current account balance	Private sector to GDP ratio	Total credit to GDP ratio	Real GDP*
Filter and threshold value (in brackets)	Threshold method						
HP (1.5)	2010q3- 2011q2 2011q1	2010q4- 2011q1 2011q1 <i>2015q3</i>	2007q2- 2007q4 2007q3 <i>2008q3</i>	2012q1- 2012q2 2012q1	2010q2- 2011q2 2011q1	2010q4- 2011q1 2011q1	2008q2- 2008q3 2008q3
HP (1.75)	2010q3- 2011q2 2011q1	2010q4- 2011q1 2011q1	2007q2- 2007q4 2007q3	<i>2012q1</i>	2010q3- 2011q2 2011q1	2010q4- 2011q1 2011q1	-
Hamilton (1.5)	<i>2009q3</i>	<i>2011q1</i>	<i>2007q3</i>	-	<i>2009q3</i> <i>2010q1</i> 2010q3- 2011q1 2010q4	2010q4- 2011q1 2011q1 <i>2015q1</i> 2015q3- 2015q4 2015q4	2012q1- 2012q2 2012q2 <i>2012q4</i> <i>2013q3</i>
Hamilton (1.75)	-	<i>2011q1</i>	-	-	<i>2010q4</i>	<i>2011q1</i>	2012q1- 2012q2 2012q2
CF**, 16- 120 (1.5)	2008q4- 2011q1 2010q1	2009q4- 2010q2 2010q1	2007q1- 2009q3 2008q2	-	2009q1- 2011q1 2010q1	2009q4- 2010q4 2010q1 2015q3- 2015q4 2015q4	2000q4- 2001q2 2001q1 2008q2- 2008q3 2008q3
CF, 16-120 (1.75)	2009q2- 2010q4 2010q1	-	2007q3- 2009q1 2008q2	-	2009q2- 2010q4 2010q1	-	2000q4- 2001q2 2001q1 2008q2- 2008q3 2008q3
CF, 20-120 (1.5)	2008q2- 2010q4 2009q4	2008q4- 2009q3 2009q1	2007q2- 2009q3 2008q2	-	2008q4- 2011q1 2010q1	2009q2- 2009q4 2009q4	2000q4- 2001q3 2001q1 2008q2-

							2008q3 2008q3
CF, 20-120 (1.75)	2009q1- 2010q2 2009q4	-	2007q2- 2009q1 2008q2	-	2009q2- 2010q3 2010q1	-	2000q4- 2001q2 2001q1 2008q2- 2008q3 2008q3
Turning points method							
BB***	2011q1 2015q4	2011q1 2015q3	2007q3 2013q3	2002q2 2007q2 2012q1 2016q3	2011q1 2016q1	2011q1 2016q2	2008q3 2011q1 2013q2 2014q4

Table 4. Correlations between individual indicators of financial cycles by country.

Bold numbers denote statistically significant correlations (based on Fisher transformation) at 5% level.

Russia						
	Property prices	Private sector credit	Total credit	Private sector credit to GDP ratio	Total credit to GDP ratio	Current account balance
Property prices	--					
Private sector credit	0.875957	--				
Total credit	-0.10287	0.310505	--			
Private sector credit to GDP ratio	0.899463	0.926844	0.143675	--		
Total credit to GDP ratio	-0.67161	-0.3911	0.717739	-0.40706	--	
Current account balance	-0.67728	-0.52576	0.213862	-0.56541	0.549446	--
Kazakhstan						
Property prices	--					
Private sector credit	0.853896	--				
Total credit	0.830785	0.98931	--			
Private sector credit to GDP ratio	0.816986	0.948963	0.935325	--		
Total credit to GDP ratio	0.777542	0.921662	0.930514	0.98666	--	
Current account balance	-0.4042	-0.48482	-0.51574	-0.44375	-0.47149	--
Belarus						
Property prices	--					
Private sector credit	0.811271	--				
Total credit	0.488898	0.74905	--			
Private sector credit to GDP ratio	0.754402	0.984762	0.721406	--		
Total credit to GDP ratio	0.340233	0.657942	0.901583	0.705336	--	
Current account balance	-0.31196	-0.74047	-0.60006	-0.73106	-0.50332	--

Appendix 3. Boom and busts periods for composite measures of financial cycles for different countries.

Composite measures of financial cycles denote the following combinations (with equal weights):

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

FC2 = total credit + total credit to GDP ratio + property prices.

FC3 = total credit + total credit to GDP ratio.

FC4 = total credit + total credit to GDP ratio + property prices + CA balance.

Italics denote situations when boom was detected only during one quarter by one of the filters.

Bold font demotes the highest point of the boom.

Table 1. Russia.

	HP	Hamilton	CF, 16-120	CF, 20-120	BB
Booms					
FC1	2007q2-2007q3 2007q3 2008q1-2008q2 2008q1 <i>2009q1</i>	2007q1-2008q2 2007q2	2007q3-2009q3 2008q3	2007q3-2009q3 2008q4	2009q3 2014q4
FC2	2010q1-2010q3 2010q1	2010q2-2010q3 2010q3	-	-	2004q1 2016q2
FC3	2003q2-2004q2 2004q1	2010q2-2010q4 2010q3	-	-	2004q1 2010q4 2016q2
FC4	2010q10-2010q2 2010q1	<i>2010q1</i> <i>2015q2</i>	2014q4-2016q1 2015q3	2015q1-2015q4 2015q3	2004q2 2011q4 2015q4
Busts					
FC1	2005q2-2005q3 2005q3 <i>2006q1</i> 2011q1-2011q4 2011q2	<i>2003q4</i>	2000q4-2001q3 2000q4	2000q4-2001q3 2000q4	2011q1
FC2	2005q1-2006q2 2005q2 <i>2008q3</i>	2005q1-2006q2 2006q1	2005q2-2007q1 2006q2	2005q2-2007q2 2006q2	2001q2 2005q2
FC3	2005q1-2005q2 2005q2 2006q1-2006q2 2006q2 <i>2008q3</i>	2005q1-2006q2 2006q1	2005q4-2008q1 2006q4	2005q4-2008q1 2006q4	2001q2 2006q1
FC4	<i>2009q1</i> <i>2013q2</i>	<i>2005q1</i> <i>2006q2</i> <i>2009q1</i> <i>2017q2</i>	-	-	2001q2 2005q1 2013q2

Table 2. Kazakhstan.

	HP	Hamilton	CF, 16-120	CF, 20-120	BB
Booms					
FC1	2006q4-2007q4 2007q2	2007q2-2007q4 2007q2	2006q3-2009q1 2007q4	2006q3-2009q2 2007q4	--
FC2	2006q4-2007q4 2007q2	2007q2-2007q4 2007q2	2006q4-2009q2 2007q4	2006q3-2009q2 2007q4	2007q2 2015q3

FC3	2007q1-2007q4 2007q2 <i>2009q3</i>	2007q2-2007q3 2007q3 <i>2010q1</i>	<i>2008q2</i>	2007q2-2009q4 2008q2	2009q3 2015q4
FC4	<i>2007q2</i> <i>2008q1</i> <i>2014q1</i> <i>2015q4</i> <i>2017q2</i>	<i>2008q1</i> <i>2014q1</i>	2007q1-2009q2 2008q1	2006q4-2009q2 2008q1	2008q1 2014q1
Busts					
FC1	-	2006q1-2006q2 2006q1	<i>2003q2</i>	<i>2003q2</i>	--
FC2	-	2006q1-2006q2 2006q1	2003q2-2003q3 2003q2	2003q2-2003q3 2003q2	2012q2
FC3	-	2006q1-2006q2 2006q1 2011q2-2011q3 2011q3	2003q2-2003q3 2003q2	2003q2-2003q3 2003q2	2012q1
FC4	<i>2009q2</i> <i>2016q1</i> <i>2016q4</i>	<i>2006q1</i> 2016q1-2016q2 2016q1 2016q4-2017q1 2016q4	<i>2003q2</i>	-	2009q2 2016q1

Table 3. Belarus.

	HP	Hamilton	CF, 16-120	CF, 20-120	BB
Booms					
FC1	2010q3-2011q1 2011q1	<i>2010q1</i>	2008q2-2010q3 2009q3	2007q4-2010q2 2009q3	2011q1 2015q1
FC2	<i>2007q3</i> 2010q4-2011q1 2011q1	<i>2007q3</i> <i>2011q1</i>	2007q3-2009q4 2009q1	2007q3-2010q1 2008q4	2011q1 2015q1
FC3	2010q4-2011q2 2011q1	<i>2011q1</i> <i>2015q1</i>	2010q1-2010q2 2010q1 2015q2-2015q4 2015q3	<i>2009q3</i>	2011q1 2016q2
FC4	2007q2-2007q3 2007q3 <i>2011q2</i>	<i>2007q2</i>	2006q4-2009q3 2008q1	2007q1-2009q3 2008q2	2007q3 2015q2
Busts					
FC1	2012q1-2013q1 2012q2	2012q1-2013q1 2012q2	-	-	2012q2 2017q2
FC2	2011q4-2012q4 2012q2	2011q4-2012q4 2012q2	-	-	2012q2 2017q2
FC3	2011q4-2012q3 2012q2	2011q4-2013q1 2012q2	2002q2-2003q2 2002q4	2002q1-2003q1 2002q2	2012q2 2017q2
FC4	<i>2011q1</i> <i>2011q4</i> 2012q2-2012q3 2012q2 <i>2013q1</i>	2011q4-2012q1 2011q4 <i>2013q2</i> <i>2017q2</i>	-	-	2002q3 2012q2

Table 4. Boom periods for composite measures of financial cycles with varying weights*.

	Kazakhstan	Belarus	Russia
FC1	2006q3-2009q1 2007q4	2007q4-2010q4 2009q3	2007q2-2009q3 2008q2

FC2	2006q3-2009q2 2007q4	2007q4-2010q3 2009q3	-
FC3	2007q1-2009q3 2008q2	2009q3-2010q4 2010q1	-
FC4	2006q4-2009q2 2007q4	2006q4-2009q4 2008q1	2010q2-2011q3 2010q4 2014q3-2015q4 2015q2
FC5	2006q4-2009q2 2008q1	2008q4-2011q1 2010q1	2007q2-2010q1 2008q3
FC6	2006q4-2009q1 2007q4	2007q3-2010q2 2009q1	2006q3-2010q2 2008q1

*Weights in this case are inversely proportional to the difference between the maximum and minimum values of the time series.

Results are based on CF filter, 16-120 quarters and are robust for 20-120 quarters.

Additional financial cycle measures:

FC5= private sector credit + private sector credit to GDP ratio;

FC6 = private sector credit + private sector credit to GDP ratio + property prices + CA balance.

Appendix 4. Robustness check of results for composite financial cycles booms and busts periods – shorter samples

Composite measures of financial cycles denote the following combinations:

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

FC2 = total credit + total credit to GDP ratio + property prices.

FC3 = total credit + total credit to GDP ratio.

FC4 = total credit + total credit to GDP ratio + property prices + CA balance.

FC5= private sector credit + private sector credit to GDP ratio;

FC6 = private sector credit + private sector credit to GDP ratio + property prices + CA balance.

Italics denote situations when boom was detected only during one quarter by one of the filters.

Bold font demotes the highest point of the boom.

Results are for CF filter, 16-120 quarters, threshold 1.75. Results for threshold 1.5 are also robust, and are available from the authors upon request.

Weights are inversely proportional to the difference between maximum and minimum points for each time series.

Country	Sample period	FC1	FC2	FC3	FC4	FC5	FC6
Booms							
Russia	2000q4-2007q3	2007q2-2007q3 2007q3	-	-	-	2007q2-2007q3 2007q3	-
	2000q4-2008q1	2007q3-2008q1 2008q1	<i>2008q1</i>	-	<i>2008q1</i>	2007q3-2008q1 2008q1	-
	2000q4-2012q1	2007q4-2009q2 2008q3	-	-	2011q2-2012q1 2012q1	2008q2-2009q1 2008q3	2007q4-2008q2 2008q1
	2000q4-2017q2	2007q2-2009q3 2008q3	-	-	-	2007q4-2009q3 2008q3	2007q2-2009q1 2008q1
Kazakhstan	2003q2-2008q1	-	-	-	-	-	-
	2003q2-2009q1	-	-	-	2007q2-2008q2 2007q4	-	2007q2-2008q2 2007q4
	2003q2-2012q1	2006q4-2008q4 2007q4	2007q1-2008q4 2007q4	2007q3-2009q1 2008q2	2007q1-2008q4 2007q4	2007q3-2009q1 2008q2	2007q1-2008q4 2007q4
	2003q2-2017q2	2006q3-2009q1 2007q4	2006q3-2009q2 2007q4	2007q1-2009q3 2008q2	2006q4-2009q2 2007q4	2007q1-2009q3 2008q2	2006q4-2009q2 2007q4
Belarus	2003q2-2008q1	-	-	-	-	-	-
	2002q1-2010q2	-	-	-	2007q1-2008q2 2007q4	-	2007q1-2008q2 2007q4
	2002q1-2012q1	2008q2-2010q2 2009q3	2008q1-2010q1 2009q2	2009q3-2011q1 2010q2	2007q2-2009q2 2008q1	2009q3-2011q1 2010q2	2007q2-2009q2 2008q1
	2002q1-2017q2	2008q1-2010q3 2009q3	2008q1-2010q2 2009q3	2009q4-2010q3 2010q1	2007q1-2009q3 2008q1	2009q4-2010q3 2010q1	2007q1-2009q3 2008q1
Busts							

Russia	2000q4-2007q3	2000q4-2001q1 2000q4	2000q4-2001q2 2000q4	<i>2006q1</i>	2000q4-2002q2 2001q2	2000q4-2001q1 2000q4	-
	2000q4-2008q1	-	2000q4-2001q2 2000q4 2005q3-2006q1 2005q4	2005q3-2006q3 2006q1	2000q4-2002q3 2001q3	2000q4-2001q1 2000q4	-
	2000q4-2012q1	-	2005q4-2006q1 2006q2	2005q3-2007q2 2006q3	-	<i>2000q4</i>	-
	2000q4-2017q2	2000q4-2001q2 2000q4	2005q2-2006q1 2005q4	2005q3-2007q3 2006q3	2000q4-2001q3 2000q4	2000q4-2002q1 2000q4	2000q4-2001q4 2001q2
Kazakhstan	2003q2-2008q1	-	-	-	-	-	-
	2003q2-2009q1	-	-	-	-	-	-
	2003q2-2012q1	-	-	-	-	-	-
	2003q2-2017q2	<i>2003q2</i>	2003q2-2003q3 2003q2	2003q2-2003q3 2003q2	<i>2003q2</i>	2003q2-2003q3 2003q2	<i>2003q2</i>
Belarus	2003q2-2008q1	-	-	-	-	-	-
	2002q1-2010q2	-	-	-	-	-	-
	2002q1-2012q1	-	-	-	-	-	-
	2002q1-2017q2	-	-	2002q2-2003q2 2002q4	-	2002q2-2003q2 2002q4	-

Table 2. Correlations between combined measures of financial cycles for different countries. Bold numbers denote statistically significant correlations (based on Fisher transformation) at 5% level.

	Russia	Kazakhstan	Belarus
FC1			
Russia	--		
Kazakhstan	0.905794	--	
Belarus	0.881216	0.815864	--
FC2			
Russia	--		
Kazakhstan	0.173918	--	
Belarus	0.299422	0.902183	--
FC3			
Russia	--		
Kazakhstan	-0.42469	--	
Belarus	0.18253	0.634009	--
FC4			
Russia	--		
Kazakhstan	0.314424	--	

Belarus	0.268102	0.846158	--
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