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CENTRAL BANK OF
MONTENEGRO

APPLYING HP FILTER IN
LOANS AND DEPOSITS IN MONTENEGRO

Nina Vujanović, Special Advisor in the Directorate for Monetary Policy and Fiscal Research
Maja Ivanović, Special Advisor to the Director of the Department for Financial Stability, Research, and Statistics

CONTENTS

1. Introduction

Credit boom represents an unsustainable credit growth which is followed by adverse effects for the banking sector, as well as for the entire economy. The research shows that credit booms may have the following causes: liberalization of the financial system, positive economic shock, increased banking competitiveness, inflow of foreign capital, as well as the growth of prices in the real estate market. By encouraging consumption and growth of economic activities, credit growth has a direct impact on the economic flow, thus reheating the economy.

Positive perception of borrowers' creditworthiness may result in bankers overestimating their managerial capabilities in managing credit risk (Thakor, 2015). This can make the banking system highly unstable, because poor assessment of credit risk results in insufficient allocation of reserves for credit losses. Following bursting of the credit bubble, banks' credit portfolios have higher amount of non-performing loans with uncertain repayment. Thus, the banks are exposed to higher solvency risk (Ottens et al. 2005). As a result, the lack of confidence can prompt depositors to start withdrawing deposits, which influences the increase of liquidity risk of the banking sector (Ottens et al. 2005). Stability of the banking system can be also easily compromised, because loss of confidence in one bank overflows easily to the whole banking sector. Logically, following a credit boom banks will be extra cautious and they will apply restrictive credit policy, which discourages economic activity. Some studies have shown a clear connection between credit boom and financial crisis.

The latest financial crisis, mostly accompanied by a credit boom, showed that there is a greater need for an analysis of expansive credit growth and timely identification of credit booms and their potential causes. Transition countries are prone to credit expansions. Credit booms in transition economies seem to be associated mostly with financial reforms, large capital inflows, productivity gains and favourable international liquidity conditions.

To the knowledge of the authors of this study, there has been no analysis of credit expansion in Montenegro in the period following the crisis. The aim of this study is to remove this "deficiency", which will hopefully contribute to the better understanding of the lending activity in transition

economies. It is very interesting to analyse Montenegro because the credit expansion was followed by the inflow of foreign direct investments (FDI) as well as the rise in real estate prices.

The study is organized as follows: Section 2 provides a theoretical and empirical overview of papers analysing credit boom, with a focus on causes, consequences, credit boom financing, as well as credit booms in transition economies; Section 3 explains the HP filter method for credit boom detection; Section 4 provides an analysis of the credit boom in Montenegro using the HP filter method, Section 5 concludes the study.

2. Theoretical and empirical literature

2.1. Causes of a credit boom

Credit boom represents an excessive credit expansion which stops suddenly at a certain point (Mendoza & Terrones, 2004). However, not every excessive credit growth is synonymous with credit expansion. Economic theory explains that excessive credit growth may represent a financial deepening - the emergence of credit growth at a rate higher than the rate of GDP growth, as a result of development of a financial system (Goldsmith, 1996, Tornell & Wetermann, 2002). In this case, credit booms should be associated with permanent take-offs in the credit to GDP ratio. Research suggests that financial deepening leads to permanent changes in financial conditions and increased investment, which encourages economic growth (Mishkin, 2001; Ottens et al. 2005), although this relationship weakens (or disappears) in a period of a financial crisis (Rousseau & Wachtel, 2011).

In addition to credit expansion and financial deepening, excessive credit growth may result from working capital financing (Mendoza & Terrones, 2004). The need for working capital depends on the phase of an economic cycle, which is why this credit growth, as a result of financing of such investments, is called *cyclical*. Cyclical credit growth may be higher than GDP growth, and unlike financial deepening it is not followed by lasting positive economic consequences, but it lasts as long as the financing of production inputs.

Credit boom, on the other hand, represents an *unsustainable* credit growth. Unlike financial deepening, which is the cause (consequence) of economic growth and cyclical credit growth that follows a normal economic cycle, the credit boom can have very negative consequences for an economy. Credit boom reheats the economy, which can be followed by a "credit burst" and possible recession. Several factors influence the creation of the credit boom. Theory suggests that credit boom can be a natural successor of liberalisation of a repressive financial system. Countries that have a high interest rate gap, too many regulations in the banking sector and/or centralised decision-making regarding lending have a significantly lower loans to GDP ratio (Gourinchas et al.

2001). Therefore, the reduction of banking regulation (for example, by reducing the reserve requirements) can encourage banks to excessively emit their assets (Cottarelli et al, 2003; Ottens et al. 2005). Credit boom as a product of financial liberalization can have serious consequences, especially if prudential regulation is underdeveloped (Gourinchas et al. 2001).

Credit boom may follow positive economic shocks, government guarantees in collection of loan receivables and increased banking competiveness. Positive economic shock (e.g. technological) can cause excessive borrowing because it motivates the banking sector to issue loans due to the increased productivity of entrepreneurs and their profits (Gourinchas et al. 2001). Mendoza and Terrones (2008) explained that technological progress and innovation are often financed through external resources and that there is a clear evidence that loans play an important role in the process of technological innovation in advanced economies. Positive expectations about rapid technological progress and future increases in the value of collateral are often followed by a strong credit growth. Also, Government guarantees for certain loans in underdeveloped markets may result in high-risk credit arrangements[1] (Kiss et al. 2006), due to unexpected losses in case of failure to collect receivables. On the other hand, by reducing the profit margin, the increased competitiveness of banks can cause banks to use excessive credit programs to find new sources of profit (Kiss et al. 2006). Increased competition affects the reduction of interest rates and a greater variety of credit products. Mechanisms to reduce costs of borrowing and new loan arrangements encourage credit growth.

Another common reason for a credit boom is high foreign capital inflow (Aghion et al. 2004), which is attracted by various external factors such as low interest rates in developed economies (Calvo et al. 1993; Gourinchas et al. 2001; Ottens et al. 2005; Hoffman, 2014). The inflow of foreign capital increases the wealth of entrepreneurs through the growth of prices of goods and stocks. As their wealth increases so does their creditworthiness, i.e. the ability to repay debt, which results in higher borrowing. While analysing episodes of credit booms in emerging and industrial countries, Mendoza and Terrones (2008) find that the frequency of credit booms in emerging markets is higher when preceded by periods of large capital inflows but not when preceded by domestic financial reforms or gains in total factor productivity, while industrial countries show the opposite pattern. Namely, credit booms in industrial countries are more frequent after periods of high total factor productivity and financial reforms, and less frequent after large capital inflows. While analysing 99 credit booms of twenty-one advanced and forty-three developing economies in the period from 1960 to 2010, Elekdag and Wu (2011) indicate that 60 percent of credit booms come as a result of large amount of foreign capital that preceded the boom in developing markets.

Using a sample of 70 advanced and emerging market countries, Calderón and Kubota (2012) also find that surges in gross capital inflows (particularly other investment inflows) are a strong empirical predictors of credit booms. Furthermore, Dell'Ariccia et al. (2012) find that, in addition to financial reforms, capital inflow surges associated with capital account liberalisations, and peri-

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[1] *a phenomenon which is categorised by economic profession as moral hazard*

ods of strong economic growth are empirically associated with credit booms. In addition, they stressed that country specific indicators are important. Namely, credit booms are likely to occur in countries with fixed exchange rate regime, expansionary monetary and fiscal policies and low quality of banking supervision.

Decressin & Terrones (2011) find that capital inflows are good predictors of credit booms and merit close monitoring not only because of their impact on competitiveness but also because of other implications for financial stability. In line with Mendoza & Terrones (2008), Decressin & Terrones (2011) find that credit booms in emerging market economies seem to be associated mostly with large capital inflows, unlike those in advanced economies often coinciding with productivity gains. In a recent study of credit boom drivers in low income countries, Arena et al. (2015) indicate that the incidence of credit booms is positively associated with capital inflows and favourable international liquidity conditions. Moreover, their analysis suggests that countries with managed or fixed exchange regimes could experience significant credit expansions during surges in capital inflows, potentially rendering them more vulnerable to capital flow reversals. In addition, their research shows that financial liberalisation can trigger credit booms. Finally, their results suggest that low-income countries should remain mindful of the inter-linkages between financial liberalisation, increased cross-border banking activities, as well as ability to deal with large capital inflow.

Credit booms can be caused by the increase of real estate prices in the real estate market (Bernanke & Gertler, 1995; Bernanke et al. 1999; Kiyotaki & Moore, 1997; Aiyagari & Gertler, 1999), which is one of the main reasons for the global financial crisis from 2008. The increase in real estate prices increases the wealth of its owners, thus increasing their ability to borrow and repay debt through the sale of real estate. On the other hand, in their off-balance sheets, banks can have mortgages as collateral for issued loans. With the growth in real estate prices the banks increase issuing of loans to debtors, while anticipating collection of receivables through the sale of the real estate. This leads to an increased wealth of debtors on one hand and greater issuing of loans on the other. The spillover of the credit cycle to the business cycle through the value change of the balance sheets of banks and companies, as well as through increased lending activity is called financial accelerator (Sa, 2007). Financial accelerator directly affects business cycles through the already mentioned increased consumption and investments. In anticipation of the growth in real estate prices, this process (consumption and investments) continues, whereby the credit and real estate markets record excessive "growth". When the "real estate bubble" bursts, what follows is a sharp drop in real estate prices. Financial accelerator then works in an opposite direction: wealth of real estate owners declines, as well as their creditworthiness, and the banks issue fewer loans because of lower collection of receivables and the anticipation of a further decline in real estate prices. By selling real estate for the purpose of loan collection, banks encourage further drop in real estate prices, thus accelerating the negative effects of the financial accelerator.

Table 1 gives a summary of possible causes for credit booms.

Table 1 – Causes for credit booms

Causes for credit booms	Support to theoretical explanation and empirical evidence:
Liberalisation of the financial/ banking system	Gourinchas et al. (2001); Cottarelli et al. (2003); Ottens et al. (2005)
Positive economic shock	Gourinchas et al. (2001); Mendoza & Terrones (2008);
Government guarantees	Kiss et al. (2006)
Increased banking competition	Kiss et al. (2006)
Inflow of foreign capital	Aghion et al. (2004); Mendoza & Terrones (2008); Elekdag & Wu (2011); Calderon & Kubota (2012); Decressin & Terronnes (2011); Dell' Ariccia et al. (2012); Arena et al. (2015)
Growth of real estate prices	Bernanke & Gertler (1995); Bernanke et al. (1999); Kiyotaki &| Moore, (1997); Aiyagari & Gertler (1999), Sa (2007)

2.2. Consequences of a credit boom

Positive perception of debtor's creditworthiness may result in bankers overestimating their managerial capabilities in managing credit risk (Thakor, 2015). Inadequate risk assessment of the mentioned loan placements often results in an insufficient allocation of reserves for loan losses. Therefore, due to the aforementioned negative effects following bursting of the credit bubble, banks' portfolios have a higher amount of non-performing loans with uncertain repayment. In this way, the bank is exposed to an increased solvency risk (Ottens et al. 2005). As a result, mistrust can make depositors start a deposits withdrawal cycle, causing an increase in liquidity risk. Stability of the banking system can also be easily compromised, because the lack of confidence in one bank can easily overflow to the entire banking sector (Fabris, 2006; Ottens et al. 2005), which may result in a banking crisis.

The current literature does not have a consistent attitude towards relation between credit expansion and banking crisis. Gourinchas et al. (2001) indicates that most banking crises follow credit expansion, while this relationship does not have a reverse causal sequence. Mendoza & Terroness (2004) indicate that 75%-85% of credit booms in emerging market economies coincide with the banking and currency crisis. On the other hand, other studies indicate that the growth of private debt to GDP ratio increases the possibility of a banking crisis (Demirguc-Kunt & Detragiache, 1998; Roy & Kemme, 2011, 2012). Roy and Kemme (2012), using a sample of historical banking crises in advanced economies[2], suggest that the chances of a banking crisis increase after a credit expansion in the liberalised financial markets. The crises in the banking sector are very dangerous, because they can have a lasting negative impact on economic growth (Cerra and Saxon, 2008; Teulings and Zubanov, 2010). Roy and Kemme (2012), using a sample of historical banking crises in advanced

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[2] *Australia (1989), Canada (1983), Denmark (1987), Finland (1991), France(1994), Germany (1977), Italy (1990), Japan (1992), Norway (1991), New Zealand (1987), Spain (1977), Sweden (1991), the UK (1984, 1991, 1995), and the US (1984).*

economies suggest that the chances for a banking crisis increase following a credit boom in liberalised financial markets. Crises in the banking sector are very dangerous, because they can have a lasting negative effects on economic growth (Cerra and Saxon, 2008; Teulings and Zubanov, 2010).

Apart from the possible mistrust of depositors, credit boom is followed by a period of distrust of the banking sector in terms of collectability of loans as well as by a restrictive lending policy, i.e. enhanced analysis of business entities before concluding new loan arrangements. Restrictive lending policy has a number of negative consequences for the economy. It discourages economic activity from performing regular activities because it can prevent funding of necessary funds for working capital, which may also induce negative inflation which is detrimental to economic growth[3]. Economic activity is also discouraged through the reduction of long-term investment activities, which encourage GDP growth. Model offered by Aghion et al. (2010) indicates that restrictive lending policy increases the liquidity risk of the corporate sector, which reduces the likelihood of a long-term borrowing due to expectations that the obligations will not be duly met. This has a direct impact on the reduction of productivity and economic growth. The limiting of lending activity also reduces investments in research and development, which is a form of long-term investments (Agihion et al. 2012).

Therefore, excessive credit growth may adversely influence the economic growth (Jorda et al. 2013; Gadea Rivas & Perez-Quivas, 2015) and investment spending (Jorda et al. 2013), thus increasing the possibility of deepening the recession period and/or reducing the expansion period (Jorda et al. 2013; Gadea Rivas & Perez-Quivas, 2015). Thus, credit growth carries essential information about the beginning of a financial crisis (Jorda et al. 2011, 2013; Schularick & Taylor, 2012; Gadea & Perez, 2015). Schularick & Taylor (2012) and Jorda et al. (2011), in a study which covered fourteen developed countries in the period 1870 - 2008, show that credit growth can be the best signal to the economic policy makers when forecasting financial instability. However, Gadea & Perez (2015) suggest that credit growth is not a perfect indicator of a financial crisis, but that the correlation between credit growth and business cycles was mainly dominant during the last financial crisis.

Table 2 summarises possible consequences of a credit boom.

Table 2 - Possible consequences of a credit boom

| Possible consequences of a credit boom	Theoretical explanation and empirical evidence:
Banking crisis	Demirguc-Kunt & Detragiache (1998); Gourinchas et.al (2001); Menodoza & Toress (2004); Roy & Kemme (2011, 2012)
Weaker economic growth	Jorda et.al (2013); Gadea Rivas & Perez-Quivas (2015)
Weaker investment spending	Jorda et al. (2013)
Financial crisis	Schularick & Taylor (2012); Jorda et al. (2011)

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[3] *Negative inflation, i.e. deflation discourages economic growth. The general decline in prices discourages entrepreneurs from increasing production, which directly reduces GDP.*

2.3. Credit boom financing

The ownership structure of banks is cited in literature as an important factor of credit growth. In many transitional countries the carriers of accelerated loan growth were mainly foreign banks. Higher credit growth came as a result of the foreign banks` arrival in the emerging market economies and their borrowing abroad under more favourable conditions. De Haas & van Lelyveld (2006, 2014) report that credit growth of foreign banks in CEE countries is associated with their parent banks' financial position. Kolev & Zwart (2013) note that the Western European banks improved access to credit in emerging European countries by introducing very important banking products that were largely absent in these economies during 1990s.

Most CEE countries experienced potentially unsustainable growth rates in the years before the crisis. Namely, credit growth significantly exceeded deposit growth in most CEE countries. The loan to deposit (LtD) ratio has been relatively high and rising in all of these countries, suggesting that deposits have not been able to meet loan demand in recent years. This has led to an increasing dependency on foreign funding, which has mainly been channelled through the banking sector. UniCredit CEE Banking Study (2011) reports that with leveraging on abundant international liquidity and the low cost of country risk, local banks were able to support credit growth by financing domestic lending via international capital inflows, given the context of low domestic deposit rates. As can be seen in Figure 1, with the exception of Bosnia and Herzegovina, Macedonia, and Serbia, the changes in bank credit to GDP ratio significantly exceeded those in the bank deposits to GDP ratio.

Figure 1 - Change in deposit and credit to GDP (2003-2007), in percentage points
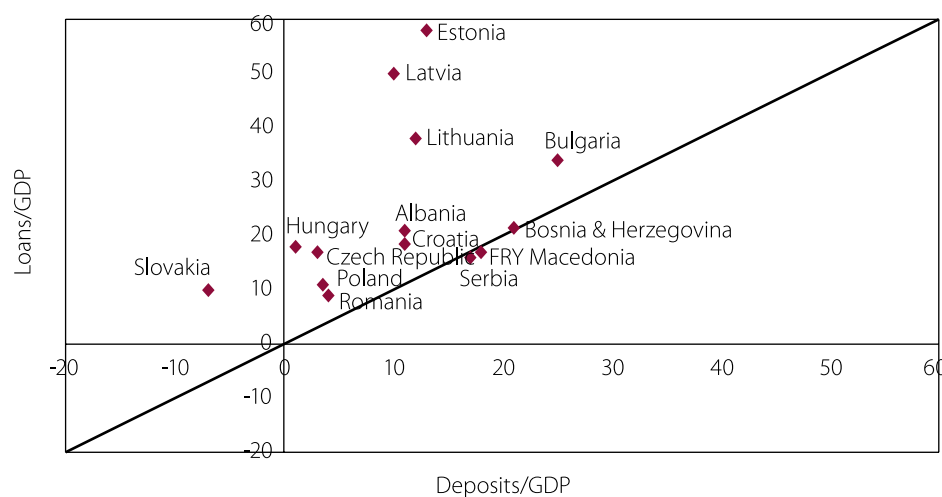
Source: Arvai et al. (2009)

Previous studies, such as Kashyap, Rajan & Stein (2002) and Gatev & Strahan (2006), show that banks that extend lending activities are more prone to fund themselves with deposits. In these circumstance banks at greater risk of cuts in lending activities are at less risk of a run by the short-term creditors. However, the experience of the global financial crisis highlighted some facts about the new financial architecture. Brunnermeier (2009) provides an example that fire-sale externali-ties and network effects suggest that financial institutions have an individual incentive to take on too much leverage, to have excessive mismatch in asset–liability maturities. Moreover, Brunner-meier (2009) reports that during the last global financial crisis banks had difficult time rolling over their short-term debt because of concerns about the solvency and liquidity of the banking system.

According to de Haas & Van Lelyveld (2014), the foreign bank subsidiaries' access to parent bank and wholesale funding, one of their main competitive advantages before the crisis, turned out to be a mixed blessing when these alternative funding sources dried up during the 2008 global financial crisis. Namely, Cetorelli & Goldberg (2012) note that parent banks, when hit by a fund-ing shock, reallocate liquidity in the organisation according to a locational pecking order. Cull & Martínez Pería (2013) show that foreign banks fuelled credit growth prior to the crisis in Eastern Europe and that their total loan growth fell more than domestic private credit growth during the crisis. Allen et al. (2014) provide evidence that foreign bank subsidiaries that depended on par-ent bank financing via the interbank market increased their credit supply prior to the global cri-sis. However, during the global financial crisis interbank market-dependent subsidiaries reduced their lending activities which may be attributed to the decline in funding from the parent banks.

Given that global financial crisis primarily resulted in a liquidity crunch in the money markets, many parent banks incurred financial losses. Thus, access to local deposits might strongly deter-mine the future credit growth. This is confirmed also by Allen et al. (2014) study. Namely, their findings indicate that bank-specific characteristics, such as deposit growth and profitability ra-tios, are important determinants of credit growth during both normal economic times and crisis periods. Similar to their findings, Ivashina and Scharfstein (2010) stressed that banks with better access to deposit financing, decreased lending to a lesser degree during the recent financial crisis.

2.4. Credit boom in transition economies

The reason for excess credit growth in transition economies may be lower credit basis compared to developed economies. Credit growth, in this case, may represent a process of "catching up" with the credit and economic level of the developed countries (Coudert & Pouvelle, 2010), which repre-sents financial deepening. As explained in Section 2.3, the reasons for financial deepening in the European transition economies may also be the entry of foreign banks and their foreign borrow-ing under favourable conditions (Haas & van Lelyveld, 2006, 2014; Cull & Martinez Pería, 2013). In other words, foreign bank can finance the credit boom by using the funds of parent banks at lower interest rate than the rate in the transitional economy in which they operate.

It seems that the credit boom in transition economies is mostly associated with financial reforms, large capital inflows, increased productivity and favourable international liquidity, as stated in Section 2.1 about the causes of credit boom. Eastern European countries with a low level of financial intermediation at the beginning of the new millennium experienced rapid credit growth. Credit growth in those countries is a result of financial liberalisation, stabilisation of the macroeconomic environment, privatisation in the financial sector, foreign capital inflow and increased confidence in the banking sector. The study of Terrones & Mendoza (2004) notes that real credit to the private sector has grown faster than 20 percent a year in some East Asian and Eastern European countries. This study points to the particular risk of a credit boom in less developed markets, which are often followed by a sharp economic downturn and financial crisis. The study concludes that there is almost a 70 percent probability that a credit boom coincides with either a consumption or investment boom in transition economies. Hilbers et al. (2006) explain that, on the demand side, credit boom in the Central and Eastern Europe is supported by higher income expectations, often related to these countries' (prospect of) accession to the European Union. On the supply side, the credit surge has been facilitated by foreign financial institutions entering these markets with the objective of rapidly gaining market share.

When it comes to the consequences of a credit boom in countries in transition, there are several studies. Coudert & Pouvelle (2010) suggest that there is no clear link between credit boom and financial crisis in the Central and Eastern European countries during the period 2006-2007, because the crisis spilled over from other countries into this region. However, a sudden drop in loans has more severe consequences in countries that experienced higher credit expansion. Barajas at al. (2011), in the study that includes a hundred developing economies as well economies in transition in the period 1980-2004, concluded that credit booms in the conditions of high inflation and weaker economic growth are more susceptible to cause a financial crisis. On the other hand, banking supervision and open trade reduce the chance of credit booms turning into a crisis. Laidroo & Mannasoo (2014) study indicates that excessive credit offer in eleven countries of the Central and Eastern Europe in the period 2004-2010 influenced banking losses arising from lower reserves. The reduction of banking reserves, on the other hand, has a negative impact on GDP growth in the analysed economies.

Compared to the countries in the region, there are couple of studies on credit growth from the pre-crisis period. Cottarelli et al. (2005) indicate that bank credit to the private sector-to-GDP ratio in Central and Eastern European and Balkan[4] countries may be the result of financial deepening, privatisation process and "catching up" of market economies. The research also indicates that foreign sources of funding have not affected credit growth. Kraft & Jankov (2005) indicate that excessive credit growth in Croatia caused lower quality of the loan portfolio which stimulated the current account deficit as well as the use of foreign sources of financing. The authors indicate that it is necessary to implement a proactive monetary policy, restrictive fiscal policy and higher capital requirements towards banks that are expanding. While analysing credit growth in transition

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[4] *Without Montenegro as an independent country.*

economies of Southeast (Croatia, Bulgaria and Romania) and Central Europe, Boissay et al. (2006) concluded that credit growth during the pre-crisis period cannot be fully explained by the fast economic growth, declining interest rates or the process of catching-up. Also, their study shows that countries with fixed exchange rate regimes experienced higher credit growth, taking into account their macroeconomic environment. Palić (2007) indicates that the credit growth in Serbia cannot be attributed to the credit boom but rather to the low base and the convergence process towards the level of loans in developed countries, and that the country has more room for credit growth. The credit boom in Montenegro has not been covered by any previous analyses.

3. HP filter – the method for determining deviation from a long-term trend

There are several ways for monitoring credit growth: determining the arbitrary threshold of credit growth, econometric methods, as well as statistical methods (HP filter). The methods and respective research papers are summarised in Table 3.

Table 3 – Credit boom detection techniques

Credit boom detection techniques	Research papers:
Arbitrary threshold of credit growth	Tornell & Westerman (2002); Barajas et al. (2011)
Econometric method	Kiss et al. (2006); Egert et al. (2007)
Statistical method (HP filter)	Mendoza & Terrones (2004, 2008); Coudert & Pouvelle (2010); Boissay et al. (2006), Ottens et al. (2005); Elkdag & Wu (2011, 2013)

One of the methods is the arbitrary threshold of credit growth that can be identified with credit boom. Tornell & Westerman (2002) believe that credit boom represents a credit growth of 20 percent, 30 percent or 40 percent over a period of two years. Authors Barajas et al. (2011) suggest that if bank credit to the private sector-to-GDP ratio grows at more 10%, then the credit growth is identified as a credit boom. However, the drawback of this method is that the numerical threshold of credit growth is fully arbitrary. Therefore, different threshold definitions provide different levels of credit boom.

Econometric method of identifying credit booms is a technique implemented by most developed and transition economies with longer time series (e.g. Backé et al., 2006). This method explains the level of loans (or credit growth) as a function of economic variables such as interest rates, GDP, inflation, exchange rates, and other indicators. However, due to the short length of time series of the given variables, this method cannot be used in the case of Montenegro.

The third method is a statistical method and is based on the HP filter (*Hodrick-Prescott filter*) technique, which is now widely used in macroeconomics. Its purpose is to determine the long-term trend of time series as well as the deviation from the trend, aimed at monitoring the cyclical movement of economically important variables (e.g. time series of loans, foreign direct investment, GDP, prices, capital, consumption, etc.). The application of the HP filter was first introduced by economists Hodrick and Prescott in 1997, by studying postwar business cycles in the United States. They explain that time series (y) at a given time t (y_t) include growth component (g_t) and cyclical components (c_t), which is mathematically shown by the equation (1).

Yt = gt + ct (t = 1, 2, 3...)   (1)

The first component represents "smooth" movement of a series, while the second component represents deviation in relation to this movement. The sum of cyclical components c_t of one time series, according to the HP method, equals to zero. To obtain the trend's direction, it is necessary to minimise the weighted average of the sum of squared cyclical component and the squared difference of two consecutive time differentials of trend component ($[\Delta g_t - \Delta g_{t-1}]^2$) at each time period t of the given interval. In numerical terms, it is necessary to minimise the following objective function:

$$\underset{(g_t)_{t=-1}^{T}}{Min_T} \left\{ \sum_{t=1}^{T} c_t^2 + \lambda \sum_{t=1}^{T} \left[(g_t - g_{t-1}) - (g_{t-1} - g_{t-2}) \right]^2 \right\}$$ (2)

In the given equation, C_t can be expressed as (y_t - g_t) with respect to the equation (1). The problem of minimising (or maximising) a certain function is handled by searching for extreme points, which are obtained by calculating the first differential of this function with respect to a common component of the equation (1) and (2) (in this case, g_t). More recent values of the time series are given greater weight. The parameter λ is a positive smoothing parameter of series that reduces the variability of the trend component. The higher its value, the less cyclical oscillations are recorded by the series of HP trend. Let's suppose, if the value of the parameter $\lambda= +\infty$, the trend is a straight line. Lower value of λ produces a trend that closely follows the actual values of the yt series. Therefore, the issue of selection of parameter λ arises. According to previous empirical research of determining the trend of loans on a quarterly basis, the typical parameter for detecting business cycle $\lambda = 1600$ (Booms & Are, 2004; Sa, 2006; Courdert & Pouvelle, 2010; etc.) was used, which represents a selection of the given value and this research.

A long term trend of the time series is obtained after implementing the above method. Comparison of the trend line (c_t) with the cyclical series line (g_t) indicates whether there is excessive growth or decline of loans. The amount of distortion that can be considered a credit boom differs from research to research. The IMF's study (Mendoza & Terrones, 2004) suggests that credit booms are associated with 1.75 standard deviations from a trend line. Elekdag & Wu (2013) use a standard 1.55 deviation from the trend line. The authors opted for the IMF's definition, which is widely implemented in practice (Mendoza & Terrones, 2008, Coudert & Pouvelle, 2010 and others).

For the purpose of researching credit boom, different definitions of yt variable were used, namely: the ratio of nominal value of loans to GDP, the nominal amount of loans and real amount of loans of the banking sector. Research papers and respective series are summarised in Table 4.

Table 4 – Series used for identifying credit boom by using HP filter method

	Series used	Research papers
1.	Nominal amount of loans of the banking sector to the private sector/GDP	Coudert & Pouvelle (2010), Boissay et. al (2006), Ottens et. al (2005)
2.	Real amount of loans of the banking sector	Mendoza & Terrones (2008); Elkdag & Wu (2011 and 2013)
3.	Nominal amount of loans of the banking sector	Mendoza & Terrones (2004), Palić (2007)

The first of the above series does not allow loans to have a different trend from the GDP trend. This can be a problem in identifying situations when loans grow faster than GDP (Elekdag & Wu, 2011). Namely, when the percentage of GDP falls less than the loan, the loans to GDP ratio increases, which leaves room for wrong conclusions (i.e. conclusion on a possible credit boom). In addition, loans given to the private sector are excluded from loans from abroad (Gersl & Seidler, 2012). The second option is not acceptable in case of Montenegro because of a short series of the CPI index[5]. Therefore, the authors decided to use the third option - nominal amount of loans of the banking sector, on a quarterly basis.

Notwithstanding the widespread use of the HP filter for detecting credit booms, it also has some drawbacks. Interpretation of the results obtained through the HP filter is subjected to criticism because different series can point to different credit booms (Coudert & Pouvelle, 2010). In addition, the resulting trend is sensitive to the movement of the series' value and if there is a big difference in the initial and final values of the series, the trend may be exaggerated, upwards or downwards (Giorno et al. 1995). The trend is significantly affected by the length of the time series, which is particularly significant in transition economies that mostly do not have long time series. Basel III points out that the main criticism of this technique is that it does not incorporate economic factors that affect the balanced amount of loans. On the other hand, this technique is useful when the series is accompanied by structural changes that are effectively "mitigated" by the HP filter (Bank for International Settlements, 2010), which is especially a problem with time series of transition economies.

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[5] *Monthly series of CPI index in Montenegro does not include the period before the crises, but dates from 2009.*

4. Identifying credit boom in Montenegro using HP filter method

Credit growth in Montenegro at the beginning of a transitional period, like in other transitional countries of Central and Eastern Europe, was created as a result of macroeconomic stabilisation, comprehensive banking reform and privatisation of the financial sector. Since the initial level of financial intermediation was low, higher credit growth rates were essential for financial and economic development of the country.

The expansion of the banking assets in Montenegro was one of the highest in Central and Eastern Europe. Namely, the impressive growth in the Montenegrin banking sector in the pre-crisis period, resulted in an increase in the share of total banking sector assets in gross domestic product (GDP) from 26.6 percent in 2004 to 111 percent in 2007. The rapid growth was driven by the entry of foreign banks, along with increased domestic demand, particularly in the real estate sector.

Figure 2 - Total banking sector assets/ GDP (%) in the period 2004-2015
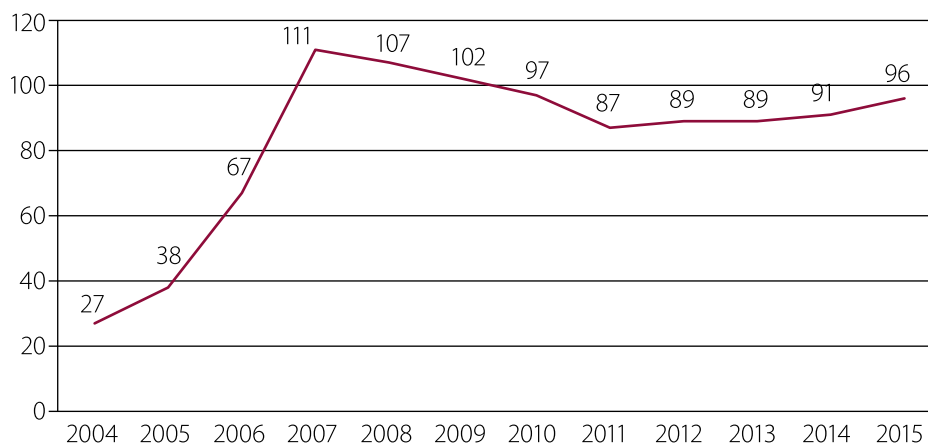
Source: CBCG

The expansion of the banking assets was based on the extremely high rate of credit growth. In order to examine whether those high rates of credit growth could be identified with a credit boom we apply a Hodrick-Prescott (HP) filter, using a series of total loans during 2006-2014 period. In particular, this approach allows us to identify the main characteristics of credit boom episodes (e.g. duration and peak period of the episode). HP filter is estimated using the typical parameter for cycle detection lambda (λ) which equals to 1600, given that we are using quarterly data.

Figure 3 - HP filter in total loans*
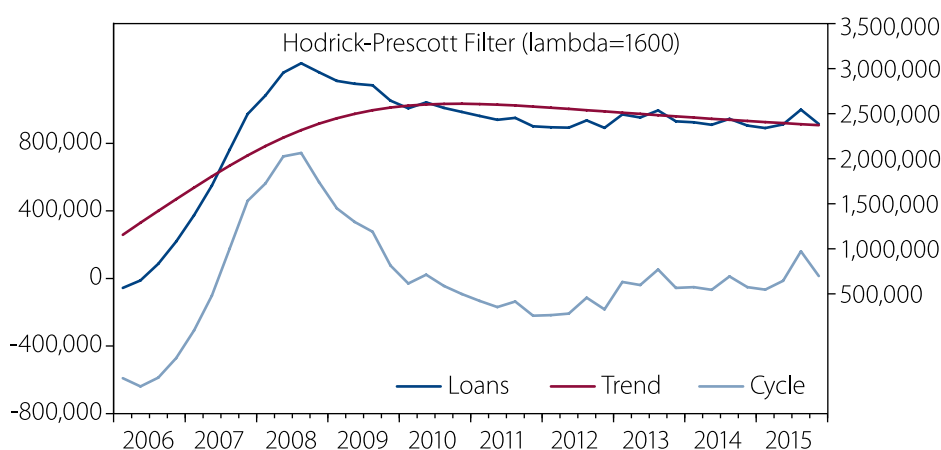
Source: CBCG
*Data and methodology revised from 2006-2012

Looking at the figure above, we can note that loans significantly exceed their long-term trend from the period from second quarter of 2007 to the last quarter of 2009, reaching the peak in the second quarter of 2008. The power of the credit boom is measured as a percentage deviation of total loans from a long-term trend line in the peak episode of the credit boom and it amounts 32%. Thus, according to the discussion from previous sections, this could be considered as signal for a credit boom. However, such high growth rates in loans were not accompanied by adequate growth rates in provisions and capital. That underestimation of assumed risks later led to deterioration in all parameters of the asset quality in the system. From 2010 to 2013 we identify an opposite credit cycle, due to the global financial crisis and asset deterioration. As banks became concerned about their worsening liquidity situation and the ability of their parent banks to provide additional financing, the lending activity began to decline. Banks' deterioration of asset quality and a decline in demand for loans from the corporate sector was affected by the weakening situation in the real economy sector. The highest negative deviation of loans from the long-term trend was recorded during the fourth quarter of 2011 (8.5%).

After the global financial crisis escalated, there was a dramatic increase in the ratio of non-performing loans to total gross bank loans (NPLs). Asset deterioration was a consequence of an excessive credit growth in previous years when the banks' management, motivated by quick profits, neglected adequate and objective assessments of the financial ability of borrowers to repay loans from primary sources. This rapid increase of NPLs, combined with increasing post-crisis banking regulation, more stringent supervision, and the impact of those assets on banks' risk-weighted assets (RWAs) encouraged Montenegrin banks to reconsider their long-term strategies concerning their assets. As a result, banks decreased their lending activities. According to the banks' reports to the CBCG, the rapid growth of loans was mainly based on borrowings from abroad. Most of the borrowings from abroad refer to the borrowing from parent banks. Funding from parent banks

(borrowings from parent banks as a share of total liabilities) increased from 2005, reaching the peak in 2008. Financing from parent banks accounted for 76 percent of total borrowings at end-2008. During the crisis period, parent banks largely supported their subsidiaries in Montenegro.

In 2013, there was a certain stabilisation and improvement of bank's lending. However, only since the third quarter of 2015 the loans exceed the long-term trend and possibly indicate the beginning of a new positive phase of the lending cycle. At the same time, it is too early to estimate whether such trend will continue because of the high indebtedness of the private sector as well as high borrowing costs, despite positive tendencies over the last couple of months.

Applying the same methodology, we analyse the long-term trend in total deposits. Looking at the figure below, we can see that total deposits exceeded their long-term trend from the last quarter of 2006 to the last quarter of 2008. In that period, credit growth was supported by an increase in deposits related to high capital inflows, and a greater formalization of the economy. However, the positive trend in the total deposits stopped in the third quarter of 2008. The global financial crisis and loss of confidence in the banking sector caused a withdrawal of deposits. In particular, withdrawals happened due to the panic instigated by the media and negative experiences from failed foreign currency savings from the early `90s. Withdrawals of deposits were compensated with an increase in borrowings and foreign credits. From 2009 until the third quarter of 2014, total deposits were mainly below and around the long-term trend line, with the exception of the third quarter of 2013. However, total deposits made a significant shift in the fourth quarter of 2014, when they again exceeded their long term-trend.

Figure 4 - HP filter in total deposits
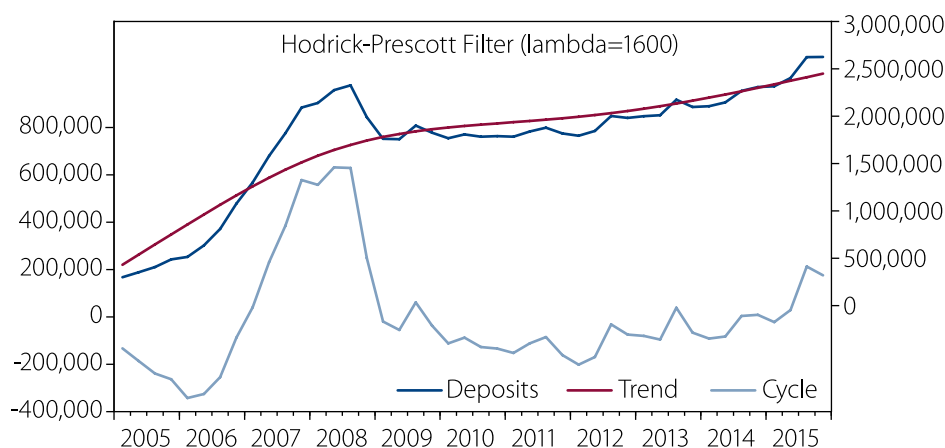
Source: CBCG database

For the last ten years, the Montenegrin banking sector has experienced a significant balance sheet adjustment. Large deposit outflows following the outbreak of the global financial crisis required banks to downsize their balance sheets, or to harmonise their lending with a sustainable funding.

Even though parent banks largely supported their subsidiaries in Montenegro, they had to reduce lending and to start competing for domestic deposits. The result of the adjustment of the banks' balance sheets is that the banks are currently reaching a position where they have excess liquidity relative to lending opportunities in the domestic market. Until recently, the main reasons for limited credit supply were also high levels of NPLs which had an impact on the banks' risk aversion and credit growth.

5. Conclusion

Monitoring of the amount of loans and timely detection of a credit boom is important for the banking system and the overall economy of a country. By encouraging spending and increasing economic activity, credit growth has a direct impact on the economic course. The latest financial crisis, largely followed by a credit boom, indicated a more intensive need for an analysis of an expansive credit growth and timely identification of credit booms and their potential causes. Countries in transition are also prone to credit booms. There are numerous empirical analyses of lending booms, and include a large number of transition economies. However, there has not been an analysis of a credit boom in Montenegro.

By applying HP filter in total loans and total deposits, we have identified their different episodes. First, the episode of a credit boom, were loans significantly exceed their long-term trend. In that episode of a credit cycle, banks were prepared to lend extensively, due to the influence of an intense inflow of foreign capital. In addition, the excessive credit growth in those years was stimulated by banks' management that was motivated by quick profits, thus neglecting adequate and objective assessments of the borrowers' financial ability to repay loans. The consequence of that episode was deterioration of asset quality in banks` balance sheets. Due to the asset quality deterioration and the influence of the global financial crisis, lending activity began to decline below its long-term trend line, marking the episode of a credit bust.

By applying the same methodology, we have identified that total deposits exceeded their long-term trend until the beginning of the global financial crisis. However, significant deposit outflows following the outbreak of the global financial crisis marked the episodes where total deposits were below their long-term trend line. That episode lasted until 2014. Total deposits made a significant shift in 2015, reaching the levels above their long term-trend.

After significant changes in banks' balance sheets, we can conclude that currently, the banks are in a position where they have excess liquidity relative to lending perspectives. The reason for a limited credit supply remains to be high level of non-performing loans in total loans, which have an impact on bank risk aversion and future credit growth. However, it is expected that the high level of liquid assets will increase pressure on the credit policy of banks towards increasing the volume of lending and reducing interest rates for creditworthy customers, so the banks do not

incur losses. In any case, it is a process that requires time. In addition, the increased number of banks should encourage competition in the banking market, quality of services and lending activity under favourable conditions.

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