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SHOTA BAKHUASHVILI

International School of Economics at Tbilisi State University, Georgia

CREDIT TO GDP GAP AS AN INDICATOR FOR UPCOMING FINANCIAL CRISIS

Abstract:

According to the Basel III Framework, the gap between Credit to GDP Ratio and its long-run trend is the single best indicator for setting the Countercyclical Capital Buffer (CCB). The aim of setting the CCB is to increase the Capital Adequacy Requirement (CAR), in order to increase the resilience of the banking system in the case of upcoming financial difficulties. For calculating the long run trend of the Credit to GDP Ratio, the Basel Committee suggests to use the Hodrick-Prescott (HP) filter. In order to detrend the Credit to GDP Ratio, the HP filter only relies on the Credit to GDP Ratio itself and does not take into account other variables, which may be relevant to the risks to financial stability. Economic theory immediately suggests the Real Gross Domestic Product and the Real Estate Price Index as these relevant variables. During periods of negative Real Gross Domestic Product and Real Estate Price Index gaps, a high Credit to GDP Gap is less dangerous than is indicated by the HP filter. The reverse is true when gaps of these two variables are positive, that is a high Credit to GDP Gap is more dangerous for the financial system and the economy than is indicated by the HP filter. The present paper provides a theoretical and empirical justification of using Real GDP and Real Estate Price Index gaps in the process of detrending Credit to GDP ratio. Since the HP filter cannot work with different variables simultaneously, the paper introduces the Kalman filter as a solution. Comparing credit to GDP gaps calculated using different filters, the paper shows two cases when the Kalman filter outperformed the HP filter in Georgia between the years 2000 and 2016. The first case is the financial crisis of 2007-2008, during which the HP filter could only signal that a crisis was occurring after the fact, while the Kalman filter could work as an early warning indicator, informing about an upcoming crisis in the beginning of 2006. The second case is the first half of 2016, when the HP filter suggested to set the CCB while there was no financial crisis, which was correctly indicated by the Kalman filter.

Keywords:

Credit to GDP gap, Countercyclical Capital Buffer, Financial cycles, Financial crisis, Hodrick-Prescott filter, Kalman filter.

JEL Classification: G01, G21, E61

Introduction

In order to detect and handle financial risks in time, supervisors of the banking system use a variety of macro prudential instruments, which are divided into three groups affecting (i) the balance sheets of financial instruments, (ii) the terms and conditions of loans and other financial transactions, and (iii) the structure of the market (Bank of England, Financial Services Authority, 2011). Countercyclical capital and liquidity buffers, sectoral capital requirements and time-varying provisioning practices are potential macro prudential instruments, which affect the balance sheets of financial institutions. Other potential macro prudential instruments like caps on Loan-To-Value (LTV) ratios and margining requirements on repo and derivative transactions are the ones those that affect the terms and conditions of loans and other financial transactions; and instruments like the use of central counterparties (CCPs) affect the structure of the market. My work is concentrated around the Countercyclical Capital Buffer, which should not be understood as a minimal capital adequacy requirement, since the former is a distinct macro prudential instrument. The (CCB) is a requirement on top of the Capital Adequacy Ratio, so that capital is available to absorb losses in times of financial difficulties (Drehmann, et al., 2010).

The Capital Adequacy Ratio (CAR) is an international standard that measures the risk of bank insolvency at a time of unexpected losses. If the CAR is 10.5%, it means that commercial banks should save 10.5% of their risk weighted assets as regulatory capital, which consists of Tier 1 and Tier 2 capital. Tier 1 capital consists of instruments that can cover losses unconditionally, immediately after they occur, in order for banks to continue working without interruptions. Tier 2 capital is supplementary capital that will be liquidated to cover losses in the case of bank liquidation or significant financial difficulties. Maintaining the CAR over this level ensures depositors and the whole financial system, which in turns becomes a prerequisite for macroeconomic stability. But the CAR should change over time in order to account for financial cycles. In reality the CAR does not change often, which is why the CCB exists. The CCB has two closely-related goals: first by increasing the elasticity of the banking system CCB reduces the negative effect of shocks on it; and, second, reduce the banking system amplifying economic fluctuations. These two objectives are closely related and usually it is impossible to separate them, but by observing policy makers preferences, we can understand how the banking supervising system works. For instance, if the supervising authority is concentrated on the first objective, it may not agree to decrease the CCB when there are bad days for the economy.

According to “Basel III: A global regulatory framework for more resilient banks and banking systems” – which is a comprehensive set of reform measures developed by the Basel Committee on Banking Supervision to strengthen the regulation, supervision and risk management of the banking sector – the most adequate indicator for measuring cycles and determining “good” and “bad” periods for the financial system is the gap of the credit to GDP ratio (Basel Committee, 2010), where the credit to GDP ratio is the ratio of the amount of credit that has been extended to households and the corporate

sector (nominator) to the country's GDP (denominator). This indicator measures the difference between the actual value of the credit to GDP ratio and its trend. When the gap is positive and exceeds 2%, capital requirements should be increased by setting the CCB between 0% and 2.5%. Under exceptional circumstances, it can be more than 2.5% (Basel Committee, 2010). So, if the authorities decide to set CCB at 2.5% – according to our example when the CAR was 10.5% – the total capital requirement will become 13%. When the gap of the credit to GDP ratio is negative, i.e. the long-run trend is higher than its observed value, only the CCB should be released. This means that the total capital requirement cannot become less than the CAR (in our case 10.5%) and, accordingly, the CCB cannot become negative.

A significant amount of work has been done by academics and practitioners to answer three main questions that arise around the credit to GDP gap: (i) is it a good indicator for setting CCB?; (ii) can it really foresee upcoming banking crises?; (iii) is the calculation methodology proposed by Basel III the most appropriate? This paper is mostly concentrated around measurement problem and, using the existing literature, proposes a new way of detrending process. Academics and practitioners agree that setting the CCB only relying on the credit to GDP gap is not optimal. Therefore, they suggest that other macroeconomic variables should be taken into account in the decision-making process. One solution that is proposed by Behn et al. (2013) is using multivariate models. However, as will be discussed, it is totally different from the methodology adopted in this paper. Instead of observing other variables simultaneously with the credit to GDP gap, it is better and easier to use these variables while calculating trends for the credit to GDP ratio. Since the Hodrick-Prescott (HP) filter, which is suggested by the Basel committee as a best methodology for calculating long run trends, cannot work with several variables simultaneously, this paper introduces a new methodology relying on the Kalman filter. I test my methodology for the case of Georgia and show that the Kalman filter would have outperformed HP filter in terms of predicting the 2007-2008 financial crisis.

The paper proceeds as follows. The next section briefly reviews the existing literature. Section two reviews theoretical concepts. Section three details in data. Section four describes the model and results, and section five concludes.

1. Literature Review

As was mentioned above, the credit to GDP gap is proposed as the single best indicator for setting CCB by the Basel Committee on Banking Supervision (BCBS) at the Bank for International Settlement. It is worth mentioning that this guideline is based on a sample of 26 countries from all over the world and it is not clear from that guideline if the performance of this variable can warn banking supervisors early enough, so that setting CCB can increase the resilience of the banking system. Borio and Lowe (2002, 2004) were the first to document the significance of this indicator. Their results were later confirmed for different sets of countries and time periods by Borio and Drehmann

(2009), Behn et al. (2013) and others. One of the papers that argues against the credit to GDP gap is Repullo and Saurina (2011). Concentrating around business cycles, their main argument is the fact that the gap and GDP growth move counter cyclically and, instead of smoothing fluctuations in GDP, setting CCB according to the credit to GDP gap is making it more severe. Drehman and Tsatsaronis (2014) argue that this criticism is not correct, since the aim of the CCB mechanism is to defend the banking system against the financial cycle, which is different from the business cycle and is usually much longer and more severe than the business cycle; consequently, a countercyclical connection cannot be used as an argument against the credit to GDP gap. Furthermore, the aim of the CCB is not to smooth cycles, but to smooth their effects on the banking system.

The EU Capital Requirements Directive (CRD IV) also recognizes the credit to GDP ratio gap as an important indicator, but, in addition, specifies that buffer rates should also account for “other variables relevant to the risks to financial stability” (EU, 2013). This directive became the motivation for several important works searching for the “other relevant variables”. One of these papers is by Behn et al. (2013), which aims to evaluate the effectiveness “... of credit and other macro-financial variables for the prediction of banking sector vulnerabilities in a multivariate framework, hence enabling a more informed decision on the setting of CCB rates”. The paper finds that the credit to GDP ratio gap is the best predictor for upcoming financial vulnerabilities among domestic credit variables, but for completeness, the joint behavior of several variables should be observed by using multivariate models. Studying the panel data for 23 EU member countries from 1982 to 2012, Behn et.al found that aside from domestic and global credit variables, there are plenty of macro-financial variables that can be used as a predictors for negative shocks in the banking system. They concentrated on the following measurements: domestic house price growth, global equity growth, banking sector profitability and banking sector capitalization. All these four variables are positively related to the vulnerability of the macro-financial system and setting CCB only relying on the credit to GDP gap and not controlling for other important variables can significantly decrease the effectiveness of CCB in achieving its main objective: increasing the resilience of the banking system.

For calculating the long-run trend of the credit to GDP ratio, the Basel committee suggests using the Hodrick-Prescott (HP) filter. The aim of the HP filter is to divide the original series (y_t) into two components: the trend (g_t) and the gap (or cycle) (c_t) so that $y_t = g_t + c_t$. The filter achieves its goal by minimizing the following expression:

$$\sum_{t=1}^T (y_t - g_t)^2 + \lambda \sum_{t=2}^{T-1} [(g_{t+1} - g_t) + (g_t - g_{t-1})]^2 \quad (1)$$

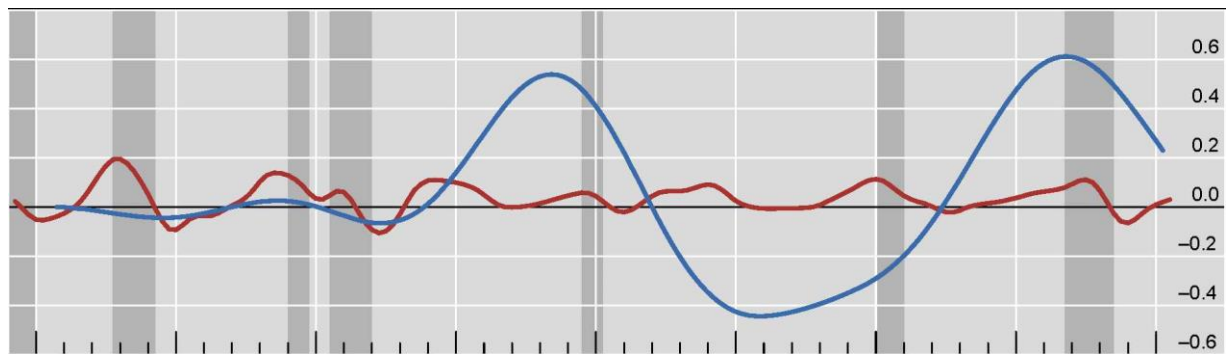
With respect to $\{g_t\}_{t=1}^T$, where λ is a smoothing parameter and it can be chosen. As we see, there are two components in the formula, the first is the gap and the other is smoothness. The value of λ depends on the preference between these two components. When λ increases, the trend becomes more and more linear. Since the

main aim of the CCB is to protect the banking system from financial cycles, which are characterized by bigger fluctuations than business cycles, the Basel committee suggests using the high smoothing parameter, $\lambda = 400,000$.

Drehmann and Tsatsaronis (2014) suggest that there are at least two issues triggered by using an HP filter: (i) stability of the filter's outcome as new data points become available; and (ii) structural breaks that affect the outcome of the filter. The first issue is mostly connected to the "end point problem", which means that the long-run trend changes every time new observations become available and, in some cases, the trend can change dramatically if new observations are too severe. One solution for this problem could be using the two-sided HP filter methodology that requires future values of the credit to GDP ratio. Drehmann and Tsatsaronis (2014) show that even if policymakers could use some sophisticated forecasting methodology, a two-sided filter would not be able to outperform the one-sided filter in terms of achieving CCB goals. Another similar issue is the "starting point problem", which arises when the time series is too short. It is a rule of thumb for supervisors that the credit to GDP gap can only be used as an indicator if the data is available for more than 10 years. According to this, Drehman and Tsatsaronis (2014) show that if the length of time series is more than 10 years, the "starting point problem" has almost zero effect on the decision of setting the CCB.

2. Theoretical reasoning

It is worth saying that while detrending the credit to GDP ration the HP filter only relies on one variable: the credit to GDP ratio itself, and does not take into account other macroeconomic variables. Economic theory suggests that during periods of negative real GDP and real estate price index gaps, a high credit to GDP gap is less dangerous than is indicated by the HP filter. The reverse is true when the gaps of these two variables are positive, that is a high credit to GDP gap is more dangerous for the financial system and the economy than indicated by the HP filter. As mentioned above, financial and business cycles are different events. One is connected to credit booms and the other is connected to economic expansions and contractions. This difference is well displayed in a graph that shows these two cycles simultaneously for the United States (Figure 1).

Figure 1: Financial and business cycles in the United States

The blue line traces the financial cycle measured as the average of the medium-term cycle in the component series using frequency-based filters. The red line traces the GDP cycle identified by the traditional shorter-term frequency filter used to measure the business cycle

Source: Drehmann and Tsatsaronis (2014)

The main reason why supervisors control commercial banks is the fact that they hold the money of depositors and in the case of bankruptcy depositors will lose their money. The solvency of banks depends on their assets, which are mostly loans taken by consumers. We can think of these loans as investments made by banks' consumers. If the gap between the actual real GDP and its trend is positive, economists expect that real GDP should grow and the next phase should have a negative gap. If this is the case, investors will have lower incentives to invest and depositors will have higher incentives to withdraw their money from their bank accounts. Consequently, banks' burden will increase in the next period and a high credit to GDP gap is more dangerous for the banking system. By Table 1 I presents correlations between real GDP growth and the credit to GDP gap for some developed countries and for all countries combined. It is visible that on average these two variables do not move in the same direction and, according to the logic described above, some methodologies should be used to control for real GDP variations.

Table 1: Correlations between real GDP growth and the credit to GDP gap

	All periods	Periods when gaps indicate positive buffers ¹	Non-crisis periods when gaps indicate positive buffers ^{1,2}
France	-0.24***	-0.38***	-0.01
Germany	-0.24***	0.65***	-0.65***
Italy	-0.09	-0.36***	-0.14
Japan	0.54	0.59	0.55***
Spain	0.14	0.11	0.29*
United Kingdom	0.07	0.13	0.44***
United States	-0.02	-0.23**	-0.07
All countries	-0.08	-0.06***	0.02

***/**/* indicates statistical significance at the 1/5/10% level

¹ Only periods when the credit-to-GDP gap is above 2 percentage points are considered, as this is the critical threshold suggested by BCBS (2010) when countercyclical capital buffers should start to become positive. ² The quarter in which financial crises are recorded and the following two years are defined as crisis periods and are hence excluded

Source: Drehmann and Tsatsaronis (2014)

Another important macroeconomic variable is the real estate price index, which is directly connected to business cycles and since the credit to GDP gap is used for observing financial cycles, it does not take into account the real estate price gaps. Real estate is usually used as a collateral to secure mortgage loans. Higher prices on real estate leads to an increase in loans. Some part of these loans return to the real estate sector, thereby increasing demand and consequently increasing real estate prices. If nothing controls and restricts this process, it can lead to real estate price bubbles. In other words, if real estate prices are too high i.e. gap is positive, the negative gap is expected in future periods. If prices are too low, the value of real estate can become lower than the loan and debtors may decide that it is worth not paying loans at all. Consequently, the deleveraging risk, the risk that real estate prices will go down and mortgages will not be enough to cover loans, goes up, which in turn can trigger a collapse of the financial system. According to this reasoning, the positive credit to GDP gap that is accompanied with a positive gap of the real estate price index is more dangerous than is indicated using the methodology introduced by Basel III.

Many papers have been written with the aim to explain the connection between real estate price and credit booms and to answer the question: how the real estate price booms can trigger a financial crisis and poor economic performance. One such paper is by Christopher et al. (2013). The authors observe 40 countries across a 9-year time span (from 2000 to 2009). All of the countries experienced financial crisis and/or a deterioration of economic performance over this time. It is worth mentioning that the

authors define the financial crisis as a systematic banking crisis, as is identified in Laeven and Valencia (2010), while poor performance is defined as more than a one percentage point decline in real GDP growth rate in 2008-2009 compared to the 2003-2007 average. The results of their estimations are given in Table 2.

Table 2 **Booms, crises and macroeconomic performance**

Boom	Followed by financial crisis	Followed by poor performance	Followed by financial crisis or poor performance	Followed by both	Number of countries
Real estate	53%	77%	87%	43%	30
credit	67%	78%	93%	52%	27
Real estate but not credit	29%	71%	71%	29%	7
Credit but not real estate	100%	75%	100%	75%	4
Both	61%	78%	91%	48%	23
Neither	27%	18%	45%	0%	11

Source: Crowe et al (2013)

Looking at Table 2, we can see that from the 40 countries observed by the authors, over the period, more than half experienced real estate and credit booms simultaneously and only four had a credit but not a real estate boom, and almost all countries with a “twin boom” experienced a severe financial crisis or poor economic performance. Motion of real estate prices play an important role in the process of creating early warning indicators for a financial crisis. According to this reasoning, the real estate price index should be taken into account by policy makers in the process of setting the CCB.

3. Data

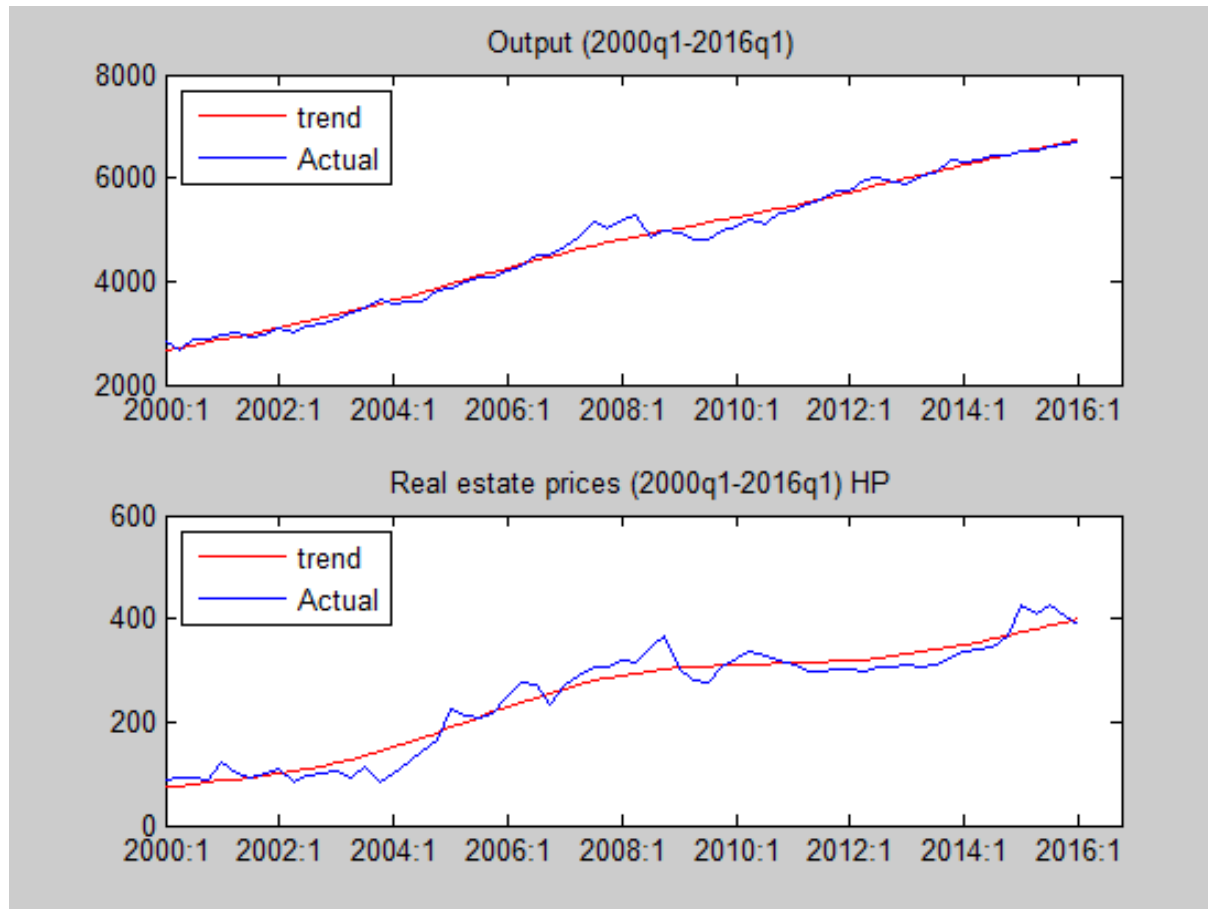
I employ data for Georgia with a sample period ranging from 2000 to 2016. This is the maximum time span that can be observed in order to obtain all relevant variables. Since the length of the time series is more than 10 years, by the rule of thumb that was originally suggested by Borio and Lowe (2002) and adopted in BCBS (2010), the credit to GDP gap can be used as a guide for setting the CCB. For each quarter, I have available information on nominal GDP, real GDP, total loans to the domestic economy, commercial property price index, residential property price index and rent index. Information about nominal GDP, real GDP and total loans to the domestic economy are available on the website of the National Bank of Georgia (NBG). Commercial property price, residential property price and rent indices are not available on the website but can be obtained from the NBG upon request. All the variables are measured in Georgian lari, and GDP variables are measured at the end of quarters.

For each quarter, in order to exclude seasonality, I obtain the credit to GDP ratio by dividing the value of total loans to the domestic economy by the sum of the last four quarters' nominal GDPs. Furthermore, in order to exclude the seasonality problem in real GDP, I made a seasonal adjustment using the X-13-ARIMA filter. Also in order to obtain the real estate price index, I calculated the weighted average of commercial property, residential property and rent indices with weights 0.2, 0.5 and 0.3 respectively. These weights are subjective and one could choose another combination, but in any case the final results would not change significantly, since only the pattern is important and all of these three indices have a relatively similar pattern. After these transformations we are left with three variables: seasonally adjusted real GDP, the real estate price index and the Credit to GDP gap, which is free of seasonality.

4. The model and results

In order to show that setting CCB according to the credit to GDP gap that is calculated using the Kalman filter methodology is better than according to the gap calculated by the HP filter, I mainly rely on a simple model created in Matlab software, using an Iris toolbox, which is a specific tool for macroeconomic modeling and forecasting. On Figure 2 one can observe trends for output (real GDP) and the real estate price index calculated by the HP filter.

Figure 2



Sources: NBG, author's calculations

The smoothing parameter (λ) is set to 1,600 as this is the commonly used value for quarterly data in economics. As is visible from the graphs, both variables have increasing trends, while the real estate price index is characterized by larger fluctuations. Consequently real GDP has a smoother trend.

In order to use a Kalman filter methodology, I decomposed all three variables between their own trends and gaps:

$$Y = Y_t + Y_g \quad (2)$$

$$P = P_t + P_g \quad (3)$$

$$R = R_t + R_g \quad (4)$$

Where Y, P and R are the actual values of real GDP, real estate prices and the credit to GDP ratio respectively. The subscript t indicates the trend and subscript g indicates the gap. In the HP filter the second part of equation 1 is the second order difference of trend and by choosing its coefficient λ one can control the smoothness of the trend. In my methodology, in order to control smoothness, I am controlling standard deviations of ER_t , EY_t , and EP_t Where:

$$\Delta(\Delta(R_t)) = ER_t \quad (5)$$

$$\Delta(\Delta(Y_t)) = EY_t \quad (6)$$

$$\Delta(\Delta(P_t)) = EP_t \quad (7)$$

For my analysis the absolute values of deviations does not matter, only comparative variance matters. Standard deviations for, EY_t , and EP_t are same and have value $1/\lambda^{0.5}$, where λ has the same definition as it has in the HP filter. It is a smoothing parameter and since both real GDP and real estate prices are connected to business cycles and are measured quarterly, I set its value to be 1600, that is usually suggested by researchers (Ravn & Uhlig, 2002). For this particular λ , $1/\lambda^{0.5} = 0.025$. Since financial cycles are much bigger and longer, Basel III suggests using much larger smoothing parameter $\lambda = 400,000$ in the process of detrending the credit to GDP gap by HP filter. According to this, I allow standard deviation of ER_t to be 0.001 ($1/\lambda^{0.5}$ where $\lambda=400,000$).

To construct the Kalman filter I define gaps of the variables as follows:

$$R_g = \beta_1 * Y_g + \beta_2 * P_g + \beta_3 * ER_g \quad (8)$$

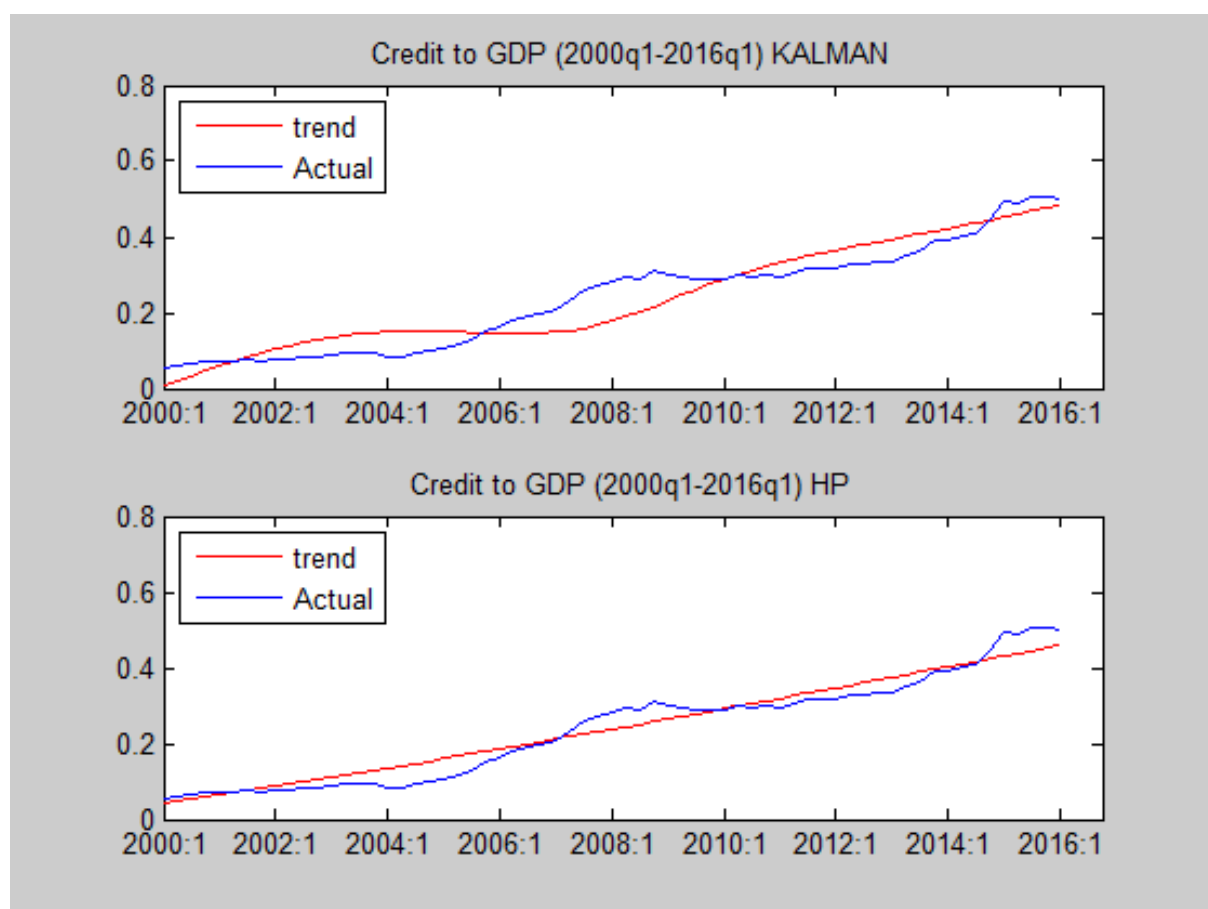
$$Y_g = EY_g \quad (9)$$

$$P_g = EP_g \quad (10)$$

Where I described the credit to GDP ratio gap (R_g) as a linear combination of its own shocks (ER_g), the real GDP gap (Y_g) and the real estate price index gap (P_g) (equation 3). β_1 , β_2 , and β_3 are constant coefficients. Values for the coefficients that I used for

empirical analysis – $\beta_1 = 0.17$, $\beta_2 = 0.08$, $\beta_3 = 0.7$ – are the results of different tests and long discussions with the macroeconomic research department of the NBG. I also control for standard deviations of ER_g , EY_g and EP_g and since absolute values do not matter and there is no argument why they should be different, I set their values to be 1. Afterwards, I used equation 8 as the main equation while detrending the credit to GDP ratio with the Kalman filter. The results of this procedure as well as HP filter are provided in Figure 3. It is visible from the graphs that the HP filter gives quite a different result and a much smoother trend than the Kalman filter and also in general gaps are smaller compared to the Kalman filter.

Figure 3 **Credit to GDP ratio trends with Kalman and HP filters**



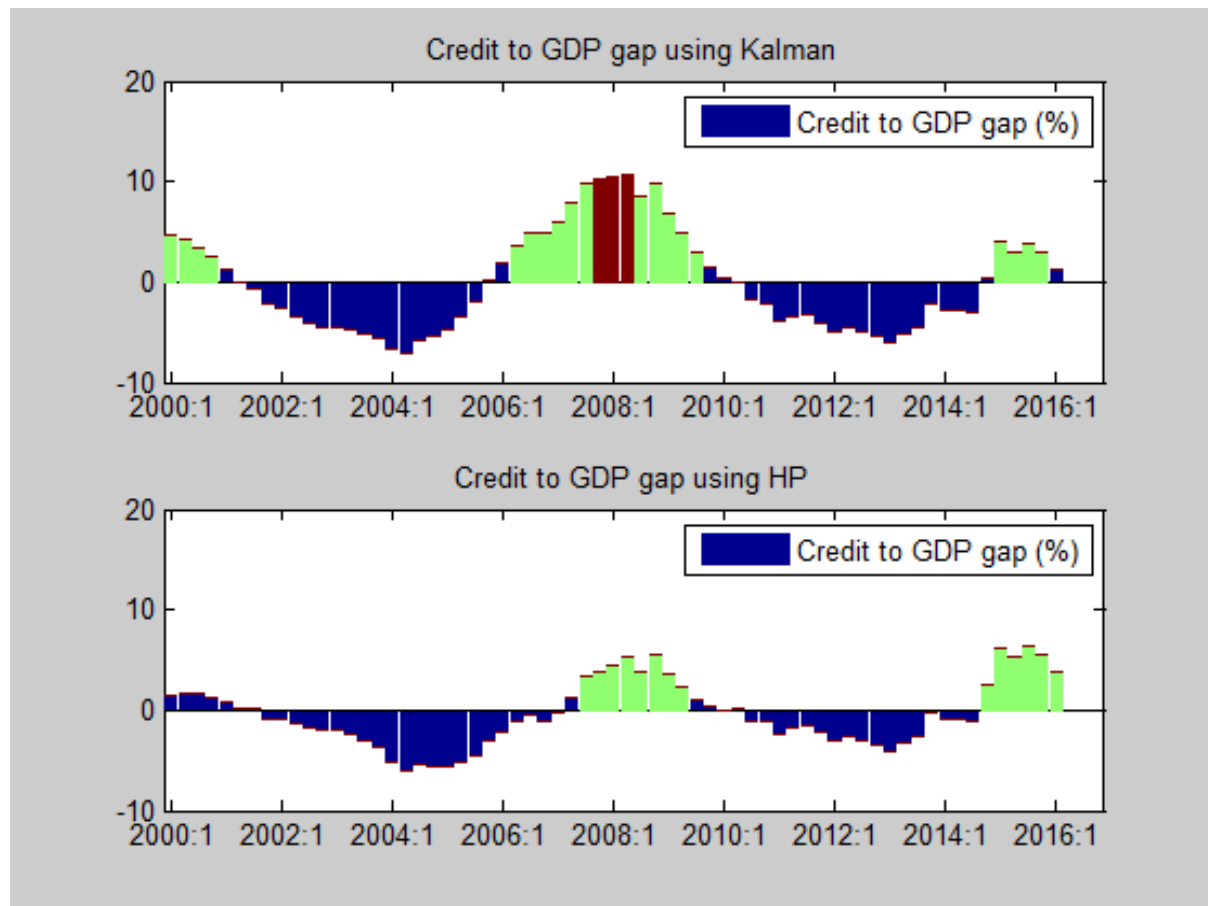
Sources: NBG, author's calculations

According to Basel III, if the credit to GDP gap exceeds 2%, supervisors should set the CCB to a maximum of 2.5% in order to avoid a banking crisis, if the gap exceeds 10%, supervisors should be much stricter in setting the CCB value, since a large Credit to GDP gap increases the probability of a financial crisis and the main reason for setting the CCB is to increase the resilience of the banking system. The methodology of calculations that I described here is meaningful, if it can affect the decision making process effectively. Credit to GDP gaps by the Kalman and the HP filters are presented

in Figure 4, where the gap is blue if it is less than 2%, green if it is between 2% and 10%, and red if the gap is more than 10%.

Figure 4

Credit to GDP gaps by Kalman and HP filter



Sources: NBG, author's calculations

As discussed above, CCB cannot become negative and the total capital requirement cannot be less than the CAR. Consequently, we are not interested in cases when the credit to GDP is less than 2%. Green bars indicate situations, when the credit to GDP gap exceeds 2% and when supervisors are required to set a positive CCB. It is visible that the credit to GDP gap calculated using HP filter could not work as an early warning indicator for the global financial crisis of 2007-2008 since it warned us about the danger of the crisis only in the middle of 2007, when the crisis was already there. But looking at calculations done by the Kalman filter, one could observe the danger of the upcoming financial crisis much earlier, at the beginning of 2006. So, regarding the 2007-2008 financial crisis, the Kalman filter provides a much more appropriate picture of the events that were happening in the banking system. The main reason why the credit to GDP gap calculated by the Kalman filter outperforms the gap calculated by the HP filter as an early warning indicator, is the fact that the HP filter cannot control for the real output and the real estate price index gaps. Looking at Figure 2, one can see that starting from

2006 the gap of the real estate price index was positive and that, according to the logic described in section 2, was increasing the risks of a banking crisis. Furthermore, the real output gap also became positive from the second half of 2006, which is an additional hint that the high credit to GDP gap was more dangerous for the financial system than it is indicated by the HP filter. In addition, in the first quarter of 2016 the HP filter suggests setting the CCB, while the Kalman filter does not. The main reason for that is again negative real GDP and real price index gaps. If policymakers were using an HP filter in the decision making process, they would increase the CCB. One may think that there is nothing wrong in setting the CCB since it is protecting the banking system, but when it is not needed, CCB forces banks to hold extra capital, which is not an optimal decision.

5. Conclusion

I have reviewed the existing literature and main criticisms of the credit to GDP gap as the single best indicator for setting the countercyclical capital buffer under Basel III. Many academics and practitioners agree that the credit to GDP gap is a good indicator but other indicators should also be used that are relevant in order to foresee upcoming financial crises. I provide a theoretical and empirical justification of using real GDP and the real estate price gaps in the process of detrending the credit to GDP ratio. Since the HP filter cannot work with different variables simultaneously, I introduce the Kalman filter as a solution. Comparing the credit to GDP gaps calculated by different filters, I show that in at least two cases Kalman filter outperformed HP filter in Georgia between 2000 and 2016. One case is the financial crisis of 2007-2008, when the HP filter could only notice the crisis when it was already there while the Kalman filter could work as an early warning indicator, informing about an upcoming crisis from the beginning of 2006. The second case is 2016 when the HP filter suggested setting the CCB, while the Kalman filter does not. Nowadays the National Bank of Georgia is not using the CCB methodology, instead, they are using systematic capital buffers. When they decide to introduce CCB, it would be beneficial to take into account the results of this paper, since this is an entirely new approach. However, regardless of the models and methodologies used, there will always be a risk from the mechanical use of the credit to GDP gap and, since no indicator is infallible, the decision-making process always requires judgement.

References

- Bank of England, Financial Services Authority, 2011. *Instruments of Macroprudential Policy*, London: Bank of England.
- Basel Committee, 2010. *Basel III: A global regulatory framework for more resilient banks and banking systems*. s.l.:Basel Committee on Banking Supervision, Basel.
- Basel Committee, 2010. Guidance for national authorities operating the countercyclical capital buffer. *Basel, Switzerland*.
- Behn, M., Detken, C., Peltonen, T. A. & Schudel, W., 2013. *Setting Countercyclical Capital Buffers based on early warning models: would it work?*. s.l.: (No. 1604). European Central Bank.

- Borio, C. E. & Drehmann, M., 2009. Assessing the risk of banking crises—revisited. *BIS Quarterly Review*, Volume 29.
- Borio, C. & Lowe, P., 2004. *Securing sustainable price stability: should credit come back from the wilderness?*. s.l.:(No. 157). Bank for International Settlements..
- Crowe, C., Dell'Ariccia, G., Igan, D. & Rabanal, P., 2013. How to deal with real estate booms: Lessons from country experiences. *Journal of Financial Stability*, 9(3), pp. 300-319.
- Drehmann, M. et al., 2010. *Countercyclical capital buffers: exploring options*. s.l.:(Vol. 317). BIS Working Paper..
- Drehmann, M. & Juselius, M., 2012. Do debt service costs affect macroeconomic and financial stability?. *BIS Quarterly Review*, Volume 21.
- Drehmann, M. & Tsatsaronis, K., 2014. The credit-to-GDP gap and countercyclical capital buffers: questions and answers. *BIS Quarterly Review*, march.pp. 55-73.
- EU, 2013. *Capital Requirement Directive IV*. s.l.:s.n.
- Laeven, L. & Valencia, F., 2010. *Resolution of banking crises: The good, the bad, and the ugly*. s.l.:(No. 10-146). International Monetary Fund..
- Lowe, P. & Borio, C., 2002. *Asset prices, financial and monetary stability: exploring the nexus*.. s.l.:(No. 114). Bank for International Settlements..
- Ravn, M. O. & Uhlig, H., 2002. On adjusting the Hodrick-Prescott filter for the frequency of observations. *Review of economics and statistics*, 84(2), pp. 371-376.
- Repullo, R. & Saurina Salas, J., 2011. *The countercyclical capital buffer of Basel III: A critical assessment*. s.l.:(No. 8304). CEPR Discussion Papers..