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Measuring Basel Credit Gap in Iran: Assessing Implications in Banking Supervision and Crises Prediction

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Abstract

Credit is the basis for financing and stimulating investments. However, excess credit can be the source of systemic risks and financial crises. In this paper, using Iran's credit data from 2000 to 2019, the Basel credit gap was calculated as a recommended indicator for measuring excessive credit. We perceive that in the years in which the economy is suffering from currency overvaluation; for example, from 2005 to 2011, excess credit is noticeably visible. Moreover, in periods with a fair exchange rate, for instance, from 2000 to 2004, no excess credit was observed. Using capital buffers is an essential regulatory policy to reduce the risk of excess credit. So, the counter-cyclical capital buffer was calculated for all these periods. We also found that Basel's credit gap has good power in predicting exchange crises in Iran. It seems that the root cause of excessive credit and foreign currency jumps should be sought in the exchange rate-based stabilization plan in Iran (exchange rate anchor). Nonetheless, policymakers can reduce the probability and severity of crises by strengthening the bank credit sector's regulatory systems and using the proposed buffers.

Highlights

- Global experience has shown that excessive credit growth is one of the leading causes of financial crises.
- In order to prevent excessive credit growth, according to Basel III, a countercyclical capital buffer should be applied to banks.
- This study identified periods of excessive credit growth in Iran based on the official Basel method and calculated the required buffer.
- From 2005 to 2011, there was the most considerable excessive credit growth.
- There seems to be a close link between currency crises and excessive credit growth, and BCG has good power in predicting exchange crises.

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1. Introduction

The credit boom, which means rapid credit growth, is one of the economic policy mysteries. Having credit in the economy can provide easier access to finance and be a fulcrum for increasing investment, a factor in economic growth. However, the rapid growth of credit in the economy can cause vulnerabilities to the entire economic system through weak financial standards, especially in the banking sector and the asset, pricing model, creating a price bubble. Many researchers have considered these potential harms; For example, Reinhart & Rogoff (2009) present financial crises as entirely related to credit booms. Borio & Lowe (2002) conclude that historical experience has shown that only Part of credit booms lead to crises, but some of these crises have been very important. Hence, credit booms are dangerous at best, and in the worst case, they lead to disaster. Also, Ariccia et al. (2012) stated that the credit boom is a herald of financial crises. They concluded that while only a minority of booms end in crisis, those can have real, long-term, devastating results if be unchecked.

Therefore, if we accept that credit booms can be a factor or at least a sign of the emergence of future financial crises, it is vital to identify excessive credit growth periods.

In macro-financial economics, examining the growth rate of credit is considered an important concept; because countries seek to avoid excessive credit growth to prevent creating systemic risks in the financial sphere. Systemic risk is a phenomenon that can be the primary source of many financial crises. Excessive credit growth stimulates the creation of large credit cycles, when turned downward, dispose of the field for financial crises, and influence the real sector. Therefore, macro-policymakers seek to prevent excessive credit growth in an economy by using methods and taking the necessary measures to avoid the accumulation of risks arising from it, especially in the banking system. The fundamental question that arises is when can be said that an economy is engaged in excessive credit growth, and what is the appropriate measure to judge this issue? On the other hand, after recognizing this issue, what countermeasures should be taken?

In a study on banking crisis risk assessment, Borio & Drehmann (2009) concluded that simple indicators could be constructed to assess risk aggregation in the financial system. These indicators are based on a sharp increase in the credit and price of assets. The Basel Committee on Banking Supervision - BCBS (2010), in a guideline for using countries' financial officials, states that the credit-to-GDP ratio is used to set buffer and to start reference points for decision-making properly. Toward obtaining the gap in this index (difference from the long-term trend), the guideline calculates this ratio with the ""HP"" filter. Drehmann (2013) states that the credit-to-GDP gap is a valuable early warning indicator for systemic banking crises and total credit developments predict the risk of systemic crises better than indicators based solely on bank credit. Aldasoro et al. (2018) cite domestic and international debt as potential sources of vulnerability and believe that they can ultimately lead to banking crises. Accordingly, they evaluate the

performance of these types of debts as early warning indicators (EWI) for banking crises. These indicators have been built based on the credit to GDP gap, the difference of the credit-to-GDP ratio from its long-run trend computed with a one-sided HP filter. Drehmann & Yetman (2018) introduce the selection of the best metrics as an early warning indicator for crises as an important empirical question. They conducted a competition using quarterly data from 1970 to 2017 for 42 countries and concluded that no other gap works better than the credit to GDP gap. Liu & Molise (2019) inspect the extent to which fluctuations in the housing and credit markets are mitigated by Basel III Bank's capital regulation and the maintenance of financial and macroeconomic stability. They conclude that operations under Basel III in counter-cyclical capital buffer effectively reduce fluctuations in the housing and credit markets and prevent bubbles.

In Iran, the occurrence of financial crises, especially in foreign currency, highlights the need to pay attention to prudential policies in the field of credit. This importance comes from two aspects; first, according to monetary theory, the value of a country's currency, in the long run, is directly affected by the difference between liquidity and production growth. In the monetary approach, the balance of payments is primarily interpreted as a monetary phenomenon, so liquidity plays a vital role as a disruptive factor and moderator in the country's balance of payments in the long run (Salvatore, 2014). The primary tool for creating this liquidity is creating credit in the banking system (Although not the only factor). On the other hand, in the medium term, some of the expanded literature in currency crises point to the common roots of exchange and banking crises that can be significantly adapted to Iran's situation. This literature's origins can be found in the works of Kaminsky & Reinhart (1999) under the title ""Twin Crises"." In other words, in Iran, types of financial crises should be considered in light of the specific context of monetary and exchange rate policy, especially the exchange rate based stabilization program (ERBS). For instance, Bank balance sheet problems may not be apparent due to foreign exchange policies. Therefore, the need for a comprehensive look at the banking and foreign exchange system issues in Iran and the study of risks in these areas makes studying the country's credit situation and related prudential policies a research priority.

Credit studies in Iran are often limited to the effects of banking facilities on economic sectors, and macroeconomics of credit and its effects on regulatory policies have been less considered. This paper seeks to answer the questions raised according to the Iran's situation; have there been periods of excessive credit growth in Iran? How should the banking system react during these periods? What is the relationship between these periods and crises?

In this regard, in the theoretical framework section, the subject first briefly examined the mechanism of the impact of financial crises and credit issues. Then, we explained the existing literature and records to measure the periods of excess credit and reaction to it. In the data and model section, after collecting and introducing data related to Iran, using the method recommended by the Basel Committee, periods of excess credit have been identified, and then precautionary

measures have been taken. In the results section, the obtained outputs are interpreted; the summary is then provided.

2. Methodology

2.1 Theoretical Framework

What is the relationship between rapid credit growth and real macroeconomics? The relationship between real economic and credit fluctuations is explained through the wealth effect and financial acceleration mechanism. In building the framework of relations between Credit and real economy, (Bernanke et al., 1999) designed significant models. They develop a DGE[1] model to illustrate the obligation of credit market friction in business fluctuations from a quantitative and qualitative perspective. According to them, this model is a combination of leading approaches in the literature. This framework represents a financial accelerator as endogenous developments in credit markets amplify and propagate macroeconomic shocks. They add several aspects to the model that are designed to enhance empirical communication. For instance, they allow for investment delays, enabling the model to create the hump output dynamics and the lead-lag relationship between asset prices and investment.

Claessens et al. (2012) attempted to analyze the interplay between business and financial cycles. They used an extensive database of more than 200 business cycles and 700 financial cycles in 44 economies. They conclude that different stages of the business and financial cycles have significant links. In particular, periods of financial turmoil, especially housing price downturns, are longer and more profound than other downturns. In contrast, improvements related to rapid growth and housing prices are more potent. These findings highlight the credit crunch for the real economy.

In terms of process, in a growth cycle in the real sector, a positive growth outlook improves the credit-worthiness of loan applicants and collateral valuation, so credit providers also increase credit supply and sometimes respond to requests with lower standards. Even a positive outlook boosts financial innovation in this era. On the other hand, the existence of much credit allows for more investment and consumption. Thus, the real economic and credit cycles reinforce each other (Ariccia et al., 2012). After the boom period is overdue to real factors or external shocks, there are potential risks such as significant fluctuations in asset prices, some of which are known as financial crises. According to Eichengreen & Portes (1987), a financial crisis disrupts financial markets typically accompanied by changes in asset prices and bankruptcy among debtors and credit intermediaries. These problems spread through the financial system and disrupt the market's capacity to allocate capital.

Thus, according to the described mechanism, credit's rapid growth has led to the credit boom being recognized as one of the financial crisis predictors. Indeed, this mechanism is a stimulus for the systemic financial risk that can lead

[1] Dynamic General Equilibrium

to a financial crisis. Systemic risk is the risk of disrupting financial services that result from a loss in all or Part of the financial system and may have serious negative consequences for the real economy (FSB et al., 2009). Conceptually, systemic risk has two dimensions, a cross-sectional and a cyclical dimension. In the cross-sectional dimension, the financial system's structure affects how to respond to shocks and possibly strengthen them. In this case, the relationships between financial institutions are essential, and the policy issue is how to address the interactions between financial institutions. In the cyclical dimension, increasing risk interacts with the macroeconomic cycle over time, as expressed in the relationship between rapid credit growth and economic activity. In this case, the question is how to adjust the financial system's cycles (Caruana, 2010).

In general, countries seek a set of monetary, tax, and regulatory policies to cover the dimensions of systemic risk, including those of the credit boom. On the other hand, banks, as the most crucial credit providers globally, affecting systemic risks creating, are also affected. Thus, in the banking regulatory policy area, the Basel Committee on Banking Supervision (BCBS), focusing on regulatory deficits related to the occurrence of systemic risks. In this regard, the reform package entitled ""Basel III"" is a comprehensive set of scales developed by the Basel Committee, which addresses the shortcomings of the financial system, especially in the field of supervision (BIS, 2018). One of these shortcomings was the lack of a comprehensive systemic approach to financial sector risks, a macro-prudential perspective that seeks to promote financial stability and reduce systemic risk. To cover this shortfall in excess credit, ""Basel III"" introduces a buffer that should apply to all banks; Countercyclical Capital Buffer (CCyB) (FSI, 2019).

The CCyB seeks to ensure that banking capital regulations consider the macro-financial environment in which banks operate. The purpose of using CCyB is to protect banks from cyclical risk and to prevent periods of excessive credit growth. The CCyB, due to its counter-cyclical nature, acts primarily against the credit cycle stage, and banks are required to maintain another layer of capital during periods of excessive credit growth. Secondly, in the downward spiral, this buffer reduces credit constraints by increasing credit supply. CCyB has been created to protect the banking sector from potential losses due to increased economic cyclical risks. Therefore, this buffer requires banks to maintain capital (more than capital adequacy) when credit is overgrowing. Buffer is reduced when the financial and economic environment deteriorates. Banks can even raise capital from the consolidated buffer to cover the impasse period's potential losses and continue to supply credit to the real economy (FSI, 2019). The first step in this operation is to identify situations where there is excessive credit growth. The crucial question is when there is excess credit in the economy?

Like many other economic areas, there is no universally agreed method for measuring when credit growth is excessive, reflecting the lack of a central theoretical approach based on macroeconomics in this area (Baba et al., 2020). So, a fundamental question about the capital buffer is the time of its activation

and release. However, the initial judgment must be based on common principles for making the right decision to set up a counter-cyclical capital buffer to help banks and other stakeholders understand the root cause of the decisions and help implement the authorities' decisions for creating the buffer.

In this regard, ""Basel III"" uses the gap between the ""ratio of credit to GDP"" and its long-term trend as a guide to adjust the counter-cyclical capital buffer (Drehmann & Tsatsaronis, 2014). The Basel Credit Gap (BCG) is the difference between the ""ratio of credit to GDP"" and the amount of ""HP"" filter associated with it. Jokivuolle et al. (2015) approved the function of Basel III's counter-cyclical capital buffers. They found that if the private sector were too indebted, the decrement in production would severely impact loan losses. Since the increase in bank credit risk must be matched with higher bank capital, it stimulates the counter-cyclical capital buffers as a function of private debt relative to its trend. Focusing on EU countries, Detken et al. (2014) found that credit-to-GDP gaps are the best predictors of systemic banking crises related to excess credit growth in Univariate signaling. Therefore, directing prudential policies in the area, especially counter-cyclical capital buffer, requires recognizing excessive credit growth periods. One of the standard methods in this area is to use the Basel credit gap.

As experience has shown that Iran's financial crises have often appeared in exchange crises, it is necessary to explain the relationship between financial crises, especially in the field of currency, at the end of this section. One of the main approaches to global exchange crises is defined in the form of third-generation crises. This generation's crucial feature is the attention to the common roots of exchange and banking crises, which are known in the literature as twin crises. Kaminsky & Reinhart (1999) introduced a variety of theoretical models to explain the links between the exchange crisis and the banking crisis: a chain of causal problems in the banking crisis, where an initial external shock, such as an increase in foreign interest rates, is accompanied by a fixed exchange rate will cause the loss of reserves. This process will lead to a credit boom, rising bankruptcies, and a financial crisis. Some models also point to the opposite cause: financial sector problems cause the national currency to fall. Such models emphasize that when central banks cover financial institutions' problems by printing money, and banks create excess credit in the absence of active regulation, we are dealing with foreign exchange jumps' classic story. The third type of model claims that the exchange and banking crises have common causes.

An example of the third type can be seen in the exchange rate-based stabilization program. Since inflation converges only to the international level, there is a significant over-valuation in the national currency. In the early stages of the program, imports and economic activity entered a prosperous period, usually provided by borrowing abroad. About Iran, two decades ago, this prosperity was supported by increased sales and oil prices. As the current account deficit widens, financial markets become convinced that the stabilization program through the exchange rate is unstable and leads to speculative attacks. Since this boom is

usually financed by bank credit, the banking system is at risk of a crisis when capital outflows occur and the asset market is in turmoil. Due to the described mechanism, the amount of bank credit is not the leading cause of the crisis but plays a significant role in the crisis chain. So, measuring excess credit can confirm the existence of such a crisis mechanism in the Iranian economy and can be used to guide banking prudential policies.

2.2 Data and Model

Drehmann et al. (2010) conducted a wide-spreading analysis of various indicators to measure excess credit and direct counter-cyclical buffers. The variables evaluated by them can be divided into three groups. The first group includes macroeconomic variables, GDP growth, credit growth, credit-to-GDP ratio deviation from the long-term trend, stock price deviation from the real value, and real estate price deviation from the long-term trend. The second group includes criteria related to the banking sector's performance, profit, and loss proxy. The third group also includes alternatives to financing costs. This study examines the performance of all three groups of these indicators. It concludes that the credit-to-GDP ratio gap has the best performance in the range of variables considered, and reliance on credit, compared to many other variables, has a significant advantage over many other variables in setting up the counter-cyclical capital buffer.

Empirical analysis shows that choosing a broad definition of credit is better than a narrow definition in predicting future banking problems. Ideally, the definition of credit should include all credit allocated to households and other non-financial private entities in an economy, regardless of the type and identity of the funder. So, the definition should include credits granted by domestic and international banks and non-bank financial institutions. All debt securities issued to finance households and non-financial private institutions, domestically or internationally, be included, regardless of who holds the securities. Such a broad definition of credit encompasses all sources of debt creation for the private sector. These assumptions contributes to the definition's stability over time, as it will not be affected by changes in the type of institutions providing credit to the private sector. It suggests that banks are likely to suffer from the excess credit consequences, even If they did not direct it themselves (BCBS, 2010).

Public sector funding should not be included in this indicator; Analysis performed by ""BIS"" shows that its inclusion will weaken this indicator's performance, distorting cyclical characteristics. Public debt tends to decrease in the booms and increases in periods of economic weakness. The bank and credit institutions that provide facilities to the non-governmental sector must be considered in credit definition. In Iran, Islamic treasury bonds are government financing instruments, so they should not be considered private credit. Also, the volume of private-sector debt securities compared to banks' facilities in creating credit is quite negligible. So, these securities were ignored in the credit data. For

example, corporate bonds balance at the end of 2016 is about %1 of the bank facilities balance granted to the private sector.[2]

There will be three steps to deciding on the required buffer. The first step is to calculate the ratio of total private sector credit to GDP. The second step is to calculate the gap between the credit to GDP ratio and its trend. The last step is also the conversion of the calculated gap as tip for adjusting the buffer.

The credit to GDP ratio at time t defined as follows:

$$RATIO_t = CREDIT_t / GDP_t \times 100$$

C_t is the credit allocated to the private non-financial sector on a large scale. Both GDP and credit are on a nominal scale and have a quarterly frequency.

In the second step, the credit to GDP ratio is compared with its long-term trend, interpreting the difference between this ratio and the long-term trend at time t as the credit gap.

$$GAP_t = RATIO_t - TREND_t$$

Excessive credit is considered when this ratio is larger than the long-term trend, and the resulting gap is positive. How to determine the long-term trend?

The trend approximates a variable based on historical background that can be interpreted as the sustainable average of that variable. Various methods can generate a variable trend, such as a simple moving average or a linear trend. The BIS uses the Hadrick-Prescott (HP) filter because it has the advantage of giving more weight to recent observations. This feature is crucial because it can probably deal with structural fractures more effectively. The HP filter is a standard mathematical tool used in macroeconomics to detect variable trends over time.

The conceptual framework of this filter is based on the principle that every time series like y_t includes the growth component of $\mathbf{g}_t$ and the cyclic component of c_t:

$$y_t = g_t + c_t$$
$$for\ t = 1, \ldots T.$$

A measure of the $\mathbf{g}_t$ 'path's smoothness is the sum of the squares of its second difference. c_t indicates deviations from g_t and is assumed to be close to zero in the long run. These considerations lead to the following programming problem for determining the growth components (Hodrick & Prescott, 1997):

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

The λ is a positive number that limits the changes in the growth component of the time series. The larger λ, the smoother the answer to the problem. For this study, we use a one-sided HP filter with a high smoothing parameter. The smoothing parameter, referred to in the technical literature as the lambda, is set at 400,000. Lambda 1600 is common for the business cycle with quarterly

[2] According to the Stock Exchange Organization statistics at 2017, the balance of companies' debt securities was about 90 thousand billion rials.

observations, but a higher figure is considered suitable for longer cycles such as the credit cycle. Experimental studies by Drehmann et al. (2010) show that the trends calculated using Lambda 400,000 have good performance in extracting long-term trends.

In the third step, an attempt is made to turn the credit gap from the previous into a suitable buffer. When the gap is below the specified threshold (L), the buffer (as a percentage of risk-weighted assets) is zero. As the gap widens, the buffer also increases until the gap crosses the upper threshold (H), when the buffer reaches its maximum level (Bmax). Low and high thresholds **L** and **H** are essential in determining the retaining setting's timing and speed. Basel Committee investigations have shown that an adjusted factor based on L = 2 and H = 10 provides a reasonable and appropriate profile based on the history of banking crises. However, this depends on the smoothing parameter's choice and the credit and GDP data length (BCBS, 2010).

If we consider "L" and "H" as 2 and 10, respectively:

$$\boldsymbol{GAP} < \%\mathbf{2} \rightarrow Buffer\ is\ zero$$
$$\boldsymbol{GAP} > \%\mathbf{10} \rightarrow Buffer\ is\ max$$

If we consider the maximum buffer as 2% of risk-weighted assets, by crossing the gap of 10%, the buffer will be determined as 2% of risk-weighted assets. For example, if the gap is 7%, a buffer of about 1.3% of risk-weighted assets is suggested.

3. Results and Discussion

Collecting the quarterly GDP data and credit allocated to the private sector (in the order described in the previous section) the ratio created. Using the method described above, this index's trend and the Basel credit gap were obtained as the difference between the trend and the real ratio. The results are shown in the appendix.

Figure 1 shows the BCG curve (Area curve). The solid curve represents the real ratio (credit/GDP), and the dashed curve shows the long-term trend. The horizontal axis represents the time quarterly, and the vertical axis is in percentage. Also figure 2 shows the amount of buffer prescribed each quarter, and its values are displayed on the left vertical axis. The solid curve represents the BCG; the dashed curve is the required buffer whose values are visible on the right vertical axis (both in percentage). The period of the data is from 2000 to 2019.

Figure 1. The Basel credit gap in Iran
***Source**: Research calculations*

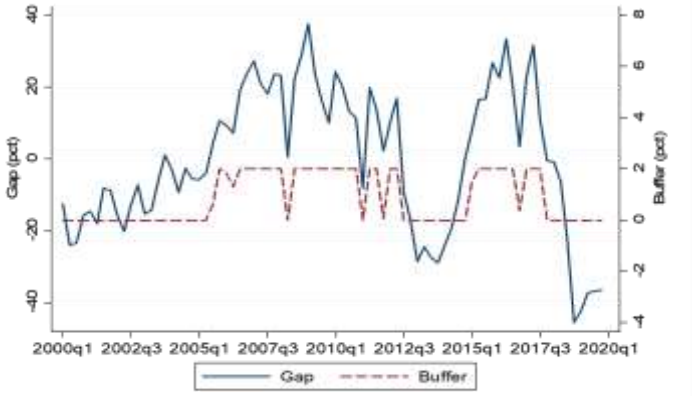

Figure 2. The proposed counter-cyclical buffer in Iran
***Source**: Research calculations*

As the curves show, the results of the BCG and the buffer required over the entire interval can be divided into several periods :

2000 to 2004. The credit gap is often negative. The average BCG in this period is about -11.8. Therefore, according to this index, there is no excessive credit in the mentioned period. As seen in Figure (2), by calculating the amount of buffer required, it becomes clear that during this period, in most years, there was no need to maintain a counter-cyclical capital buffer.

2005 to 2011. The positive average BCG is about 14.8. Therefore, during this period, banks should have been required to maintain a counter-cyclical capital buffer. To prevent the accumulation of risks due to excessive credit increase in the country's financial sector, the banking system in most years of this period has required the maximum buffer (2% of risk-weighted assets).

2012 to 2014. During these two years, BCG is negative. The average of the index is about -13.6. Therefore, there is no need to create a capital buffer in this period. To avoid a possible recession in the economy, banks can use the buffer's accumulated resources in the previous period.

2015 to 2017. During this period, BCG averages about 17.7. Therefore, according to this index, banks must maintain capital over capital adequacy in this period. Due to the thigh gap, the maximum level of caution is required (buffer 2%).

2018 & 2019. In these two years, BCG has changed again and become negative. According to the model, the average index in this period is -28.5, so no capital buffer is required.

Excessive credit growth and foreign exchange policy

Interpreting the above results, the effect of foreign exchange policy in Iran on the formation of excessive credit periods is quite evident. Figure 3 shows the natural logarithm of the exchange rate in Iran. As it turns out, the excessive credit growth periods are consistent with the fixed exchange rate periods. So, there seems to be a relationship between the overvaluation of domestic currency and excess credit. In the fair exchange rate periods, there is no evidence of excessive credit growth.

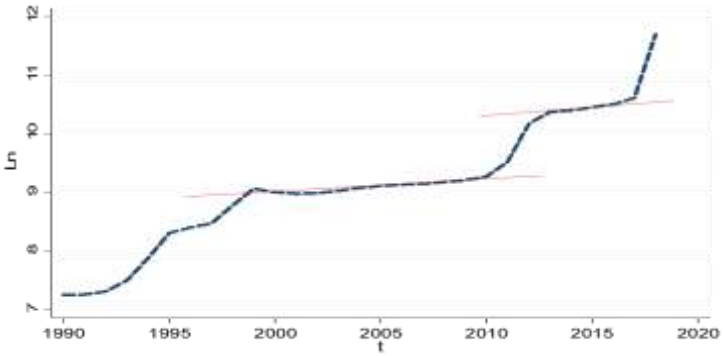

Figure 3. Non-official exchange rate (IRR per USD, period average)
***Source**: CBI (Central Bank of Iran)*

It is necessary to state the research background of this interpretation. Sobolev 2000, in an article entitled ""The Relationship between the Exchange Rate Stabilization Program (ERBS) and financial fragility"," outlines the characteristics of countries that use the exchange rate anchor to control their inflation and the consequences of this policy. One of the accepted facts in this field, clearly stated in this article, is the relationship between increasing the private sector's credibility and the exchange anchor. When stabilizing the economy is pursued through exchange rate control, the domestic currency becomes valuable; therefore, domestic currency demand increases, increasing

credit demand. There is also an initial boom in the economy due to increased purchasing power. These events, on the other hand, are a stimulus for investments that need credit. Therefore, the exchange rate anchor leads to an increase in credit, accepted as a stylized fact.

Our results confirm the existence of the above conditions in Iran. As the credit gap index results showed, before 2005, there was no excess credit in the economy, but from 2005 to 2011, there was a significant excess credit in the economy. This period is accompanied by an increase in oil revenues that provide the policymaker with the necessary stabilization tools through the exchange rate. According to the process described above, the economy's stabilization policy through the exchange rate leads to excessive credit growth. Interestingly, this period led to a financial crisis of the kind of foreign currency jump in 2012. The negative BCG in the years 2012 to 2014 is significantly affected by national currency devaluation. Currency jumps and the resulting deflation of inflation increase nominal GDP, which increases the denominator of the ratio and causes the BCG index to become negative in these two years. When the effects of the currency devaluation have subsided and oil revenues have improved since 2015, the existence of excess credit is once again confirmed by the BCG index. From 2015 to 2017, there was a credit gap in the economy, leading to an exchange rate jumping again. So, the above cycle is repeated. In 2018 and 2019, the years after this currency devaluation, a negative gap appeared, the same reasons mentioned in 2012 and 2013.

Table 1 shows the state of Basel's credit gap for three years before foreign currency jumps; See the maximum, minimum, and average values of the Basel credit gap in these years. According to these results, during the three years before the national currency devaluation, the average Basel credit gap always indicates a severe excess credit (above 10). These results confirm the Basel credit gap's initial role in predicting Iran's financial (exchange rate) crises.

Table 1. The exchange crisis prediction; BCG three-years before the crisis in Iran

Crisis	1 year			2 year			3 year		
	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
exchange crisis 2012	19.9	-8.1	6.9	24.3	11.41	17.3	37.7	10	21.7
exchange crisis 2018	31.7	-0.5	16.2	33.4	3.5	20	26.9	8	17

***Source**: Research calculations*

Role of GDP definition; (Non-oil GDP)

As mentioned at the beginning of this section, the above results were obtained based on the private sector's credit and the total GDP. In the next step, to examine the additional dimensions of the discussion, non-oil GDP was also used to discuss possible results. At this stage, GDP is converted to non-oil GDP. Figures (4) and (5) show the results of this change.

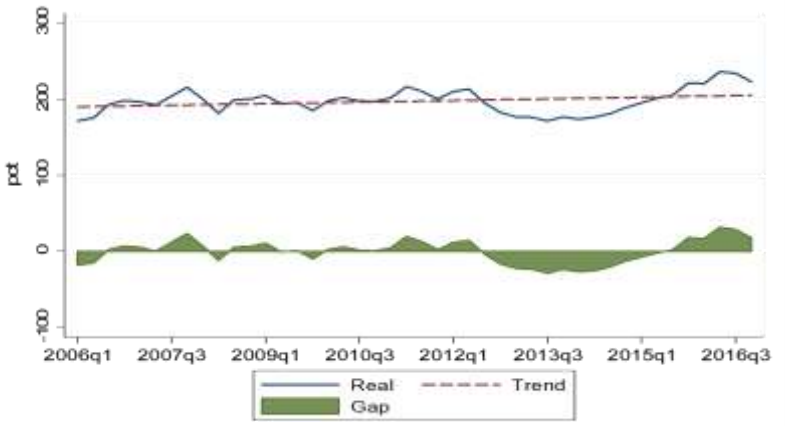

Figure 4. The Basel credit gap in Iran (Assuming non-oil GDP)
***Source**: Research calculations*

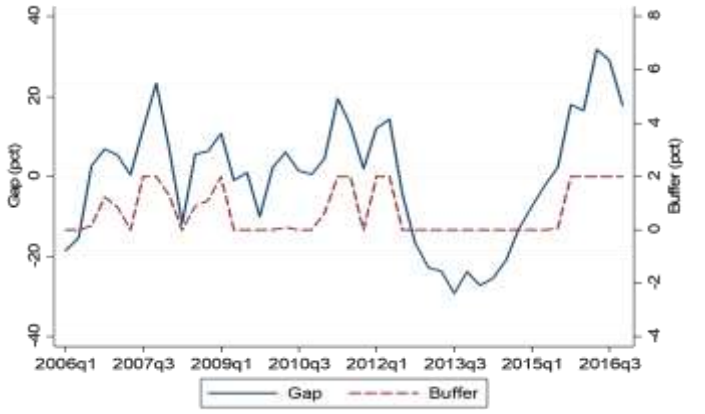

Figure 5. The proposed counter-cyclical buffer in Iran (Assuming non-oil GDP)
***Source**: Research calculations*

The rationale behind this change is that oil revenues depend on oil revenue sales and the exchange rate. Perhaps its exit from GDP will make significant changes in the results that are debatable. However, as shown in figures (4) and (5), this change did not cause fundamental variation in the Basel credit 'gap's overall trend at different intervals and only moderated the gap to some extent. Table 2 shows the results of recognizing the existence of excess credit in the Iranian economy. The judgment about the excess credit does not vary with changing the range of GDP. Note that it was impossible to calculate the credit gap in some periods due to the statistical limitations on GDP without oil.

Table 2. Existence of excess credit in Iran based on BCG

Period	GDP definition: Total			GDP definition: Non-Oil		
	Excess Credit	**BCG Mean** (%)	**Share of periods with max buffer (%)**	**Excess Credit**	**BCG Mean** (%)	**Share of periods with max buffer (%)**
2000-2004	×	-11.8	0	.....	.....	.....
2005-2011	✓	14.8	71	✓	3.11	21
2012-2014	×	-13.6	16	×	-15.04	16
2015-2017	✓	17.74	75	✓	13.23	62
2018-2019	×	-28.5	0	.....	.....	.....

***Source**: Research calculations*

4. Concluding Remarks

Existing excessive credit in the economy can increase systemic risk in the financial system, leading to a financial crisis. The relationship between credit and real economic cycles stems from the wealth effect and the nature of financial facilitation. In Iran, exchange rate fluctuations manifest financial crises accompanied by significant changes in asset prices. Also, Part of the literature on exchange crises refers to the common roots of exchange and banking crises, known as twin crises. The type of foreign exchange policies in the country and their impact on credit creation is considered the main elements of this analysis.

Countries pursue prudential policies throughout the financial system, especially in banks, to avoid the accumulation of systemic risks and financial crises. Banks, as the most crucial creditors, influence and are affected by the credit risks. Part of these prudential policies is to avoid cyclical systemic risks and prevent the credit cycle's intensification of the real economy cycle. Counter-cyclical capital buffers are used for this purpose. This buffer is applied to banks when there is excess credit in the economy so that banks are forced to maintain more capital adequacy and reduce their lending power. When the real economy enters a recessionary cycle, the buffer can increase existing credit and counter recession policies. However, the fundamental question is, when is there excessive credit in the economy? As a result, the answer to this question is twofold; Understanding periods of excessive credit growth, firstly, as a predictor of the possible occurrence of financial crises, Secondly, as a base for the formation of banking supervisory policies to prevent crises, Especially by activating counter-cyclical buffer in banks.

The Basel Committee proposes the Basel Credit Gap Index for this purpose, to identify periods of excess credit. This index is defined as the difference between

the ratio of ““credit to GDP”” and its long-term trend. Therefore, this paper calculated the Basel credit gap index in Iran from 2000 to 2019. Also, for each sub-period, the required amount of counter-cyclical buffer applied to the banks was obtained. In short, from 2000 to 2005, there was no excess credit in the Iran economy. Since 2005, under the influence of stabilization policy on the economy through the exchange rate stabilization plan, an excess credit has been created in the country, leading to two exchange jumps in 2012 and 2018. However, the first years after the jump, due to depletion of inflation (due to the foreign currency jump) and the increase in the credit to GDP 'ratio's denominator, the index is negative and does not show an excess credit.

In terms of predicting exchange crises, the index has been successful. A review of the Basel Credit Gap Index in the three years before the crisis shows the index in a very high-risk range and signals a severe excess credit as a sign of crisis. This index was also calculated for supplementary discussions using non-oil GDP. This change did not affect the overall results; just the index was adjusted.

The policy statement for this paper is as follows:

Since 2005, there has been excess credit in the Iranian economy in most years. A stability program through the exchange rate (exchange rate anchor) is the root of excess credit formation. Of course, the lack of regulatory policies regarding credit creation in the banking sector has also been effective in excess credit. Using the Basel credit gap index, counter-cyclical capital buffers can be applied to banks in banking supervision. These buffers prevent excessive credit growth in high-risk periods and reduce the probability and severity of potential crises. Besides, the Basel credit gap can be used as a crisis predictor.

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Appendix

Table A. Basel credit gap in Iran

t	Real Ratio	Real Ratio (Seasonal adjusted)	Trend	Gap
2000q1	84.61	84.14	96.61	-12.4657
2000q2	68.08	74.06	97.99	-23.9309
2000q3	75.09	75.98	99.38	-23.3999
2000q4	93.09	85.04	100.77	-15.7256
2001q1	88.07	87.58	102.16	-14.5721
2001q2	78.60	85.51	103.54	-18.0372
2001q3	95.69	96.83	104.93	-8.09945
2001q4	106.78	97.55	106.31	-8.76421
2002q1	92.62	92.11	107.70	-15.5896
2002q2	81.70	88.88	109.08	-20.2018
2002q3	96.61	97.76	110.46	-12.6984
2002q4	114.50	104.60	111.84	-7.23929
2003q1	98.41	97.86	113.21	-15.3492
2003q2	92.34	100.45	114.59	-14.133
2003q3	108.35	109.64	115.95	-6.31526
2003q4	129.63	118.42	117.32	1.099008
2004q1	116.32	115.67	118.68	-3.00664
2004q2	101.76	110.70	120.03	-9.3269
2004q3	117.39	118.78	121.38	-2.59773
2004q4	128.24	117.15	122.72	-5.57359
2005q1	119.02	118.36	124.06	-5.69544
2005q2	111.74	121.56	125.38	-3.82232
2005q3	129.65	131.19	126.70	4.489298
2005q4	151.78	138.65	128.01	10.64174
2006q1	139.44	138.67	129.31	9.352484
2006q2	126.71	137.84	130.60	7.234475
2006q3	149.37	151.14	131.89	19.25543
2006q4	171.72	156.87	133.15	23.71919
2007q1	162.62	161.71	134.41	27.29831
2007q2	144.04	156.70	135.66	21.03743
2007q3	153.19	155.01	136.89	18.12207
2007q4	177.06	161.75	138.11	23.64048
2008q1	163.50	162.59	139.32	23.27272
2008q2	129.66	141.05	140.52	0.539168
2008q3	162.18	164.10	141.70	22.40517
2008q4	188.05	171.79	142.87	28.924
2009q1	182.69	181.67	144.02	37.6542
2009q2	154.86	168.47	145.16	23.30924
2009q3	160.28	162.19	146.29	15.8985
2009q4	172.34	157.44	147.40	10.03519
2010q1	173.81	172.84	148.51	24.33711
2010q2	156.23	169.95	149.59	20.35997
2010q3	162.03	163.95	150.67	13.27965
2010q4	178.59	163.15	151.73	11.41405

Table A (continued). Basel credit gap in Iran

2011q1	145.48	144.67	152.79	-8.11335
2011q2	159.66	173.69	153.83	19.862
2011q3	166.50	168.48	154.86	13.62422
2011q4	173.09	158.12	155.87	2.24445
2012q1	168.22	167.28	156.88	10.40035
2012q2	160.66	174.78	157.88	16.89631
2012q3	147.98	149.74	158.87	-9.12883
2012q4	156.34	142.82	159.85	-17.0306
2013q1	133.02	132.28	160.82	-28.5427
2013q2	126.24	137.33	161.78	-24.4516
2013q3	133.70	135.29	162.74	-27.4482
2013q4	147.56	134.80	163.68	-28.8846
2014q1	141.48	140.69	164.63	-23.9362
2014q2	134.26	146.05	165.56	-19.5049
2014q3	153.11	154.93	166.49	-11.5573
2014q4	183.24	167.39	167.41	-0.01607
2015q1	177.28	176.30	168.32	7.973397
2015q2	170.73	185.73	169.23	16.49953
2015q3	184.66	186.85	170.13	16.7239
2015q4	216.62	197.89	171.02	26.86477
2016q1	195.59	194.50	171.91	22.5859
2016q2	189.56	206.22	172.79	33.42138
2016q3	191.79	194.07	173.67	20.39675
2016q4	194.89	178.04	174.54	3.500269
2017q1	199.34	198.23	175.41	22.82061
2017q2	191.19	207.99	176.27	31.72751
2017q3	185.75	187.96	177.12	10.83529
2017q4	194.30	177.50	177.98	-0.47977
2018q1	178.96	177.96	178.83	-0.86592
2018q2	159.24	173.24	179.67	-6.43744
2018q3	156.37	158.22	180.52	-22.2961
2018q4	148.65	135.79	181.36	-45.57
2019q1	140.68	139.90	182.21	-42.3059
2019q2	134.03	145.81	183.05	-37.2385
2019q3	145.35	147.07	183.89	-36.8146
2019q4	162.23	148.20	184.73	-36.5287

***Source**: Research calculations*