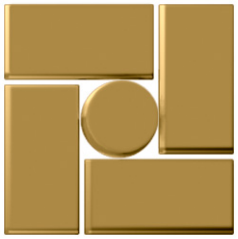
FPAS Mark II Credit Gaps, January 2023

Vahe Avagyan, Hayk Avetisyan, and Martin Galstyan*

January 2023



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ABSTRACT

The credit-to-GDP gap is an important indicator used to monitor financial cycles and assess risks of financial crises. Existing techniques used by the Bank of International Settlements (BIS) and many other institutions to estimate credit gaps rely on standard Hodrick-Prescott (HP) filtering techniques (in the case of the BIS, a one-sided univariate HP filter). In certain cases, using such techniques can be very misleading, and mechanical usage of such indicators can cast a shadow on accumulating risks and provide a false sense of safety to policymakers, thus increasing the likelihood of uncontrolled financial turmoil in the future. To illustrate the dangers and drawbacks of the current status-quo, this paper proposes extending the standard HP filter by adding a prior for the safe level of the credit-to-GDP ratio. We estimate and compare credit gaps for five countries using both the standard BIS approach and the new approach proposed in this paper. While our approach does not provide a panacea to all the drawbacks of the standard HP filter, it certainly allows for greater flexibility to generate more relevant credit gaps as indicators for policy makers, as it forces policy analysts to take a stand on what they consider to be a safe level of credit for a given economy.

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Contents

I. INTRODUCTION

This working paper provides an alternative to the BIS HP filter estimates of credit gaps. Our approach extends the standard HP filter by including an additional level condition, or prior, on the safe level of the credit-to-GDP ratio. We refer to this as a Prior-Consistent (PC) Filter as it allows us to impose a prior on the safe level of the credit-to-GDP ratio.

In theory, the safe level of debt would depend on a host of factors, such as tolerance for financial crises, degree of risk aversion, and uncertainty about the future distribution for output and interest rates. We provide a very simple illustrative example that assumes a constant prior of 150 percent of credit-to-GDP ratio. Interestingly, such an estimate would not be inconsistent with the BIS econometric methodology for evaluating one set of credit gaps versus another in terms of predicting past financial crises. The reason the PC filter might give similar patterns for the past is that the additional effects of level constraints in the new filter are kicking in only after a certain level of ratio which we call a safe level is crossed. The PC filter technique is slightly more complex than the HP filter, as it requires the user to develop some prior on the safe level of debt. The chief benefit of the PC filter approach, of course, is that it pushes the user to stop treating credit gap estimation as a purely mechanical exercise, and instead, be forced to think critically about what are the safe levels of debt. While the results may not dramatically differ in the two approaches, the simple act of coming up with a prior plays an important role in ensuring that relevant estimates of the credit gap are developed.

The remainder of this note is organized in the following way:

In Section II, we discuss environments in which the HP filter should be expected to produce significantly distorted indicators of financial risks. We show that using the HP filter means failing to take a stand on the safe level debt. China is a good example of a country that has a negative credit gap, but from the perspective and concerns of policymakers, there may very well still be an excessive credit expansion and asset price bubble. Right after the GFC, the credit ratio doubled in China from around 110 percent to about 220 percent of GDP. To understand the Reductio ad Absurdum in using the HP filter one can simply assume that the future evolves in line with the HP filter's estimates of past trends. In other words, imagine the authorities in China, for example, allowed the credit ratio to double again but in a way that didn't allow a significantly stronger trend than past trends. Obviously, putting any weight on such credit gap estimates for policy could be extremely problematic for financial stability.

Section III provides estimates for China and four largest major advanced economies (United States, Euro Area, UK and Japan) and shows how a simple naive prior on the level might help avoid potentially costly errors by placing weights on the HP-generated gaps in circumstances where past upward trends seem unsustainable.

Section IV makes the case for more research identifying the safe level of credit starting with getting key concepts nailed down such as the safe level of credit. Short of some miraculous discovery of knowledge we can rest assured that some judgement will be needed in the future to contain excessive expansions in credit and asset price bubbles. Our PC filter is easy and ready to use for people and institutions that appreciate the simplicity and user friendliness of the HP filter but might have some priors on the safe level of the credit-to-GDP ratio.

II. THE DRAWBACKS OF THE HP FILTER AS A TOOL TO ASSESS FINANCIAL VULNERABILITIES

The BIS uses a one-sided HP filter to calculate the credit-to-GDP gap.[2] It is intended as a tool for identifying potential financial vulnerabilities in an economy, such as large and persistent positive deviations from the trend can indicate an over-extension of credit and a higher risk of a financial crisis. This tool is used by the BIS and several other institutions as an indicator of potential financial vulnerabilities.

The credit-to-GDP gap, as estimated by the BIS, is a very simple indicator and in many cases is considered to be an effective tool to assess the potential risk of a financial crisis and provide early warning signals. This can help policymakers and regulators take steps to address imbalances and maintain financial stability.[3] During relatively stable times, the benefits of monitoring this measure would presumably include having early warning signals, as well as having a benchmark to compare credit growth across countries and over time. Central banks often use the BIS credit-to-GDP gap as part of a broader set of indicators to design macroprudential policies aimed at reducing financial stability risks. Additionally, as the BIS periodically estimates credit-to-GDP gaps for more than 40 countries, it provides (or intends to provide) a big picture view of the state of global financial stability.

The simplicity of the mechanics of the HP filter gives it the advantage of being easy to use from an operational point of view. However, at the end of the day it remains a very simple approach that has many drawbacks if policymakers intend to use it as a serious tool for conducting financial cycle analysis, as explored in the remainder of this section.

The HP filter and similar techniques have been subject to their fair share of criticism. Critics of this approach point out three main issues: (1) its suitability as a measure for the purpose of the buffer; (2) its reliability as an early warning indicator for banking crises (particularly in emerging markets); and (3) practical/technical problems associated with measurement and with the HP filter generally.

Edge and Meisenzahl (2011) explore in detail the first and second issues with the HP filter. They examine the use of the credit-to-GDP ratio gap as a measure of systemic risk in real time. The authors argue that the credit-to-GDP ratio gap is not a reliable indicator of systemic risk, due to the difficulty of measuring credit in real time and the presence of systemic statistical revisions in the underlying data. They also suggest that using other important indicators is appropriate while estimating the gaps.

Economists and policymakers point to several practical and/or technical problems common to the HP filter technique, which have important implications. One such issue is related to the reliability of the gaps for countries that have undergone structural changes or major crises (so called "start point problem" and "structural breaks"). Jokipii et al (2020) find that estimating the BIS gap with varying starting points shows that the length of the series, and the point in the cycle at which the data starts, can indeed have significant implications for the gap's signal.

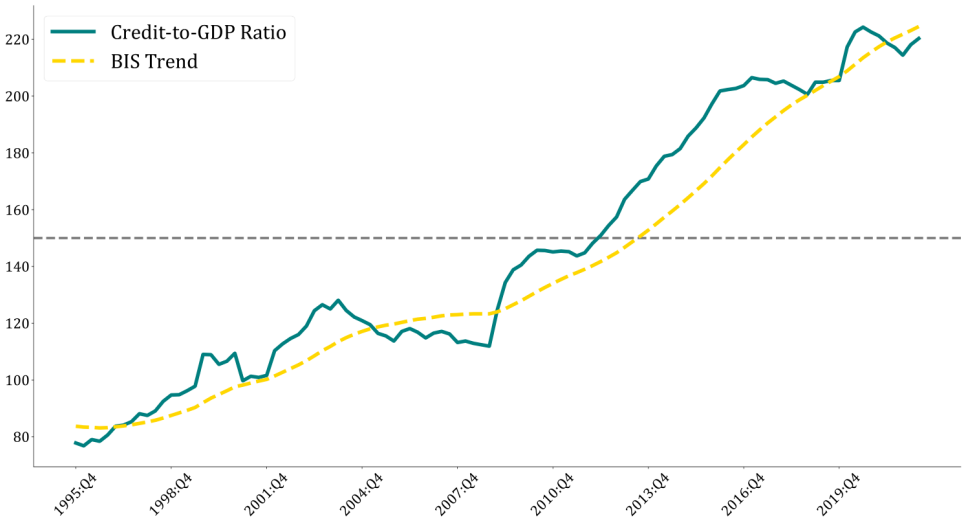
The so-called "downward bias risk" is another common practical/technical criticism, which can potentially lead to an underestimation of systemic risks.[4] When an economy experiences a credit

[2] "Guidance for National Authorities Operating the Countercyclical Capital Buffer", Bank of International Settlements, BCBS (2010).
[3] See Drehmann and Yetman (2020).
[4] See Lang et al (2019).

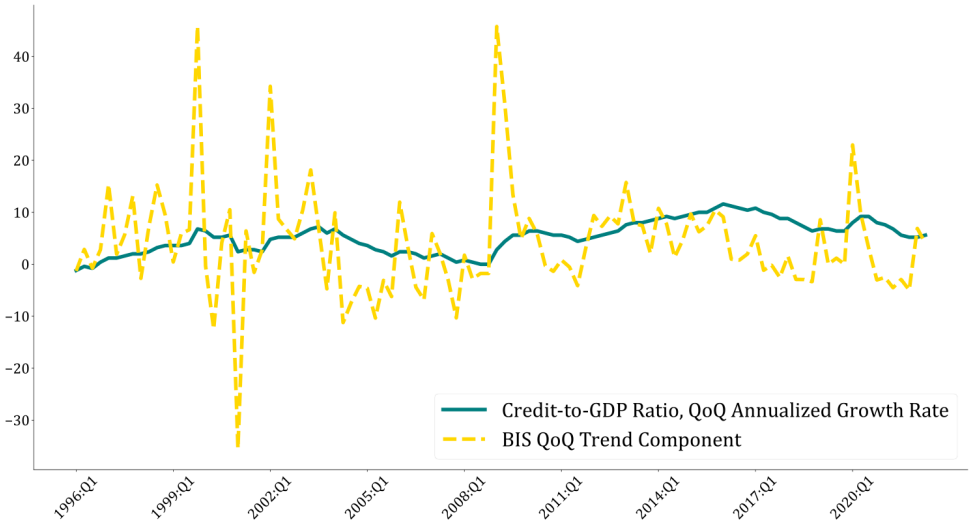
boom, the simple BIS credit-to-GDP gap estimation methodology results in it mechanically being incorporated into the trend component. And as the smoothing parameter is very large, "once it starts to fly, it is very hard to bring it down." After the boom is over, and the credit-to-GDP ratio stabilizes at some level, we may mechanically encounter a negative gap for a long period of time, or even see the credit-to-GDP ratio appear to be unsustainable. This is especially evident when the credit boom periods are long. We show this on the example of China (Figure 1). This is especially problematic because if the authorities responsible for financial stability were to stem from only looking at the HP estimates of credit gaps at the recent period as a rough proxy for prevailing financial risks, they would certainly run a risk of falling in the trap that HP filter creates after long period of persistent growth.

Figure 1: HP Filter Credit-to-GDP Ratio for China

Panel A. Credit-to-GDP and HP Filter Trend



Panel B. QoQ Annualized Growth of Actual Credit-to-GDP and the Trend Component



Source: BIS, Author calculations

Finally, the lack of consideration of important factors and not accounting for different levels of development for different countries are another source of concern. The BIS credit-to-GDP gap is a measure of credit and GDP growth, but it doesn't consider other important indicators such as asset prices, the fundamentals of the economy, or the role of global factors in driving credit growth. On the other hand, developed economies might have different credit-to-GDP ratios, and it may not be as good an indicator for them as it might be for a developing economy. The credit-to-GDP ratio can increase as a country's financial system develops and financial intermediation increases. This is because as the financial system matures, more credit becomes available to businesses and households, and thus more credit is used in the economy relative to the size of the economy. However, it is important to note that the credit-to-GDP ratio cannot continue to increase forever. Eventually, the increase in credit will reach a saturation point and the ratio will stabilize. This is because an economy can only support a certain amount of credit relative to its size and any further increase in credit will be unsustainable, because of a few factors. At some point, borrowers may become overleveraged and unable to repay their debts. This can lead to defaults, which can have a cascading effect on the financial system and the wider economy. Additionally, as the credit-to-GDP ratio increases, lenders may become more cautious about lending, as they become more aware of the potential risks involved. This can lead to a tightening of credit conditions, making it more difficult for borrowers to obtain credit, which can slow down economic growth. Furthermore, when the credit-to-GDP ratio is too high, it can indicate that credit is being used to fuel speculative bubbles in asset prices, rather than for productive investments. This can lead to a misallocation of resources, and when the bubble bursts, it can result in a severe economic downturn. Therefore, while the credit-to-GDP ratio may increase in periods of financial development, it cannot continue to increase infinitely. The underlying methodology (one-sided HP filter) used for calculating BIS credit-to-GDP gaps explicitly assumes a big persistence in trend growth. This methodological bias can result in falsely observing negative credit gaps at stabilization phase, where the financial intermediation cannot increase with the same pace as was previously observed. This may signal false assurance in terms of the financial risks at some points in cycle, highlighting the need for policymakers to consider a variety of economic indicators when assessing financial stability, rather than relying solely on the credit-to-GDP gap measure.

Summing up there are different angles the HP filter technique is vulnerable to critique, but what is the focus in this note is the one stemming from its technical limitations. By combining a formulaic understanding of the univariate HP filter with basic economic intuition, one can easily imagine certain situations like that in China where estimates based on using this filter can result in extremely distorted picture of financial cycles and provide a false sense of safety. While the HP filter can still be quite useful to catch past crises and help us render an aftermath, we argue that it should be expected to struggle in providing reliable warning signals for future crises.

However, it is also important to note that the issues with the status-quo methodology go far beyond merely technical considerations. The riskiest part of current indicators such as the credit gap is that they are designed to serve only as initial points for policy deliberations and further analysis, rather than being treated as final products that can be used right off the shelf. Unfortunately, as these indicators have grown in popularity and usage, many users (including many central banks, international institutions, and academics) often forget about the integrated to-do list and use these indicators on an "as-is" basis, devoid of important context and critical thinking. This opens the door for significant policy mistakes and missed opportunities to prevent financial turmoil.

In this paper, we seek to address these myriad issues with the status-quo—namely, to "cure" the basic HP filter of its inability to be "state aware" in terms of catching specific characteristic of the prevailing economic and financial situation in a given economy, rather than blindly extrapolating

lagging trend movements. We propose a simple extension to the BIS credit-to-GDP ratio, which should considerably improve the flexibility of the toolkit and make the produced indicators much more reliable and relevant. We do so by adding a new component to the HP filter formula by introducing a notion of the "safe level for the credit-to-GDP ratio." We include it in the standard minimization problem of the HP filter as the difference between the actual credit-to-GDP ratio and its underlying "safe level" (1), which is estimated based on the fundamentals of an individual economy and has a weight represented by the parameter ω_i. This parameter expresses our level of confidence about the estimated "safe level" of the country's credit-to-GDP ratio. This approach aligns with the basic intuition of policymakers to have this kind of "safe levels" in their minds when designing macroprudential or monetary policies. For example, in case of China (Figure 1), it seems that there have been some levels ("safe levels"), specifically levels closer to 100%, 150% and 200%, to which the financial regulators tried to push the economy back once these boundaries have been crossed.

III: PRIOR-CONSISTENT EXTENSION OF THE STANDARD HP FILTER

As we have seen with the example of Chinese economy in the previous section, the naive HP filter used by BIS and other policymakers can give misleading information on the current state of the financial cycle, especially when the decreasing trajectory of the cycle has been reached after a long wait. In order to understand the purpose of the PC filter and evaluate the added value compared the HP filter, we first begin by briefly summarizing the underlying mathematical structure of a standard one-sided HP filter used by BIS. We then introduce the extended version of it, which will already include the assumptions on the safe level and its smoothing parameter in the minimization function.

The Hodrick-Prescott filter is a widely used statistical tool that addresses the following minimization problem in order to decompose the time series into trend and cyclical components:

$$Min_{\tau_t}\left\{\sum_{t=1}^{T}(y_t-\tau_t)^2+\lambda\sum_{t=1}^{T-1}[(\tau_t-\tau_{t-1})-(\tau_{t-1}-\tau_{t-2})]^2\right\}$$

where the λ is a smoothing parameter, to control the trend smoothness.

In the previous section, we explored a major technical blindness of the filter, which appears when the estimated trend gradually "takes off" and fails to stop properly due to inertia and being overly backward looking. This can be especially problematic during boom cycles, when the trend extrapolates far above the actual level, creating 'artificial' negative gaps, which in turn prevent policymakers from having a reliable image of the actual financial cycle. This happens because the filter (as shown in the equation above) does not include any relevant information on key financial indicators or any other political, economic developments that are consistent with the actual rationale of policymakers in the financial cycle.

We present below the Prior-Consistent (PC) Filter, which addresses the above-mentioned key challenges:

$$Min_{\tau_t}\left\{\sum_{t=1}^{T}(y_t-\tau_t)^2+\lambda\sum_{t=1}^{T-1}[(\tau_t-\tau_{t-1})-(\tau_{t-1}-\tau_{t-2})]^2+\sum_{t=1}^{T}\omega_t(\tau_t-\tau_t^*)^2\right\}$$

Considering the drawbacks that the univariate HP filter has, we have extended the filter by adding an additional component $\sum_{t=1}^{T}\omega_t(\tau_t-\tau_t^*)^2$, which incorporates the deviation of the trend from the safe level into the minimization problem. Here we introduce the notion of the "safe level" of debt τ_t^*. In general, the safe level τ_t^* will be set based on the policymakers' best experience about the current developments of a given economy and financial cycle and requires them to think critically and make a judgment about safe levels of debt. Looking at the standard gap estimates for credit to GDP ratio is supposed to serve as a starting point for policy deliberations, so before policymakers take real actions, they should already have some intuitive understanding about the specifics about the state of the economy financial system including assumptions about the safe level of debt in their minds. In our example, for the purpose of simplicity, we assumed that the safe level for China, Japan, UK, Euro area and US is $\tau_t^*=150$. Next comes the role of ω_t, which is the time-varying component that penalizes the trend deviation from the assumed safe level. In our extension, whenever the actual value of credit-to-GDP ratio $y_t < 150$, then ω_t is equal to zero and the penalty for the trend deviation is zero. In other words, the values of trends in HP and PC filters would be parallel to each other when the credit-to-GDP ratio is less than the safe level. However, when the debt level surpasses the safe

level, ω_t switches to 1[5] turning on the safe level part of the filter equation and the estimated trend stays closer to the safe level, and bigger the value of ω_t, the closer it will get to the predefined safe level of the trend. This extension addresses a key limitation of HP filter mentioned above and, by preventing it from production of deep negative gaps negative gaps when, for example, the economy faces really high amounts of debts. In addition to this, the safe level τ_t^* can be based not only on critical thinking about economic indicators, but also on policymakers' notion about the shadow-banking-sector or other key dynamics relevant to financial cycles. To put it differently, policymakers have the opportunity to include more of their thinking on actual matters of the economy and to incorporate this into the filter.

[5] It can be set to any positive number. Higher is this number, higher will be the penalty for the filtered trend to diverge away from the safe level.

IV. RESULTS AND FURTHER RESEARCH

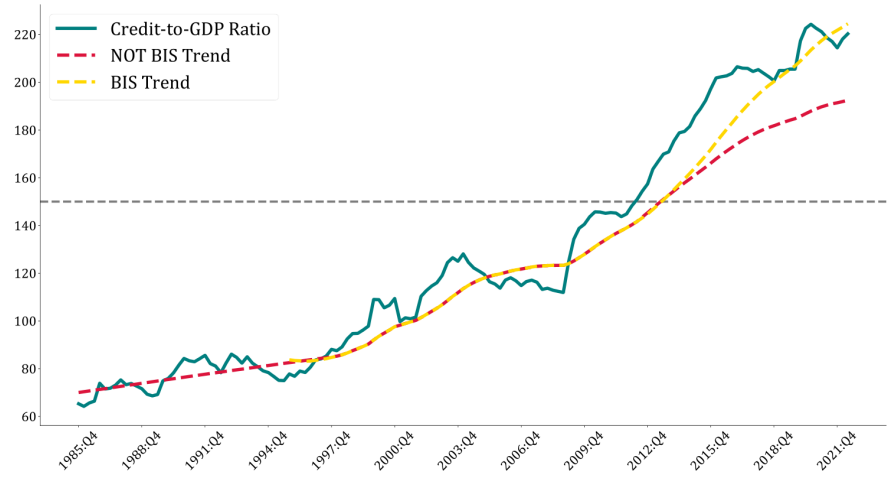
To better illustrate the implications of the PC filter, we have done a simulation of both the BIS HP filter and our PC filter on the credit-to-GDP ratio of China, Japan, the Euro Area, United Kingdom, and United States. For the sake of illustration, and as described in the prior section, we assume 150 as a prior for the safe level of credit-to-GDP ratio for these economies and a ω_t penalty component with a value of 1. Obviously in a real policymaking circumstance both parameters would and should vary across countries and time depending on a variety of factors.

IV. A. Case of China

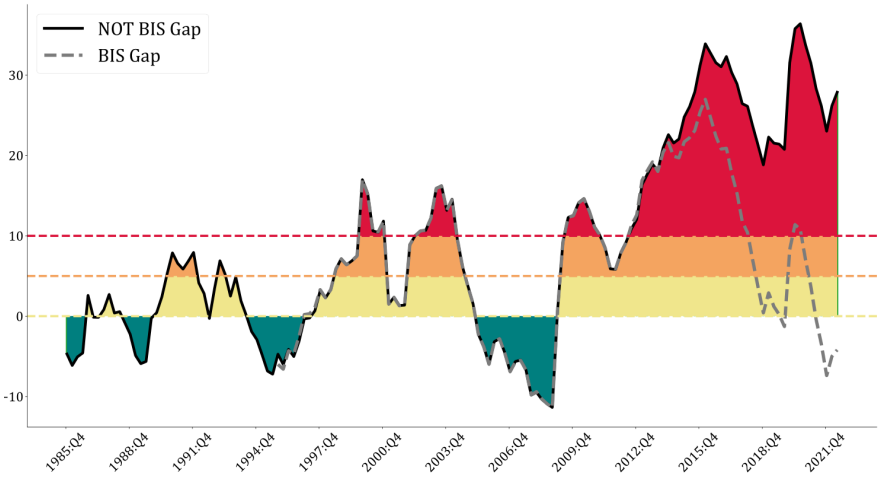
In Figure 2, we present the comparative results of HP and PC filters for China's economy. As you can see the BIS Trend and NOT BIS Trend are practically the same for both filters until the credit-to-GDP ratio's actual value y_t reaches the safe level of 150. Starting from that point, the extended restriction of the PC filter starts to penalize the trend, and it starts to change its trajectory more towards the safe level. As demonstrated after September 2021, the BIS Trend is largely above the actual credit-to-GDP ratio, and we have a situation where we have a negative credit gap, but the level of the credit-to-GDP ratio (above 200) is far above the safe level (150). If policymakers were to put any weight on the BIS gap, they could come to the conclusion that there is no need to take action to intervene in the situation in the financial markets, whereas the NOT BIS Gap is significantly higher, signaling that it's time to think about preventive policy actions.

Figure 2: The Credit-to-GDP Ratio for China

Panel A. BIS and NOT BIS Trend



Panel B. BIS and NOT BIS Gap



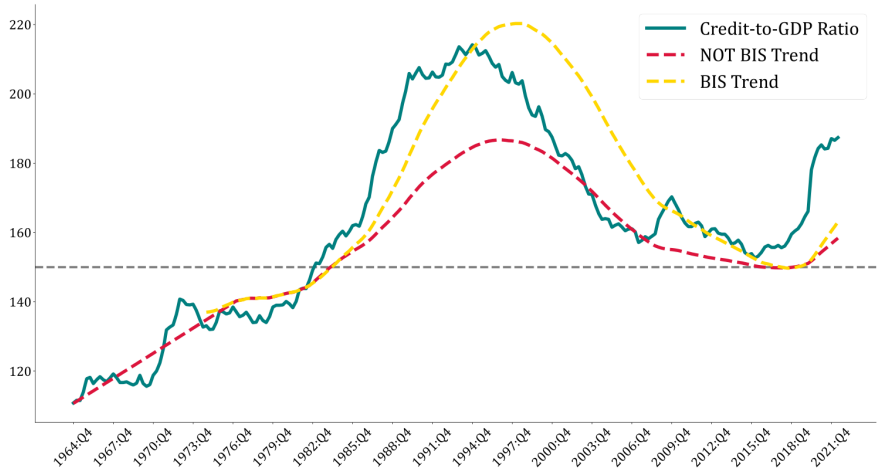
Source: BIS, Authors calculations.

IV. B. Case of Japan

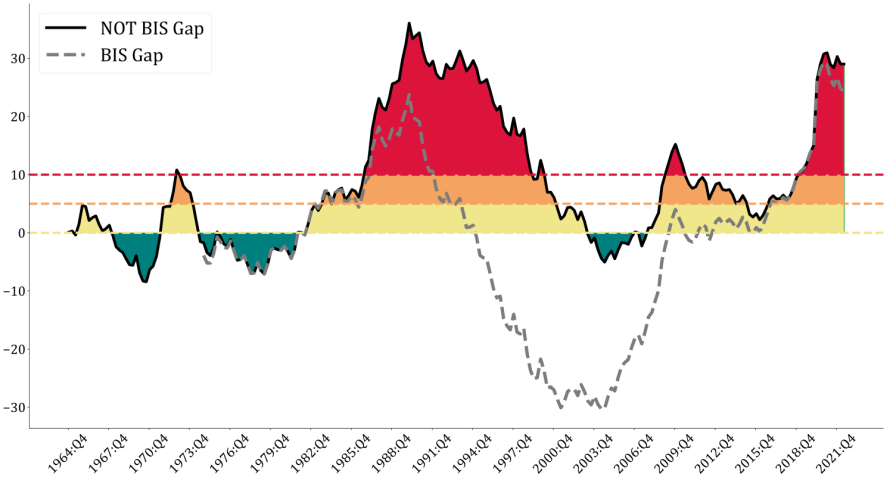
In the case of Japan, it is useful to look closely at the situation in 1980s and early 1990s in Figure 3. That period coincides with the asset price bubble in Japan, which emerged because of several factors, such as overconfidence and euphoria in markets, aggressive behavior of financial institutions, the emergence of Tokyo as an international financial center, and so on.[6] Evidently with the BIS Gap we see very small gaps and even a negative gap in the mid-1990s, when the credit levels had been really high. In such cases, the presence of a "safe level" prior would have helped to include all of the above-mentioned triggers of the situation into the filter and have a better measure of the gap for making policy decisions.

Figure 3: The Credit-to-GDP Ratio for Japan

Panel A. BIS and NOT BIS Trend



Panel B. BIS and NOT BIS Gap



Source: BIS, Authors calculations.

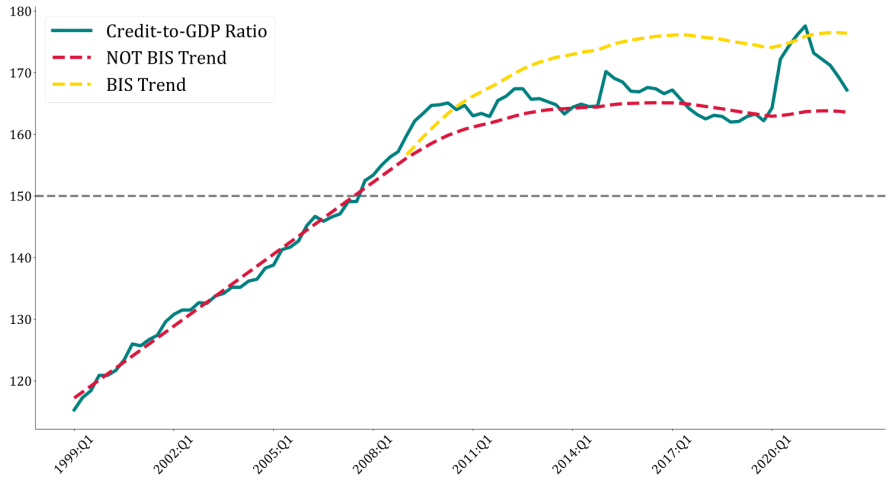
[6] See Shiratsuka (2005).

IV. C. Case of Euro Area

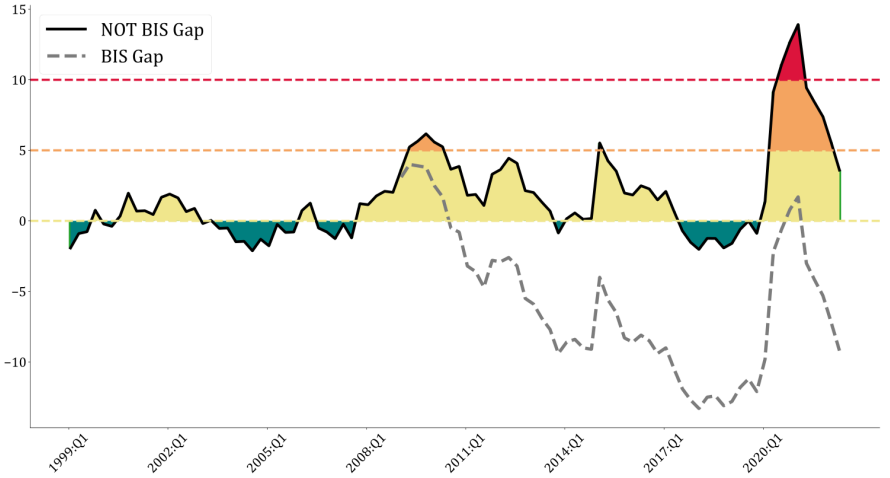
The same goes on for the results of the Euro Area, United Kingdom, and United States, which are presented in figures 4, 5 and 6. It is worth paying attention to the results of the Euro Area, especially in the period of 2009, when the European debt crisis started. While several processes contributed to the crisis, the fact remains that the credit-to-GDP ratio was already high during that period. Figure 4 shows a typical situation where the usual methodology fails to produce a trend that captures the slowdown in actual credit to GDP ratio resulting in negative output gap estimates. In contrast, with PC filter we see a positive gap on the mark-up from the predefined safe level of the debt. Hence this type of mistakes of HP filter can lead policymakers to make completely flawed judgments based on wrong measurements, leading to costly social and economic consequences.

Figure 4: The Credit-to-GDP Ratio for the Euro Area

Panel A. BIS and NOT BIS Trend



Panel B. BIS and NOT BIS Gap



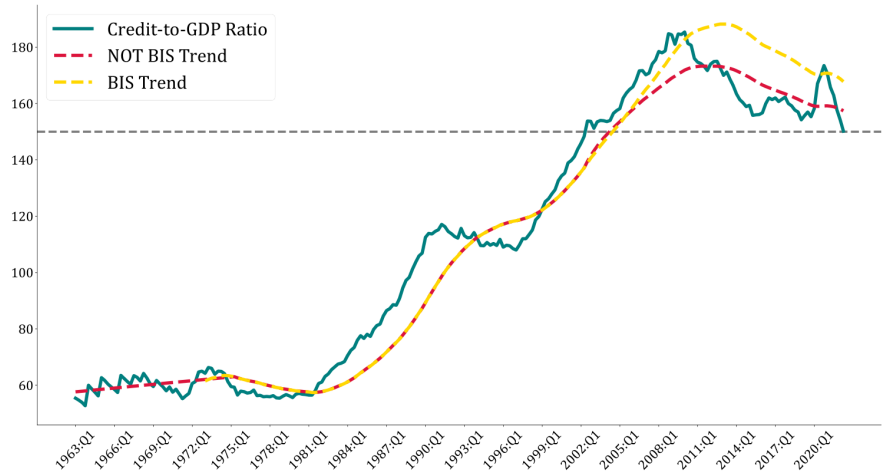
Source: BIS, Authors calculations.

IV. D. Case of the United Kingdom

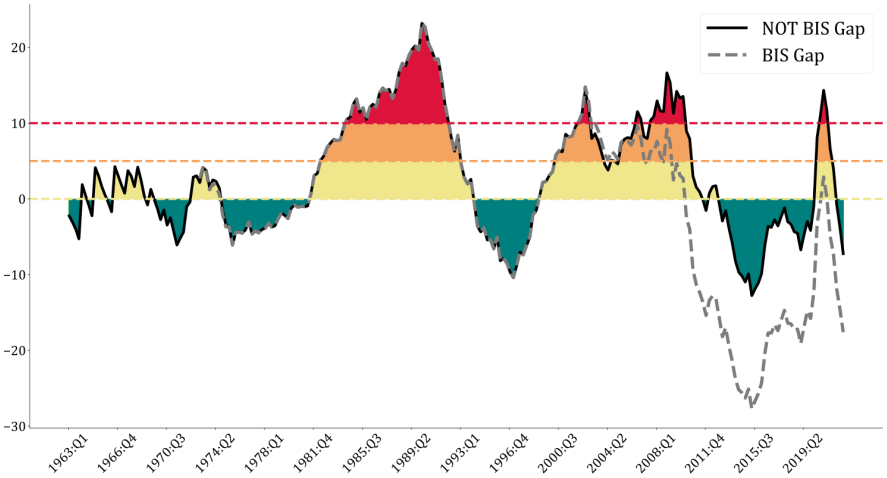
After the global financial crisis of 2008, the UK financial markets have experienced a period of recovery and growth, but also continued challenges and risks. One significant trend has been the accumulation of debt, both in the public and private sectors. The UK government borrowed heavily to finance its stimulus measures and to bail out struggling banks, leading to a significant increase in public debt levels. Meanwhile, households and businesses also took on more debt, as low interest rates and easy access to credit encouraged borrowing for consumption and investment purposes.

Figure 5: The Credit-to-GDP Ratio for the United Kingdom

Panel A. BIS and NOT BIS Trend



Panel B. BIS and NOT BIS Gap



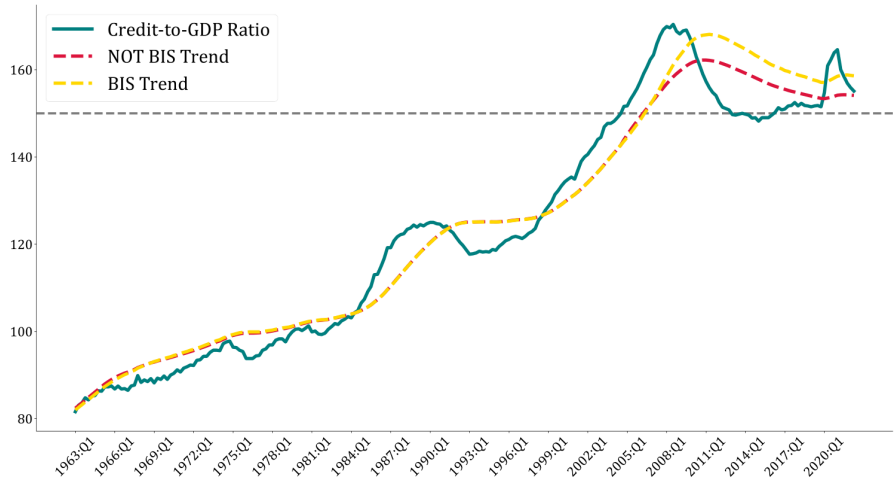
Source: BIS, Authors calculations.

IV. E. Case of the United States

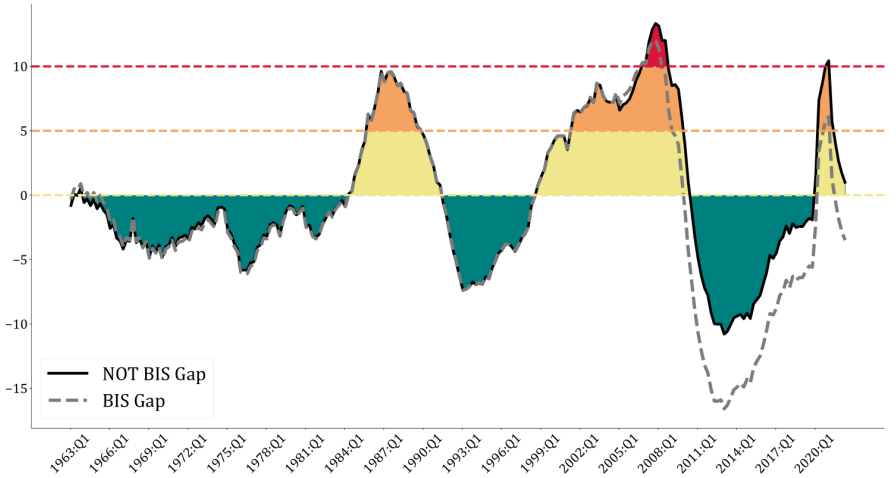
The US government, after the GFC, implemented a range of measures aimed at stabilizing the economy and reducing the budget deficit. These included the American Recovery and Reinvestment Act (ARRA) of 2009, which provided a significant fiscal stimulus to the economy resulting in a period of steady economic growth for the US economy, and the Budget Control Act of 2011, which imposed spending caps and established a framework for reducing the deficit. In addition to these measures, the US government has also implemented policies aimed at reducing healthcare costs, which is one of the largest drivers of government spending. The Affordable Care Act, also known as Obamacare, has helped to slow the growth of healthcare costs, which has contributed to a reduction in the deficit and the debt-to-GDP ratio.

Figure 6: The Credit-to-GDP Ratio for the United States

Panel A. BIS and NOT BIS Trend



Panel B. BIS and NOT BIS Gap



Source: BIS, Authors calculations.

The GFC itself was largely a reflection and materialization of the excessive risk in the financial markets, so we can naturally assume that if there is some level of credit to GDP ratio to be considered as safe, it must be closer to the pre GFC period levels, namely very close to our illustrative number 150. In this case the estimates using our filter do not drastically change the overall picture for the post GFC period, both signaling low overall riskiness in the financial markets. Still the trend produced by our approach is much faster in making a U-turn which lets us avoid getting unreasonably negative estimates for the credit to GDP ratio gap.

In all of the examples above we purposefully chose the same number for the safe level (150), but obviously, a natural vector for further research would be exploring and expanding the notion of safe level itself as by definition it is a function of time and several characteristics and in a given economy.

V. CONCLUSION

After the Global Financial Crisis, many institutions started to look for ways to develop early signals on financial risks. The aftermath of the GFC shows that one of the major mistakes was that the policymakers failed to grasp the full spectrum of accumulating risks in the financial system including issues on excess risk-taking behavior, unjustified levels of leverage, shadow banking, etc.

One approach that helps tackle the risk assessment challenge is to look at credit gaps. They contain essential impulses that can help policymakers anticipate the upcoming costs and risks associated with a financial crisis. There are countries with high credit-to-GDP ratios but smaller credit gaps, but the naive HP filter used by BIS and other institutions for such estimations are problematic and constrain policymakers to only focus on information that conforms with their preexisting rationale on financial cycles.

Current situation in China may be a good illustration of a similar situation where if we were to base our decision-making on the current version of the credit gap estimations only, or even give those estimates any significant weight, we will find ourselves in a dangerous trap. We suggest an extension of HP filter which includes a notion of the safe level for debt credit-to-GDP ratio. In case of China using the extended filter would enable us to include the risks and dynamics of the shadow-banking system in the estimations of the credit gaps. And that is just one particular example specific to Chinese economy where the new methodology allows to avoid misinterpreting current dynamics of the economy and financial sector.

It's clear that no single model can give complete assurances about an unpredictable future, and obviously, the safe level itself will be a matter of individual estimations and assumptions of policymakers, heavily relying on their critical thinking. However, the judgment-making process should ideally be an important and integral part of the whole financial risk management policy. This puts our extended filter approach in an advantageous position compared to the existing methodology as it forces the policy makers to take a stand on the safe level of credit-to-GDP ratio as an integral part of the risk assessment process. As a result, the approach presented in this paper has all chances to be a more relevant and reliable tool for producing forward-looking estimates of credit risks.

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