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Estimating Business and Financial Cycles: Case of Nepal

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ABSTRACT

With the application of frequency domain filter, this paper estimates Nepalese business and financial cycles. To estimate the cycles, the annual series of GDP, CPI and Credit to Private Sectors were used ranging from 1991 to 2017. The data is modified and indexed by applying the standard data generation process. The business cycle of Nepalese economy shows that it is in the recovery phase. There was a long recession in the 2000s that recovered within 2007. The financial cycle shows the beginning of recession after witnessing a boom in 2013. Once being at peak in 1996, the Nepalese financial system went through a long and deep recession until 2002. The both financial and business cycles in Nepal are similar that of advanced economies indicating that financial cycles are longer and deeper than business cycles.

JEL Classification: E32, G01

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I.   INTRODUCTION

Business cycle is a well-known issue among economists worldwide since very long. Researchers such as Diebold and Rudebusch (1996) had convinced the policymakers that business cycle is the most significant fundamental factor to study the economic cycles. Financial cycle, on the other hand, came in the mind of economists much later after the advanced economies suffered from financial crises. More specifically, financial factors were in less priority for many macroeconomists until the global financial crisis (GFC) of 2008 (Borio, 2014).

Development of financial sector has been presumed one of the major prerequisites for the economic development. However, there are many issues on financial sector development, thereby maintaining overall economic stability. It is believed that financial developments may reinforce the economic cycles further, leading into the breaking of saver-investors relation resulting into the serious effects to the real economy (Borio et al. 2001). Nevertheless, financial cycle is a less researched topic even today and there is still no consensus even defining it (Borio, 2014).

Financial cycle can be defined as a systematic pattern of movement in the financial variables such that there would be booms and busts in a certain interval. Borio (2014b) defines that financial cycle is "a self-reinforcing interactions among the perceptions of value and risk, attitude towards risk and financing constraints." He claims that these three variables can translate the financial sector into both booms and busts. Many economists including Drehmann et al (2012) argue that financial cycle can be described by closely observing the credit and property prices in the medium term. However, they discarded the equity prices to be the cause of financial cycle with poor relation into credit and property prices.

The financial cycle can be understood from the financial intermediation perspectives too. The economics of financial intermediation is that banking institutions usually borrow short as deposits and lend for long in an interest margin (Adrin and Shin 2010). Since short-term resource is lent for long-term, this phenomenon provides a strong rationale to study the financial cycles.

The estimation of financial cycle is also substantial to take into account the whole cycle length. The risk of "unfinished recession" phenomenon may also take place in the financial sector if the policy response is short compared to the overall length of the cycle (Drehmann et al 2012). Thus, it is argued that policy responses should be for the whole length of the cycle. Otherwise, it may help contain recessions in the short run but at the expense of larger recessions in the future.

The study of financial cycles is also important for the fiscal policy too. Research has shown a two-way relationships of fiscal and financial cycles as public debt went significantly up in the

aftermath of financial crisis (Lane, 2011; Reinhart and Rogoff, 2009, Honohan and Klingebiel, 2003). Not only the debt, such crises also influences the government revenue as it is evidenced a strong revenue growth related with rapid credit expansion and vice versa.[1]

Economic globalization has also provided the greater significance in the study of financial cycle. For instance, the higher dependence of remittance inflow would be critical to maintain economic stability especially at the home country of migration (Delgado-Wise and Márquez 2006, Delgado-Wise and Guarnizo 2007). Furthermore, financial liberalization can further fuel the financial variables to become pro-cyclical (Drehmann et al, 2012, Borio and Lowe, 2002).

It is witnessed that a peak in the financial cycle is mostly resulted into a systemic banking crises worldwide (Borio, 2014). With this notion such that preventing banks from taking excessive risks during good times, Basel Committee on Banking Supervision (BCBS) has added a countercyclical buffer in the BASEL-III version of banking regulations. The aim of the buffer was using it as a macro-prudential tool to limit the banks from excessive credit growth such that build-up of systemic risk is prevented (BIS, 2010).

The study and estimation of financial cycles become relevant in Nepalese context too. Nepal is increasingly dependent on foreign employment thereby remittance income. Also, Nepalese financial sector is getting more liberalized, globalized and complex over the years. But no any empirical research has been done in this area so far till date with Nepalese data. Most of the studies are focused on the advanced economies due to the availability of longer series of high frequency data and influence of these economies into the global market.

In this backdrop, this paper estimates the business and financial cycles of Nepalese economy following a new filtering technique: frequency domain filter. The paper argues that traditional filtering techniques such as HP filter will be no longer valid in estimating cycles. The rest of the paper flows as follows. The next chapter illustrates the methodology of the research. Chapter three presents the results while chapter four concludes the paper.

II. METHODOLOGY

The commercial bank credit to Gross Domestic Product (Credit-GDP) ratio is the major variable of study in estimating financial cycle. Based on the empirical literatures with strong evidence that excessive credit growth tend to amplify financial crises, credit-GDP ratio is being considered the major variable to study the financial cycle (Schularick and Taylor, 2012; BCBS, 2010a). This is because a strong association between credit growth and systemic risk was observed in the economies that faced the financial crises before. Furthermore, credit

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[1]   Benetrix and Lane (2010) discussed how credit expansion before 2008 financial crisis deteriorated the fiscal balance.

variable has two major benefits to use. First, credit-GDP ratio itself measures the financial deepening position of an economy. Second, credit is comparable variable for investment, consumption and even for trade since credit to private sectors can boost up these sectors. Due to this, credit variable is presumed to be endogenous to the economic growth.

With these assumptions and analogies, credit to GDP gap is the most close figure to estimate the financial crises (Eichengreen and Mitchener, 2004; Borio and Drehmann, 2009, Alessi and Detken, 2009; Schularick and Taylor, 2009; Drehmann and Juselius, 2013). Debt service ratio could also be a variable in the shorter horizons (Drehmann and Juselius, 2013). In addition, BASEL III of BCBS has emphasized on monitoring credit growth to prevent from the build-up of excessive and system-wide risks. It has recommended credit-GDP ratio gap as a key variable and urged financial regulators to enforce the countercyclical capital buffer (CCB) if the credit goes beyond the limit.

The annual series of credit to private sectors (total_credit), consumer price index (cpi), and Gross Domestic Product (GDP) ranging from 1991 to 2017 has been used for the analysis. The credit and CPI data were obtained from Nepal Rastra Bank while the GDP was extracted from Central Bureau of Statistics (CBS).

To estimate the financial cycle, we need to estimate the credit-GDP gap ratio. The following procedures are adopted to estimate such gap ratio.

First, we calculate the aggregate private-sector credit-to-GDP ratio. The credit-to-GDP ratio in period t for a country is calculated as:

$$\textit{Credit-GDP ratio}_t = (credit_t \, / \, GDP_t) \times 100 \qquad\qquad \text{……….. (1)}$$

Where,

    GDP_t is domestic nominal GDP at Producer's Prices in period t

    $credit_t$ is *total* credit to the private, non-financial sector in period t

After this, it is needed to calculate the credit-GDP ratio gap, measured by the gap between the ratio and its trend, as follows:

$$\textit{Credit-GDP gap}_t = \text{Credit-GDP } ratio_t - Trend_t \qquad\qquad \text{……….. (2)}$$

Thus, the credit-GDP gap or simply credit gap in period t for a country is calculated as the actual credit-to-GDP ratio minus its long-term trend. Normally, such gap is compared to its long-term trend and observed whether the credit-GDP ratio is significantly above or below from its long-term value. If there is a large positive credit gap, then it is an indication that credit may have grown to excessive levels relative to GDP and vice versa. BCBS (2010b) recommends the thresholds for benchmarking the magnitude of the credit gap.

2.1   Time-based Filters and Cycle Estimation

In the whole process of cycle estimation, the critical part is estimating the credit-GDP gap. To estimate the gap, various filtering techniques to detach trend and cycles of a series are available in econometrics. The most common one is Hodric-Prescott (HP), 1997 filter. While estimating cycle, it minimizes the variance of the old series with the new one, subject to a penalty constant called lambda (λ) for which we assign the value. Basically, λ that constrains the second difference of the smoothed series i.e. *gap_cycle$_t$*.

That is, the two-sided[2] HP filter chooses *gap_cycle$_t$* to minimize:

$$\sum_{t=1}^{T}(credit/GDP\_gap\_ratio_t - Gap\_ratio\_Trend_t)^2 +$$
$$\lambda\sum_{t=2}^{T-1}\left((Gap\_ratio\_Trend_{t+1} - Gap\_ratio\_Trend_t) - (Gap\_ratio\_Trend_t -\right.$$
$$\left. Gap\_ratio\_Trend_{t-1})\right)^2$$

………. (3)

Where, T is the sample size. The penalty parameter λ controls the smoothness of the series σ. Larger the λ, smoother the σ. As $\lambda =\infty$, *gap_cycle$_t$* approaches a linear trend.

However, there are several problems in using HP filter. The cycle estimation for the end period of the given series has end-sample problem. Even if there is a one-sided HP filter recommended by BCBS' (2010a) with recursive HP filter, there are other several issues on it.   Hamilton (1994) argues that HP filter produces spurious dynamic relations. It is also tricky on what value we give for λ. Thus, major issues in using HP filter were value of the smoothing parameter λ, one-sided filter as it uses the historical data up to the end of the sample, among others.

So that, we use the different approach than the BCBS recommendations in estimating credit cycle, applying the spectral analysis and band-pass filter.

2.2   Spectral Analysis and Band Pass Filter

The HP filter uses time domain to extract cycles based on the Wold Theorem which elucidates that "any covariant stationary process is decomposable into two but mutually unrelated series based on the past observations, following the ARMA models and autocorrelation function" (Wold, 1954). But instead of time, we may use the frequency domain and observe the spectrum or band of the series over time as represented by Spectral Representation Theorem of Wiener (1930). It states that an infinite sum of sine and cosine functions can represent a stationary time series data and be able to capture both time and frequency of the series (Hamilton, 1994).   Spectral analysis provides a descriptive but a convincing method to observe cycles.

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[2]   The standard HP filter available in econometrics software such as eViews is always two-sided, which uses t-1 and t+1 to extract cycles.

For a time series x_t, the spectral density function $f(\omega)$ is given by:

$$f(\omega) = \gamma_0 + 2 \sum_{h=1}^{\infty} \gamma(h)\cos(2\pi\omega_j h)$$ ………. (4)

Where,

γ = Auto-covariance between x_t and x_s of the series x(t), up to lag *h*.

$$f(\omega) \geq 0;$$
$$f(-\omega) = f(\omega);$$
$$\int_{-1/2}^{1/2} f(\omega)d\omega = \gamma(0) < \infty$$

Thus, based on this density function, we define the range or band of the cycle with high and low frequency movements: upper band (ω_{upper}) and lower band $((\omega_{lower})$. Those cycles outside this range is automatically filtered out.

Baxter-King (1999) proposes to estimate the band-pass filter with Spectral Density Function. But this method also has some estimation problems. Like HP filter, this method is also lies on time domain. The major drawback of time domain is we need to approximate lags and leads ourselves and there are still chances of loss of data at the beginning and ending period of the cycle. In addition, the series should be made stationary.

To address these issues such as data loss at the beginning and end as well as property of the time series data, frequency-based filters are also available. Frequency-domain filters are a part of Fourier analysis.[3] The idea behind the frequency domain is that the co-variance is estimated as an independent stochastic cycle that takes place at the frequency of $\omega \in (-\pi, \pi)$.

With this notion, we apply the "Ideal Band Pass" or Frequency Domain (FD) filter to estimate the Nepalese financial cycle, as given by Corbae and Ouliaris (2006). This approach addresses some of the issues of time domain filters proposed by Hodrick-Prescott (1997) and Baxter-King (1999).

The Corbae and Ouliaris (2006) ideal band-pass filter is available in EViews Add-in as FD Filter. This filter is believed to be ideal in the sense that this method can be used in the level data with both unit root and stationary property of time series.

Before we estimate the cycle by using FD filter, the data needs to be re-calibrated so as to make different data series with different units comparable. Thus, we re-generate the original series of credit and GDP data with these steps below.

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[3]   The details of Fourier analysis are available at Folland (1992) and Körner (1998).

1.   To estimate financial and business cycle, we need total outstanding credit (tot_credit), credit-to-GDP ratio (credit_gdp_ratio), consumer price index and nominal GDP (ngdp).

2.   Then, we convert the nominal series into real, except for credi-to-GDP ratio. For doing this, we divide total credit and nominal GDP by consumer price index (CPI).

3.   We normalize all the series by dividing the mid-year value of the whole series. For this, we have considered the value of year 2003. For example, the normalized real credit is:

$$n\_real\_credit = \frac{Real\_Total\_Credit}{Real\_Total\_Credit_{2003}} \times 100 \qquad\qquad \dots\dots (5)$$

Here, n_real_credit is the normalized real credit. After normalization, the value of real credit in the year 2003 becomes hundred. The similar normalization is necessary for the real_GDP as well.

4.   We calculate the growth rate of normalized series of both real credit (n_real_credit) and real gdp (nor_rgdp).

5.   At last, we estimate the financial cycle using Corbae-Ouliaris FD Filter in EViews.

III. RESULT ANALYSIS

The extraction of trends from a time series is the estimation of financial cycle. As mentioned in the methodology section, there are various methods available. The validity and reliability of estimated cycle largely relies on the methods we choose. Thus, we estimate two different approaches of cycle estimations and recommended the unbiased and best estimate.

3.1   Time-based Filtering and Financial Cycles

At the beginning, we estimate the Nepalese financial cycle with the standard filter technique: HP filter. As an alternate, we estimate band-pass filter based on the time domain as explained in the section 2.1. The graphical plots of the cycle are presented in Figure 1.

Figure 1 : Nepalese Financial Cycles Estimated using Time-domain Filters
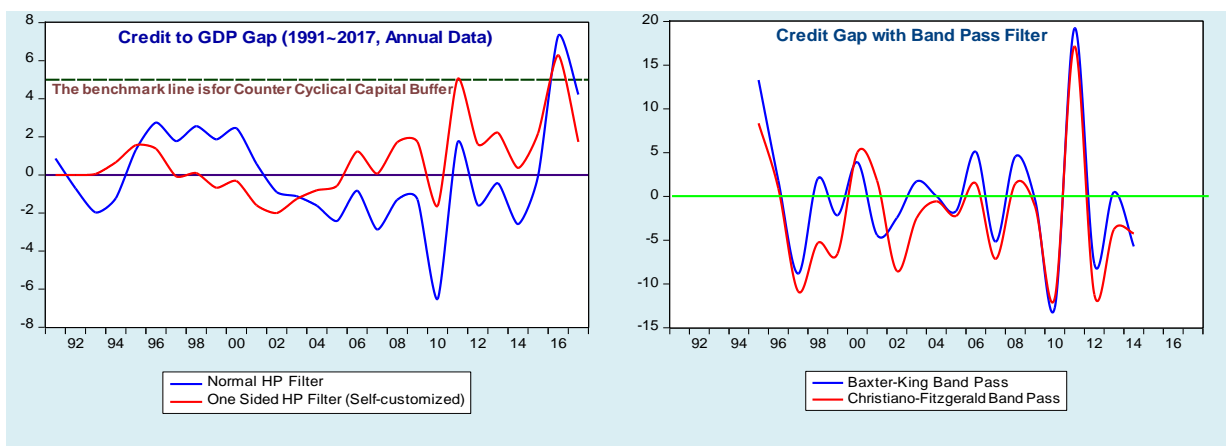

The two approaches: HP filter and band-pass filter estimates show the different results. The significant negative credit gap was noted in 2010 in both one-sided HP filter and band-pass filter but not in normal HP filter. The normal HP filter has less variant cycles compared to band-pass filter. The band-pass filter also does not indicate any specific cycle. Instead, the ups and downs are noticed in most of the years.

3.2   Frequency Based Filtering

Based on the frequency domain, we now estimate the spectral density function as given by Corbae and Ouliaris (2006) using EViews. The ideal band-pass filter of the series is estimated by modifying the credit and GDP series by applying the steps mentioned in the section 2.2. Following such approach, the estimated ideal band-pass filter is given in the Figure 2.

Figure 2 : Nepalese Financial Cycles Estimated using Frequency-domain Filters
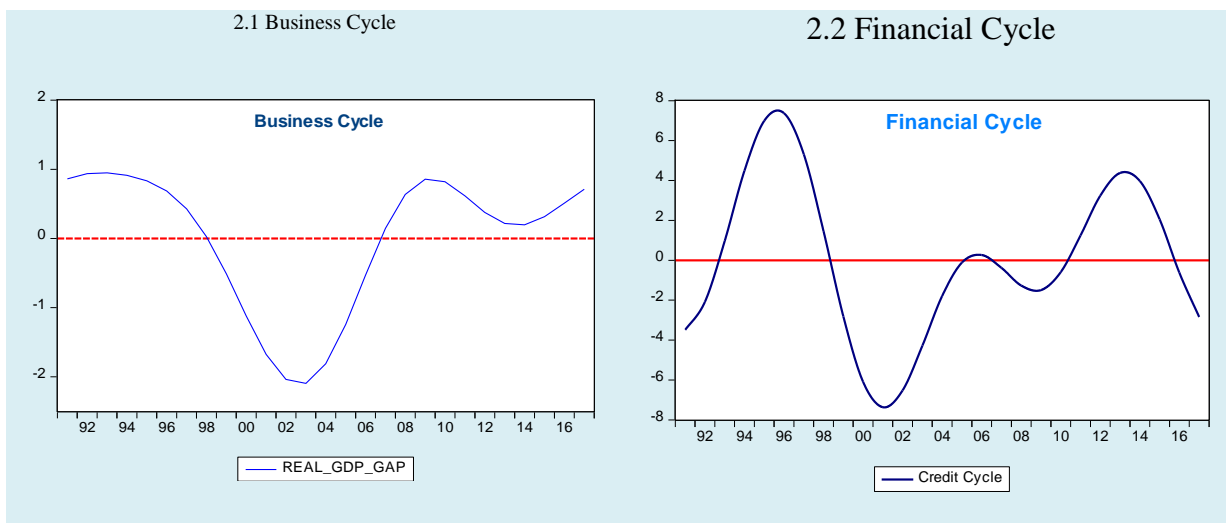

The business cycle of Figure 2 shows that Nepalese economy is in the recovery phase. During 2000s, the economy went down to the recession until 2003 and recovered within 2007. The economy bounced back within a few years but was in downturn since 2010. After a slight deep in 2015, it is observed a recovery since 2016.

The financial cycle, however seems in the recessional phase after a boom in 2013, the estimate shows. Once being in peak in 1996, the Nepalese financial system went through a long and deep recession until 2002. It took almost 5 years to recover. In 2009 too, the financial cycle was in downturn but recovered quickly. The financial system was in peak in 2013. Since then, it is in recessional phase, which is still continuing.

Figure 3 : Nepalese Financial Cycles Estimated using Frequency-domain Filters
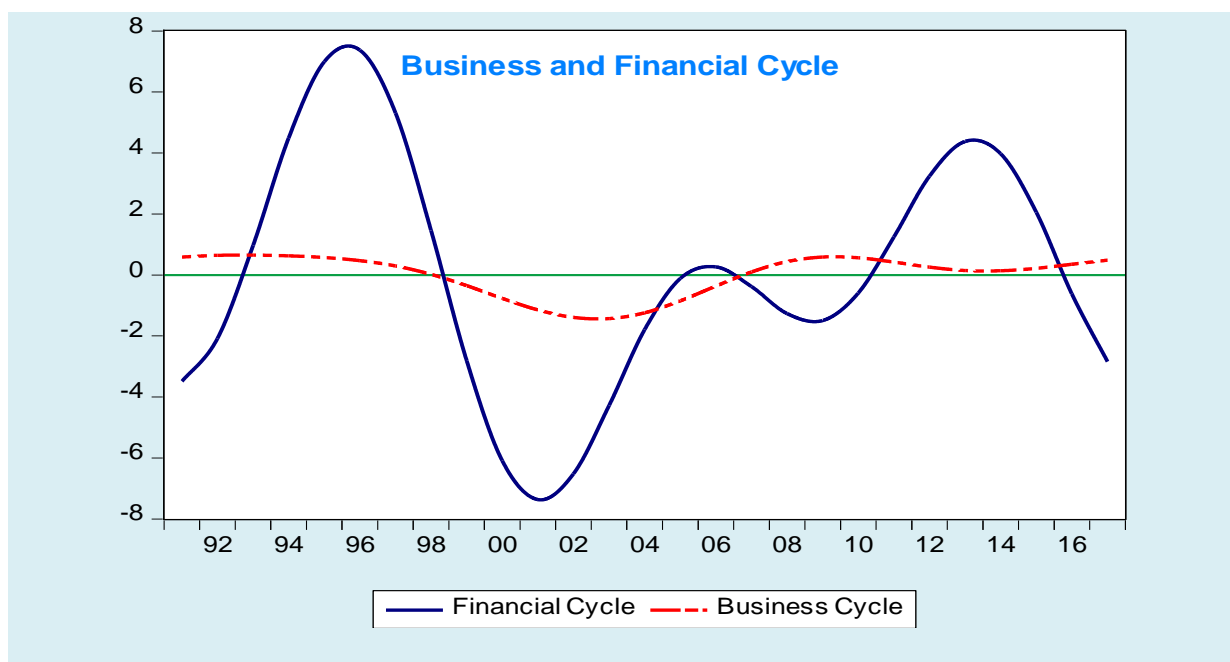
Nepal's both business and financial cycles were in downturn in the early 2000s to 2002. However, the degree of deepening of the cycle is found to be different. Although business cycle was not much deeper, it took more years to recover. In case of financial cycles, it was severely deeper but quickly recovered, even quickly than the real cycles (Figure 3).

The estimated Nepalese financial and business cycles are similar of advanced economies, as estimated by Dreahman et.al (2012). As per that estimate, Nepalese financial cycles are longer and deeper than business cycles. Likewise, we don't find a clear synchronization of business and financial cycle.

IV. CONCLUSION

Financial cycles are inevitable in every economy. Economic liberalization and globalization, innovation in financial technologies, financial development, banking behavior and several other macroeconomic variables are found to be responsible for financial cycles. Despite the availability of many other variables, credit growth is one of the most prominent indicators of financial cycle, as evident by many literatures. There are various ways of estimating financial cycles. The common one is extracting cycles from the time series data. It can be done based upon the two domains: time domain and frequency domain.

We estimate the Nepalese business and financial cycle with frequency domain filter following the methodology of Corbae and Ouliaris (2006) in the EViews. To estimate the cycles, we use the annual series of GDP, CPI and Credit to Private Sectors ranging from 1991 to 2017. The data is modified and indexed in the middle of series (2003) so as to make estimates comparable with different series. Furthermore, the series are converted into real: real GDP and real credit by using CPI.

The business cycle of Nepalese economy shows that it is in the recovery phase. There was a long recession in the 2000s that recovered within 2007. The financial cycle shows the beginning of recession after witnessing a boom in 2013. Once being in peak in 1996, the Nepalese financial system went through a long and deep recession until 2002. Both the financial and business cycles are found to be similar of advanced economies. Financial cycles are longer and deeper than business cycles

Nepalese financial cycle seems in downward trend, showing slowdown of its performance for some years from now. Symptoms of it have been already seen as a liquidity crunch and increased interest rate. As discussed above, financial cycles are lengthier than the business cycle. Sound financial system is a prerequisite for sustainable economic growth and development. Because this sector works as a lubricant to the economy by mobilizing saving and channeling investments. To shorten the cycle, authorities responsible for it need to be aware and policies that contain the cycle to bounce bank to the normal is needed. Otherwise, the recession in the financial system will be too costly to the real economy.

REFERENCES

Adrian, T. and H. Shin. 2010. "Financial Intermediaries and Monetary Economics." in B Friedman and M Woodford (eds). *Handbook of Monetary Economics*, Vol 3, Amsterdam: North Holland, pp 601-650.

Alessi, L. and C. Detken. 2009. "Real Time Early Warning Indicators for Costly Asset Price Boom/Bust Cycles: A Role for Global Liquidity." *ECB Working Paper,* no 1039, European Central Bank.

Baxter, M. and R. G. King. 1999. "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series." *Review of Economics and Statistics*, Vol. 81, No. 4, pp. 575-93.

BCBS. 2010a. "Guidance for national authorities operating the countercyclical capital buffer." Basel Committee on Banking Supervision. Available from http://www.bis.org/ publ/bcbs 187.pdf. Accessed 3rd March 2017.

_____. 2010b. "An assessment of the long-term economic impact of stronger capital and liquidity requirements. Basel Committee on Banking Supervision. Available from http://www.bis. org/publ/bcbs173.pdf. Accessed 3rd March 2017.

Benetrix, A. and P. R. Lane. 2010. "International Differences in Fiscal Policy During the Global Crisis." *IIIS Discussion Paper No. 336*. The Institute for International Integration Studies.

BIS. 2010. "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems." Basel Committee on Banking Supervision: Bank for International Settlements, December.

Borio, C. and M. Drehmann. 2009. "Assessing the Risk of Banking Crises – Revisited." *BIS Quarterly Review*. March, pp 29–46.

Borio, C. 2014. "The Financial Cycle and Macroeconomics: What Have We Learnt?" *Journal of Banking & Finance*, Vol. 45, pp. 182-98. Available from http://www.bis.org/publ/ work395.pdf. Accessed 10th March 2017.

Borio, C., C. Furfine and P. Lowe. 2001. "Procyclicality of the Financial System and Financial Stability: Issues and Policy Options." In *BIS Papers 1*, *Marrying the Macro- and Micro-prudential Dimensions of Financial Stability*, pp. 1-57. Available from http://www.bis.org/publ/bppdf/ bispap01a.pdf. Accessed 25th January 2017.

Borio, C. and P. Lowe. 2002. "Assessing the Risk of Banking Crises.'" *BIS Quarterly Review*, December, pp. 43–54.

Corbae, P. D. and S. Ouliaris. 2006. "Extracting Cycles from Non-stationary Data." Chapter 6 in Corbae, P. D., S. N. Durlauf and B. E. Hansen (eds.). *Econometric Theory and Practice: Frontiers of Analysis and Applied Research. pp.* 167-177. Cambridge: Cambridge University Press.

Delgado-Wise, R., and L. Guarnizo. February 1, 2007. "Migration and Development: Lessons from the Mexican Experience." Online Feature Story. Migration Policy Institute. Available from https://www.migrationpolicy.org/article/migration-and-development-lessons -mexican-experience. Accessed 16th February 2018.

Delgado-Wise, R., and H. Márquez. 2006. "The Mexico-Unites States Migratory System: Dilemmas of Regional Integration, Development, and Emigration." Conference Proceedings. Migration and Development, Perspectives from the South. July 10-13, Bellagio, Italia.

Diebold, F. X. and G. D. Rudebusch. 1996. "Measuring Business Cycles: A Modern Perspective." *Review of Economics and Statistics*, Vol. 78, No. 1, pp. 67-77. Available from http://www.ssc.upenn.edu/~fdiebold/papers/paper4/pabc.pdf. Accessed 5th March 2017.

Drehmann, M., C. Borio and K. Tsatsaronis .2012. "Characterising the Financial Cycle: Don't Lose Sight of the Medium Term!" *BIS Working Papers* No. 380, June. Bank for International Settlements.

Drehmann, M. and M. Juselius .2013. **"Evaluating Early Warning Indicators of Banking Crises: Satisfying Policy Requirements."** *BIS Working Papers No 421*. Available from http://www.bis.org/publ/work421.pdf. Accessed 8th January 2017.

Eichengreen, B and K. Mitchener. 2004. "The Great Depression as a Credit Boom Gone Wrong", *Research in Economic History*, Vol.22, pp. 183-237.

Folland, G. B. 1992. "Fourier Analysis and Its Applications". Brooks/Cole Publishing Co.

Hamilton, J. D. 1994. "Time Series Analysis". Princeton University Press, Princeton.

Hodrick, R. J. and E. C. Prescott. 1997. "Postwar US Business Cycles: An Empirical Investigation." *Journal of Money, Credit and Banking*, Vol. 29, No. 1, pp. 1-16. Available from https://www0.gsb.columbia.edu/cfusion/faculty/rhodrick/prescott-hodrick1997.pdf. Accessed 9th July 2017.

Honohan, P. and D. Klingbiel. 2003. "The Fiscal Cost Implications of an Accommodating Approach to Banking Crises." *Journal of Banking and Finance Vol. 27(8),* pp. 1539-1560.

Körner, T. W. 1988. "Fourier Analysis". Cambridge University Press.

Lane, P.R. 2010. "Some Lessons for Fiscal Policy from the Financial Crisis." *Nordic Economic Policy Review*, Vol. 1(1), pp. 13-34.

_____ 2011. "Fiscal Policy and Financial Stability." Bank of Korea Annual Research Conference 2011. Available from https://www.bok.or.kr/conference/pdf/2011/session4/13.pdf Accessed 7th October 2017.

Reinhart, C.M. and K. S. Rogoff. 2009. "This Time is Different: Eight Centuries of Financial Folly." Princeton University Press.

Schularick, M and A. M. Taylor.2012. **"**Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008." *American Economic Review*, Vol. 102, No. 2, pp.1029-61. Available from http://www.nber.org/papers/w15512.pdf. Accessed on 21st December, 2017.

Wiener, N. 1930. "Generalised Harmonic Analysis." *Acta Mathematica*, Vol. 55, No. 1, pp. 117-258.

Wold, H.A. 1954. "A Study in the Analysis of Stationary Time Series, 2nd RE." In Appendix on Whittle, P. "Recent Developments in Time Series Analysis". Almqvist and Wiksell Book Co., Uppsala. Available from https://www.projecteuclid.org/download/pdf1/euclid.aoms/1177730151. Accessed on 11th December 2017.