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Country Paper on Use of High-frequency Indicators by Central Banks:

Experience and Plans going forward

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1. Introduction

With nations focusing on limiting the number of casualties following the widespread coronavirus disease (COVID-19) pandemic, stringent lockdowns, international border closures, and strict social distancing measures were introduced inhibiting economic activities at alarming rates. Consequently, both global demand and supply shrunk severely and led to an unprecedented economic shock to the global economy resulting in policy makers implementing swift economic actions across the globe. With the constantly evolving nature of the pandemic and its economic consequences, policy makers had to rely heavily on timely information gathered from high-frequency indicators (HFIs) to guide policy direction. As such, the pandemic highlighted the need and the importance of monitoring and systematically analysing developments in the real economy at higher frequencies (monthly and weekly



monitoring) compared to previous models of monitoring where understanding the evolutions of the economy at quarterly and annual frequency was sufficient for policy makers to formulate short-term and long-term policies.

In the Maldives, following the COVID-19 pandemic the government of Maldives and the central bank of Maldives - Maldives Monetary Authority (MMA) - implemented a number of economic policies to combat the record deceleration of the economy such as fiscal stimulus packages, unemployment benefits, continuation of public sector investment projects (PSIP), mandatory debt moratoriums, and increased foreign exchange interventions to manage dollar shortages within the economy. The effective implementation of these policies required the authorities to obtain and monitor high-frequency data; daily and weekly developments in the activities of the economy were important to determine the magnitude of fiscal stimulus packages, and other interventions by authorities. For instance, daily movements in the tourist arrivals composition following the opening of borders in the Maldives were important to understand important markets to tap into to increase the number of arrivals into the Maldives. In addition, the uncertain trajectory of the post-COVID-19 recovery of the Maldivian economy implies the necessity of establishing systemic frameworks to monitor real-time developments of the economy as to strategize and implement effective policies to stabilise the domestic economy and anchor variances in price movements.

Although, several local authorities such as the Maldives Bureau of Statistics (MBS) and MMA collate and compile high-frequency economic data, there exists data limitations and constraints that inhibit effective and timely dissemination of these data. For example, the Quarterly National Accounts (QNA) which is the highest frequency output indicator available to monitor developments in the sectoral output of the economy, is published with a minimum of three months lag (the output of the second quarter of a year is published at the end of September) hindering policy makers to understand evolutions in the economic conditions in a timely manner. As there are several economic indicators available at much higher frequencies such as daily, weekly and monthly data, utilizing such indicators in a systemic and analytical methodology will be key in transforming the functioning of authorities as well as the sustaining the effectiveness of policies implemented by authorities. In this regard, this country paper focuses on reviewing the current practices of high-frequency indicators utilized by the



MMA, and the various hurdles which need to be overcome to effectively use the various High-frequency indicators available in the country.

The rest of the paper is structured as follows. Section 2 will briefly review the High-frequency indicators used and the recent developments in the use of High-frequency Indicators. Next, Section 3 describes the challenges that the central bank faces in terms of collating High-Frequency data, as well as the issues faced when utilizing High-frequency data in monitoring exercises. Lastly, Section 4 will provide the future work to enhance the collection, monitoring frameworks and usage of high-frequency indicators with Section 5 concluding this paper.

2. Current Use of HF Indicators

Currently, MMA conducts the monitoring of the following four sectors of the economy using several High-frequency indicators:

- Real Sector Developments:

The monitoring of the real sector developments can be divided into the monitoring of output production of various segments of the economy, the monitoring of developments in prices as well as business sentiments within the economy. In terms of monitoring the output production, MMA currently relies on the quarterly GDP estimates provided by MBS, and this monitoring exercise is assisted with analysis of other high-frequency indicators such as daily tourist arrivals provided by Maldives Immigration, daily flight movements Maldives Airport Company Limited, and monthly Fisheries purchase data provided by Ministry of Fisheries, Marine Resources and Agriculture. In addition to these high-frequency data, MMA also conducts Quarterly Business Surveys (QBS) to complement the analysis to understand the various business sentiments and market outlooks for the upcoming quarters.

With respect to prices, the main high-frequency data sets are collated by the MBS where MBS publishes monthly updates on the Consumer Price Index (CPI) which is then complemented by the quarterly updates of the Producer Price Index (PPI) also compiled by the MBS. By using these datasets,



MMA is able to gather information and insights on the real developments in the prices in the economy and identify potential implications of various policy changes that the government may enact in the future based on the quarterly inflation forecasting model used by the MMA.

- Fiscal Sector Developments:

MMA monitors the developments of the fiscal sector of the economy using the monthly and weekly government expenses and revenue data published by the Ministry of Finance. Even prior to the COVID-19 pandemic, in 2018 the government started publishing the weekly expenses report which was further enhanced following the COVID-19 where the government extolled information on various expenditure incurred by the government to combat the health and economic crisis following the pandemic.

Additionally, the government also published public debt data at a quarterly frequency which is also used for analytical purposes of MMA.

- Monetary and Financial Sector Developments:

With MMA being responsible for regulating and supervising the financial sector of the Maldives (other than the securities market), MMA conducts frequent analysis to identify the risks faced by financial system. In this regard, MMA collates data on financial soundness indicators such as regulatory capital to risk-weighted assets, return on assets, return on equity, etc. at quarterly frequency, while data on the economic sector-specific commercial bank lending to private sector is monitored at monthly frequencies. Despite the lack of direct transmission to interest rates from MMA's policy tools the MMA also monitors the monthly trends and changes to interest rates charged by banks on lending as well as on deposits.

MMA also analyses the developments on the liquidity of the banking sector and the overall economy by monitoring the excess reserves of commercial banks held at MMA, the use of Overnight Deposit Facility (ODF), and the use of Overnight Lending Facility (OLF) by commercial banks at a daily basis. In addition to this, MMA also monitors changes to broad money and reserve money on a weekly frequency in order to identify potential policy changes required to manage the liquidity in the economy.



- External Sector Developments:

The components of the External Sector that is monitored include the Gross International Reserves (GIR), Exchange rate movements, Imports and Exports, and developments in the External Debt of the country. While MMA collates real time developments and movements of GIR, the analysis was conducted on a monthly basis to identify the potential drawdowns on the reserves of the economy which includes the foreign exchange interventions conducted by MMA as well as the trends in the main inflows boosting the reserves such as the tax revenues collected by the government. However, following the COVID-19 pandemic, the need to analyse and understand the real time developments in the GIR of the economy has become paramount, and as a result the monitoring exercises are now conducted at a higher frequency, i.e. weekly analysis is conducted on reserve movements. Along with reserve developments, the MMA also monitors the evolution of external debt of the country at monthly frequency to identify external debt obligations of the government and the public sector in the upcoming months as the obligation is honoured using the official reserves of the country.

Besides this, as part of the target of the central bank, the MMA also monitors changes and movements in the exchange rate of the economy at daily rate to gauge the magnitude and timing at which the MMA needs to intervene into the market to prevent substantial movements in the exchange rate that may adversely impact the economy of Maldives.

The data on trade of goods, i.e. imports and exports of goods in the Maldives is compiled by the Maldives Customs Service (MCS), which is used by MMA to understand the market trends and the composition of goods that is being imported in and exported out of the country. The trade database is a vital database that informs policy makers on impact of changes in the global prices of fuel, food, and other commodities, as well as the direction from which the goods are imported from. In addition to this, the database also helps in identifying the markets to which Maldives mainly exports fisheries products.

a. Development of Monthly Economic Index

Recently, MMA has commenced work on developing a monthly economic growth index in order to monitor and analyse the real developments in the various sectors of the economy at higher frequencies.



The main methodology involved in the process of computing monthly economic growth indices involve, temporal disaggregation of current QNA sectoral estimates provided by MBS into monthly sectoral output estimates which is then used in regression equations to generate a nowcast for the months for which QNA data do not exist but high-frequency data (monthly) data exists.

For example, currently the QNA estimates are available for Q2-2022, and with monthly data available for the months of July-September 2022, it is possible to generate nowcasts for these three months using the aforementioned methodology to understand the output production of the various sectors of the economy during the analysed period.

Three main models of temporal disaggregation were tested (Denton-Cholette based disaggregation, Chow-Lin regression-based disaggregation, and Litterman regression-based disaggregation) and the results of this analytical methodology indicate that for each sector of the economy, the performance of the benchmarked or temporally disaggregated indicator series in the nowcasting process differs based on the benchmarking model used in the disaggregation process and the Denton-Cholette model-based indices perform the most accurately as a whole for various sectors. Chow-Lin and Litterman models also have their advantages when the Denton-Cholette model performs weakly for example in sectors such as Fisheries sector, and Miscellaneous sector. Additionally, the results also illustrated the importance of having high quality of indicator series to benchmark the quarterly QNA output as the quality of the indicator series affects the nowcasting performance of the benchmarked high-frequency estimates.

Given this computation is one of the first frameworks focusing the nowcasting aspect in the Maldivian economic context, there exists the huge potential to expand on this project to refine and produce more accurate nowcasts for each sector. For example, future line of work can focus on refining the different sector-specific equations used in the nowcasting process by either introducing more high-frequency indicators in the benchmarking processes, or by incorporating more independent variables to capture economic linkages in the local economy, or by estimating sector-specific Vector Autoregressions (VARs) and by combining nowcasts generated from different processes to produce an average nowcast for each sector. Additionally, while this methodology of computing monthly economic growth indices focuses on first disaggregating quarterly output figures to generate monthly indices for



each sector and then using these monthly estimates in the nowcasting estimation, future studies can also explore the use of mixed frequency nowcasting models such as the Bridge models, Mixed Data Sampling (MIDAS) and Unrestricted Mixed Data Sampling (U-MIDAS) models to generate quarterly nowcasts for each sector which can then be disaggregated temporally to generate monthly estimates for each sector.

3. Challenges

MMA faces a number of constraints in the adoption of non-traditional data, including Big Data (eg: Google Trends, scanner data, electricity consumption, newspaper articles, payment systems, mobile phone data) to complement official statistics in policy analysis.

Firstly, the limited information technology (IT) infrastructure in the authority hinders the ability of MMA to house bigdata sets within the authority as well as conduct computationally demanding analysis such as the most advanced machine-learning computational exercises. With investments required in terms of infrastructure, MMA also faces challenges with regards to lack of human capital or data scientists currently employed in the authority. As part of addressing this skills gap, MMA is conducting a data professional's program, and this is expected to create more opportunities in advancing the human capital in areas of collating HFIs and usage of HFIs in policy analysis.

Additionally, with authorities and other authoritys collating new HFIs and improving their coverage, the gathering of this data for MMA's analytical use is limited due to legal and privacy issues. To meet these challenges MMA will need to build on the current legal frameworks to provide systemic assurance to data providers and data collectors.

With respect to challenges, there are also key weaknesses and data gaps in the real sector and external sector statistics that hamper the monitoring and analysis of economic activity required for policy formulation. The following lists these data weaknesses and gaps that has been identified as obstacles in the conducting of timely analysis by MMA:

a. Key Data Gaps and Weakness:



- 1) Quarterly GDP based on expenditure (C+G+I+(X-M)): Currently MBS published Quarterly GDP using the Production method and these estimates are as mentioned published with a considerable lag.
- 2) Quarterly Balance of Payments (BOP): currently there is an absence of monthly and quarterly data on services imports and exports although data on goods imports and exports are available at monthly frequency. Another challenge in computing quarterly BOP is the difficulty in compiling the Financial Account of BOP with the limited data available with regards to foreign direct investments.
- 3) Export price index or Import price index: Compiling XMPI is important in order to understand how the international commodity prices passes through into local prices.
- 4) Labour market data (wages, unemployment): Currently MBS conducts labour market surveys every 3 to 4 years to understand the developments in the labour market and the government expects to monitor more real-time developments in this market using data from job centres that are currently being operationalised in the country. In addition, the expatriate labour market data is a key area lacking reliable data, largely due to the absence of a proper monitoring mechanism (discrepancies are there in numbers reported by different authorities of the government).
- 5) Consumer Confidence Surveys: Although MMA conducts quarterly business surveys, a complementary analysis using surveys conducted among consumers can be vital information to understand how consumer sentiments and confidence changes with regards to various policies implemented by the government as well as changes in the global economy.
- 6) Residential and Property Price Index: With housing market being a key policy determinant of the government and several policies being enacted to address the housing issues in the capital city, it is important to collate data on RPPI to understand the trends and changes in housing prices following various housing projects conducted by the government.

Besides this, HFIs to monitor various elements of the production side of the economy such as daily or weekly data on electricity production, water production, distribution and consumption, retail payment systems usage, volume and frequency of card transactions, call data records, fish catch and purchase, and other such HFIs are still absent from the HF database of MMA. As such, inclusion of these HFIs into the existing database platform will greatly enhance the usability of the HFIs as well as the various analytical frameworks that can be produced using the HFIs.



4. Future Plans

With the challenges and data gaps identified, MMA has the following key future plans in order to expand the use of HF indicators in the monitoring and analysis of the economic activities to guide policy formulation.

1. Adoption of non-traditional data, and expansion of HFIs collected by MMA to complement official statistics

With the recent developments in the economic monitoring in the advanced economies as well as neighbouring countries, MMA plans to invest in the capacity to collate more HF non-traditional data and traditional data such as Google Trends, scanner data, electricity consumption, newspaper articles, payment systems, and mobile phone data. The data gathered can be housed in a dedicated database as to allow access to the HFIs from the public domain or consolidate it with the existing database platform prepared by the MMA. With these collation of HFIs, it will allow MMA to use this data to as a complimentary tool to conduct analysis in the developments in the economic activities of the country and as a guide to derive effective policies that will impact the economies at a timely manner.

2. Expand on the current analytical frameworks by implementing machine-learning models in nowcasting estimations

While the MMA currently conducts analysis at monthly frequencies and forecasting exercises at quarterly and biannual frequencies, with the innovative econometric modelling techniques currently being utilised by most central banks, MMA plans to move towards these innovative ideas. In this regard, there are plans to expand on the current forecasting frameworks by incorporating more nowcasting models into the existing analytics to understand the real-time developments in the production of the economy. This incorporation will need to be complemented with enhancement of the infrastructure capacity of the authority to utilize big datasets and conduct computationally extensive processes to produce results in a more timely and efficient manner.



In addition to these plans, there are potential experimental big data projects which can be initiated using available big data with Technical Assistance (TA) from IMF STA or SARTTAC (scanner data/web scrapping can be used to estimate CPI, nowcasting GDP including the use Google Trends and ML techniques) which MMA will hugely benefit from.

5. Conclusion

With the COVID-19 pandemic and its aftermath prompting central banks to advance their monitoring and analytical frameworks as to understand the real-time developments in the economic activities, the gathering and the use of HFIs have increased immensely among central banks. In that regard, MMA has also expanded on the authority's current data collating and dissemination platforms to collect more HFIs in order to allow policy makers to formulate strategies that are more effective and timelier. Daily, Weekly and Monthly data monitoring platforms have been established with various data being gathered at these high frequencies assisting in the current analytics and computation exercises conducted by the authority. Examples such as nowcasting models have been initiated with monthly economic growth indices being computed on a trial basis to identify the monthly developments in various sectors of the economy improving both the timeliness of analysis as well as the coverage of monitoring.

Although, the use of HFIs have significantly expanded over the past few year, challenges remain limiting the authorities capacity to build on the existing frameworks and platforms. In particular investments in the IT infrastructure of the authority is required to house and gather big datasets as utilised by various other central banks. Additionally, the limited human capital currently available curtails the quality and quantity of analytical techniques used with respect to HFIs. Legal and Confidentiality issues are also other factor inhibiting the potential use of HFIs in the analysis of the central bank.

Despite these challenges, MMA plans on using the large quantity of big datasets that are being collated domestically and externally to assist in the authorities policy formulation. Highest priority is being assigned to the collation of non-traditional and traditional big data sets by improving both the infrastructure within MMA as well as by coordinating with various data providers and collectors. By



implementing more machine-learning models and advanced artificial intelligence analytics on these data gathered, the authority also plans on improving on the current analytical frameworks such as periodic nowcasting methodologies.