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FPAS Mark II Monetary-Policy-Relevant Output Gaps

by Vahe Avagyan, Hayk Avetisyan, and Martin Galstyan*

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ABSTRACT

Blanchard and Summers, as well as many economic commentators, have been very critical of the size of the combined fiscal and monetary packages that were used to support the economy during the COVID-19 pandemic. The combination of a massive fiscal stimulus and an excessive monetary policy expansion resulted in excess demand pressures, which in turn, led to higher inflation. Inflation was also exacerbated by bottlenecks and bad luck, in the form of stagflationary shocks such as the Russia-Ukraine conflict and zero-Covid policies in China. We argue that both monetary and fiscal policy would have benefitted by having access to sensible real-time measures of the output gap and the natural rate of unemployment, recognizing that the significant part of the output contraction was due to the fall in potential of the economy during the pandemic. The methodology we employ in this paper involves a combination of models and judgment, the latter of which is imposed on the models after studying various sources of information about the supply-side implications of shocks like Covid for the labor market as well as the market for goods and services. Frameworks designed to develop real-time measures of potential output are also necessary for both macroprudential and fiscal policies. We also clearly distinguish between the concepts of output gaps, which are relevant for monetary policy and financial stability, and provide a methodology how could longer-term trends inform monetary-policy-relevant output gaps.

ACKNOWLEDGMENTS

We would like to thank the leadership and Board of the Central Bank of Armenia for their leadership and support in exploring new possibilities for monetary policymaking. Additional thanks to CBA Deputy Governor Nerses Yeritsyan for his long-standing innovative thinking in pushing the Board and the staff to move away from a baseline-focused approach. The development of the proposals made in this paper has immensely benefited from their contributions and critical thinking. We thank John Taylor, Michael Bordo, and Mickey Levy for providing comments on these proposals at Better Policy Project seminars. We also thank David Archer, Archil Mestvirishvili, Shalva Mkhatrishvili, and Lawrence Schembri for their encouragement and continued insights provided at these seminars. See www.thebetterpolicyproject.org for a list of acknowledgements of people that were critical in the development of published endogenous policy baseline projections—the current gold standard for monetary policymaking that we wish to modify in order to take better account of uncertainty—at the Bank of Canada, the Reserve Bank of New Zealand, and the Czech National Bank, as well as several central banks that represented the second generation of FPAS Mark I.

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I. INTRODUCTION

Laxton and others (2019) clearly lay out the differences between the concept of potential output that is relevant for monetary policy and the concept of trend or sustainable output that is relevant for financial stability analysis. This paper updates their results within the context of the COVID-19 pandemic and the associated evolving outlooks for the US economy. It focuses on the monetary-policy-relevant output gap, while the financial-cycle gap is covered in a sister paper.[2] The distinction is highly relevant for policymaking and is closely related to the "leaning against the wind" (LAW) debate; a deeper discussion about the debate can be found in Laxton and others (2019).

This paper continues a series of research papers that are meant to build upon the analytical ecosystem of the Forecasting and Policy Analysis System (FPAS) Mark II framework, an analytical framework for a new age of central bank policy and communication that is prepared to deal with heightened uncertainty during a period like the COVID pandemic. The highly expansionary fiscal and monetary policies during the pandemic were critiqued by many at the time, including Olivier Blanchard and Lawrence Summers, who referred to this as the "worst economic policy of the past 40 years."[3] The primary concern articulated by Blanchard, Summers, and others was the failure to recognize that the massive fiscal stimulus and the resulting aggregate demand was already pushing up against aggregate supply translating into higher inflation. In addition, the "bad luck" shocks including the Russia-Ukraine conflict and China's "zero-covid" response to further waves of the virus, have led to the emergence of stagflationary risks that represent a major concern—and source of uncertainty—for policymakers, perhaps unlike anything seen in the West since the Great Inflation of the 1970s.

Why did the major central banks miss this inflationary wave so badly? One of the reasons was that the central banks of advanced countries treated their credibility as given, and therefore saw little risks of deanchoring inflation expectations as a result of overheating economies.[4] In this paper, we argue that perhaps another reason of overstimulation was the failure to recognize that a significant part of the negative growth observed during the pandemic was due to supply bottlenecks rather than deficient demand. In other words, the absolute size of the monetary-policy-relevant output gap was vastly overestimated signaling a need for a large stimulus.

There is no doubt that the pandemic rendered any real-time measure of unobservables, such as potential output, highly uncertain. This is why we advocate for frameworks like FPAS Mark II that can provide a comprehensive and systematic approach for managing this risk and uncertainty. This paper specifically focuses on a consistent way of incorporating judgment in a real time in the system of models, which is informed by a wide array available and relevant information. Indeed, no model can incorporate all the relevant features of the economy, and, of course, episodes such as the pandemic make this even more obvious. But, this does not mean that policy makers cannot inform their real-time measures of policy-relevant latent variables with sensible and relevant information outside their existing models. In fact, we argue that this is their direct responsibility. Both monetary and fiscal policy during this period would have benefitted immensely from sensible measures of the output gap that made adjustments for the supply-side implications of COVID-19-related shocks.

In particular, a major cause for concern is how many economists and policymakers conceive of measuring the output gap: as something that can simply be measured for today, without thinking

[2] See Avagyan and others (2022b).
[3] See Williams (2021).
[4] See Kostanyan and others (2022b, c).

critically about long-term projections and how this fits into a broader system for thinking about what is happening in the economy. This paper is devoted to the modeling of monetary-policy-relevant output gaps as one piece of a larger system, and places emphasis on measures of output and potential not just today, but in terms of their broader trends from the point of view of financial stability and sustainability.

Further, just as we note that there are follies in near-term baselines, we emphasize that there is even more folly in longer-term projections of maximum sustainable output. Understanding errors in how output has been calculated—and the implications of this—are particularly essential in the context of thinking about sustainable fiscal policy and rising government debt, where good policy relies on realistic and honest assessments of the sustainable tax base. If governments turn out to not be creditworthy, and if the financial system is built on the idea that government debt is risk-free, then the implications of either (or both) of these ideas proving to be false can be incredibly problematic. In other words, fiscal crises could turn into financial crises. What is important, therefore, is having the right analytical tools to explore the implications of uncertainty and potential—not just today, but in projections of potential several years into the future.

A good example of the consequences of such mistakes is Ireland during and post-GFC. In Ireland, both government and the private sector had assumed that the pre-GFC high levels of output were sustainable. However, this proved to be a flawed assumption that was one of the seeds for the financial crisis in Ireland. Both the government and banks had issued large amounts of debt at very low interest rates, but when the assumed levels of output proved to be unsustainable, this translated into a period of extreme difficulty for financial markets and the public in particular, as fiscal policy needed to be adjusted to the new reality of lower potential and sustainable tax revenues.

This paper provides updates of a parent paper for the United States and pulls together analysis by the Global Forecasting School (GFS) during the COVID-19 pandemic. The paper illustrates the treatment of different unobservable variables such as the NAIRU and potential GDP in "real time," particularly during periods of high uncertainty and volatility. In such an environment, where estimates come under political scrutiny, it can be natural to fall into a trap of treating it as "business as usual." However, given these constraints, it should not impede us from doing such analysis and testing different judgments based on some simple economic logic. The paper provides a practical example for how an institution such as a central bank can implement judgment in service of communicating in a macroeconomic consistent manner the demand-side and the supply-side implications of COVID-related shocks (lockdowns, social distancing, uncertainty, and macroeconomic policy responses, etc.).

We distinguish the terms "trend output" used for the Financial Cycle Model (FCMOD) and the concept of potential output developed with the Monetary Policy Model (MPMOD), which is based on the notion of imbalances between aggregate demand and supply in the goods market. The monetary-policy output gap is constructed from MPMOD that includes: a Phillips curve; a dynamic Okun's law equation; a monetary policy reaction function; a term-structure equation; and an equation that links the economywide output gap to measures of capacity utilization in the manufacturing sector. The exact model specification is based on a simplified version of a model presented in Alichi and others (2018). Using standard techniques for combining forecasts, this paper shows how to condition medium-term projections of actual and potential output on measures of trend output that can account for the financial cycle.

The remainder of the paper is organized in the following way. Section II summarizes MPMOD and the estimates developed in Alichi and others (2018). Section III updates the estimates for the output gap

and potential output taking into consideration the historic shock of COVID-19 and how to treat it in this type of modeling framework. Section IV incorporates the results from FCMOD as an assumption for medium-term projections in MPMOD and presents an example of an illustrative scenario for the post-COVID economy. Section V provides some concluding remarks.

II. MEASURING THE OUTPUT GAP AND POTENTIAL OUTPUT FROM MPMOD

MPMOD is based on Alichi and others (2018), which describes the model and estimation results in detail. The model is an extension of the simple multivariate filter presented in Alichi and others (2015). The basic idea behind the multivariate filter approach is to inform estimates of latent variables, such as the output gap, with theoretical relationships linking unobservable with observable variables. This is in sharp contrast to extracting measures of latent variables from purely statistical filters. The model is a tool for doing comprehensive analysis, not an all-encompassing end-all.

The original model included a Phillips curve, a dynamic Okun's law equation linking the unemployment gap to the output gap, and an equation that linked the output gap to the Fed's measure of capacity utilization in the manufacturing sector. The stochastic process for GDP included a persistent cyclical component as well as two shocks that could permanently change the level of potential output. The first shock to potential output accounts for simple level shifts, while the second shock can account for episodes when the growth rate of potential output deviates persistently from its long-term growth rate.

The COVID-19 shock represented a novel type of economic and public health crisis that was unprecedented historically. When thinking about unobservable variables like the NAIRU or potential output in the context of Covid, historical precedents are very difficult to come by, and there is an exceptional need for economists to make critical judgments when thinking about these variables as the crisis is unfolding. To factor in the effects of COVID, we have adjusted the first shock of the model—the level shock—so that the upward adjustments to the NAIRU are mirrored in downward adjustments to potential.[5] This is encapsulated by the notion that the decline in potential output was clearly reflected in large part to the lockdown policies that prevented people from working and in countries like the US, these people were correctly counted as unemployed. In other words, a meaningful share of the increase in unemployment in the first lock-down phase of COVID-19 in 2020 reflected an increase in the natural rate of unemployment. Allowing for some excess supply in the labor and goods market in this initial phase is consistent with the notion that aggregate demand fell by more than aggregate supply in the goods market, which is consistent with the basic idea that Covid-associated increases in uncertainty would trigger increases in precautionary savings and negative confidence effects on investment. The Covid shock also impacted aggregate demand, given that the consumption bundle was severely constrained and resulted in some additional savings for certain items in the basket (e.g. things like international travel) that could be consumed after the public health crisis had dissipated and the economy had recovered. These adjustments also reflect the work we have done looking at "real-time" retail and recreation activity from the Google mobility data. It is therefore plausible that a modeler could adjust such estimates in a relatively short time span following the onset of the pandemic. Although such adjustments are done with a wide degree of judgment, undertaking such analysis is necessary in times where historical precedents are virtually nonexistent, and not doing so risks underestimating the inflationary consequences of the pandemic.

[5] Fernald and Li (2021), in "The Impact of COVID on Potential Output," provide a good example of employing judgment in thinking about short-run reductions in potential output during the "extraordinary and unprecedented" crisis, and Fernald and Li (2022) also argue that the reductions in potential output represent a level shock.

Finally, the model has been extended to include a monetary policy reaction function and a model for 10-year bond yields. This allows us to estimate and project both the short-term equilibrium real interest rate, the 10-year term premium and 10-year bond yields.

The model is estimated with annual data covering the period from 1980 to 2021. The list of standard macro variables used in the model includes real GDP, the unemployment rate, CPI inflation, the Fed's survey of capacity utilization, as well as 1-year and 10-year government bond yields. We use long-term CPI forecasts from the Congressional Budget Office (CBO) as a measure of the perceived long-term inflation target. In addition, to avoid the uncertainty in the estimates at the beginning of the sample, we take the CBO's estimate of the NAIRU to be 6.2% in 1980. Unlike Alichi and others (2018), which used a regularized maximum-likelihood procedure to impose priors in the estimation procedure, we present results based on calibrated versions of the model. Conditional on these parameters, we use the Kalman filter to compute the most likely evolution of all the latent variables in the system.

III. HISTORICAL NARRATIVE AND THE COVID-19 PANDEMIC

To simplify the historical narrative, it is useful to divide the sample into four time periods. The first period (1980-1995) is characterized by disinflation and the process of anchoring long-term inflation expectations to around 2 percent. The second period (1996-2007) is characterized by anchored long-term inflation expectations and a large reduction in the variability of the output gap and inflation. The third period (2008-2018) includes the GFC and a prolonged period of economic slack, where conventional and unconventional policies are deployed very aggressively to support the economy and prevent long-term inflation expectations from ratcheting downwards. These periods are covered in more detail in the parent paper.

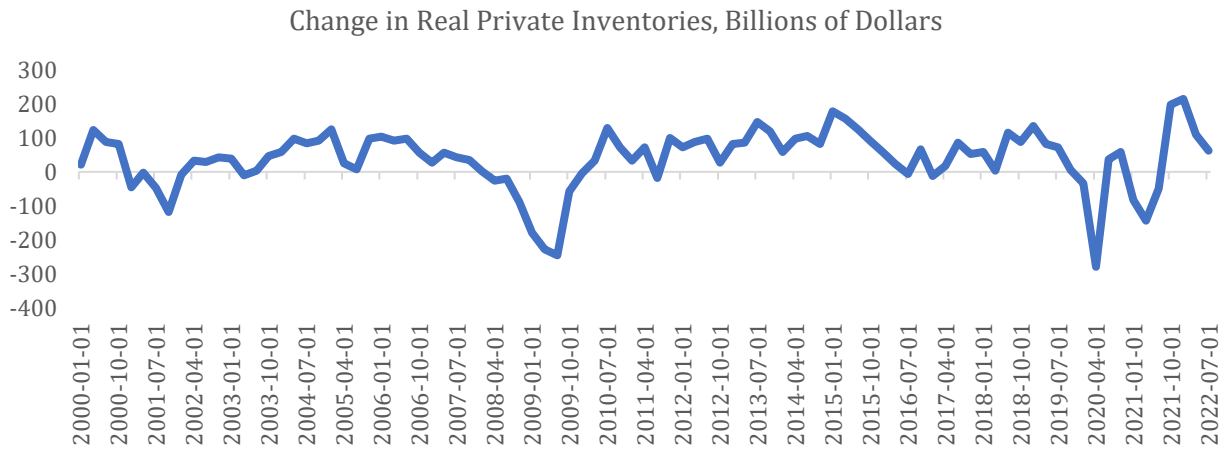
The final period is about the COVID-19 pandemic and its associated shocks which were many and far reaching. The economic consequences of the pandemic can be summarized in several phases with distinct features. The initial period can be described as the lockdown phase. Large portions of the economy (manufacturing, services) were shut down as stay-at-home policies were enforced. The uncertainty around the economic impact around such policies were enormous at the time. No one really knew how deep or how long the pandemic would last and the policies surrounding it would be needed to slow the pace of the virus and the ultimate impact on the economy. This uncertainty is best exemplified by the stock market reaction in the US before any real hard data had come out other than information from China about the measures that were being used to contain the virus and what implications similar lock-down measures might have for the global economy. Beginning in mid-February to mid-March of 2020, the S&P 500 declined by over 30% . As pointed out by Steven J. Davis, the stock market volatility during that period rivals periods such as the Great Depression and the much shorter-lived 1987 stock market crash.[6] Everyone, especially policymakers, were rightly deeply concerned, and underreacting would have risked a complete meltdown of the financial system and collapse of the global economy.

The following sequence as lockdown policies took hold included a substantial rise in unemployment, in particular, as the manufacturing and service sectors shut and locked down. Fiscal and monetary policymakers almost in lockstep responded extraordinarily to provide the necessary stimulus to keep the economy afloat. As the lockdown took hold and the virus continued to feed through the population, social distancing became ubiquitous. Households were being compensated for stay-at-home policies and began spending again, although quite modestly, as there still remained enormous uncertainty about the economic outlook and when the jobs outlook would recover, leading to a period of high precautionary saving. However, ongoing restrictions in service-oriented industries meant that that there were numerous incentives for consumers to shift their demand towards goods instead. This put additional pressure on supply in the goods market and was an important factor that led to widespread shortages, e.g. in semiconductors (Figure 1).

The second phase of the pandemic involved a reopening phase, which happened in multiple stages after the initial steps to reopen were met with new flareups in COVID incidences, which then typically led to another round of social distancing measures. These periods were inherently stagflationary, as demand was encouraged to recover strongly but would periodically run into supply constraints in various sectors. Importantly, these bullwhip effects played a major role over the course of the pandemic, as exemplified by a period of extreme volatility in inventories.

[6] Refer to Davis (2020).

Figure 1: Increased Volatility in Private Inventories



Source: FRED

The current period and hopefully the final stage, where the direct COVID situation has normalized and the economy begins to normalize as well but likely needing to still grapple with some of the lingering effects including the bullwhip effect from the supply-side and the exit from the extraordinary monetary and fiscal policy response which may still be playing a part on the demand-side. These factors and their associated analysis will be critical for developing scenarios that imply alternative paths for policy which forms the core of the FPAS Mark II analytical structure.

The initial interpretation as described was broadly understood at the time in terms of the shock to be affecting both demand and supply, as implied by Janet Yellen in April 2020 during a Q&A.[7] When demand was putting downward pressure on prices, Yellen understood well what was lurking on the horizon in terms of supply:

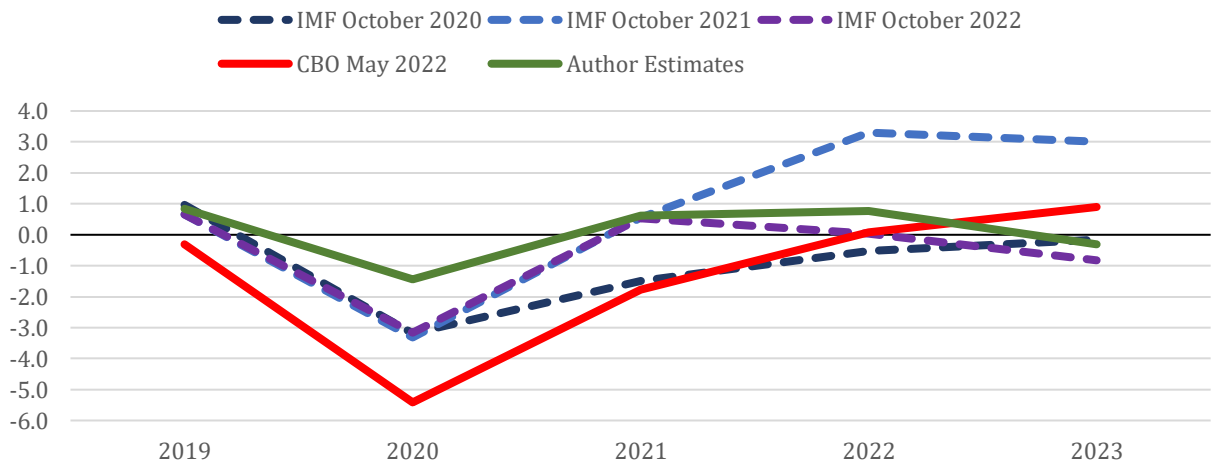
> *"Inflation could be low for a long time, but it also could rise as we climb out of this abyss and unleash a lot of pent-up demand into an economy in which the capacity to supply goods and services has been hurt."*

There was clear downside pressure on prices in the early months of the pandemic which only recovered following the enormous policy response, leading to the general perspective that at the onset of the pandemic, despite aggregate supply falling, aggregate demand had fallen by a larger magnitude. This analysis is broadly consistent with the views of Fernald and Li (2021, 2022), who argue that there are likely to be lasting effects on the level of potential, rather than on the underlying long-term growth rate of potential. While Fernald and Li argue that there were important short-run effects of the lockdowns on the NAIRU and potential, they make no explicit effort to quantify such factors. Despite our understanding of the nature of the shock at the time, this was not explicitly implemented within the modeling framework of various institutions, and largely remained a qualitative exercise. This was also true of other institutions like the OECD and the European Commission, which stated explicitly that they were not making these types of adjustments. Obviously, for seasoned FIT central banks such as the Reserve Bank of New Zealand, where the concept of potential plays a very important role in both monetary policy deliberations and communications,

[7] See Wessel (2020).

there is no way to avoid making judgments about these variables. For many institutions, revisiting the methodology for creating such estimates would have required much larger doses of judgment or adjustments to potential GDP (and the NAIRU) that would have meaningfully lowered the magnitudes of the output gap in 2020 (less excess supply). For instance, the CBO discontinued its estimates for the NAIRU that considered important short-term factors that could temporarily shift the NAIRU, as was the case during the Global Financial Crisis.[8] Part of the reason for not making downward adjustments to potential, even when they are temporary, is likely due to a combination of bureaucratic and political factors. In central banks that are seasoned flexible-inflation-targeting ("FIT") FPAS central banks, such as the Reserve Bank of New Zealand, the high degree of political independence helps incentivize the central bank to make the necessary changes. In addition, there may be an inherent bias in bureaucratic institutions to place the burden of proof on defending a very specific scenario. These types of issues will become more apparent when there is uncertainty that requires judgements that are consistent with accepted narratives such as the one presented by Janet Yellen and many others. This is yet again another folly of baseline scenarios and local approximations. Unfortunately, there is no way for policymakers to avoid this issue, particularly in times of great volatility and uncertainty. Such analysis and estimates for the short-term effects on the NAIRU would have been even more relevant during the pandemic era for thinking about the inflationary consequences of the pandemic following the policy response, which helped buttress demand while the supply side remained constrained. This can be observed by the estimates for the output gap for most countries by various institutions (Figure 2).

Figure 2: United States Output Gap Estimates during COVID



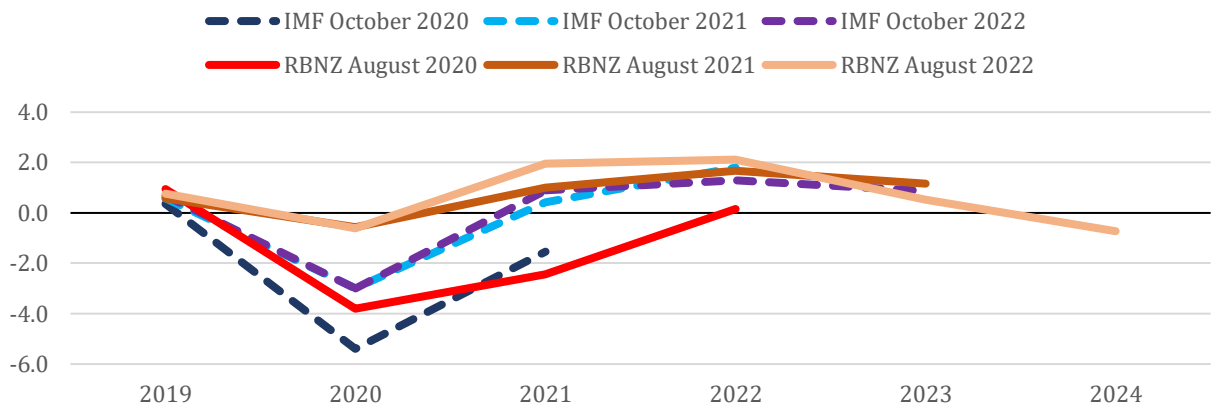
Source: IMF WEO, CBO, Author Estimates

For the US, we evaluate the treatment of the output gap by the IMF and the CBO. The former appears to attribute some of the shock to demand, and some to supply. In 2020, the IMF expected that excess supply would prevail over the following years, but made a major adjustment in 2021 in estimating a large positive output gap forming in the same year. Eventually, in the latest WEO estimates from October 2022, the IMF has put forth a more moderate view with a slight positive output gap over the same period, which will turn into economic slack in 2023. Meanwhile, the CBO appears to have made little adjustment to factor in the COVID-related supply-side shock, explaining the events of 2020

[8] Refer to https://fred.stlouisfed.org/series/NROUST.

almost entirely as a demand shock. In contrast to our approach to estimating the output gap, the CBO uses a more disaggregated, old-style production function approach for the following five sectors of the U.S. economy: nonfarm business; households and nonprofit institutions; government; farm; and the housing sector. This bottom-up approach includes detailed economic insights about the economy and, therefore, provides a credible methodology and a useful benchmark for measuring potential output. We also explore the case of New Zealand, given its storied history as an independent, seasoned FIT central bank and its experience with a dual mandate (Figure 3).

Figure 3: New Zealand Output Gap Estimates during COVID



Source: IMF WEO, RBNZ

For New Zealand, the contrast between the evolution of analysis from different organizations is more apparent. Early estimates by the IMF and the RBNZ both had excess supply prevailing during the pandemic period. Both softened this approach in successive forecasts, but the RBNZ adjusted for supply-side factors substantially more than the IMF, with a sizable positive output gap forming in 2021 and persisting into 2022, contributing to demand-side pressure on prices.

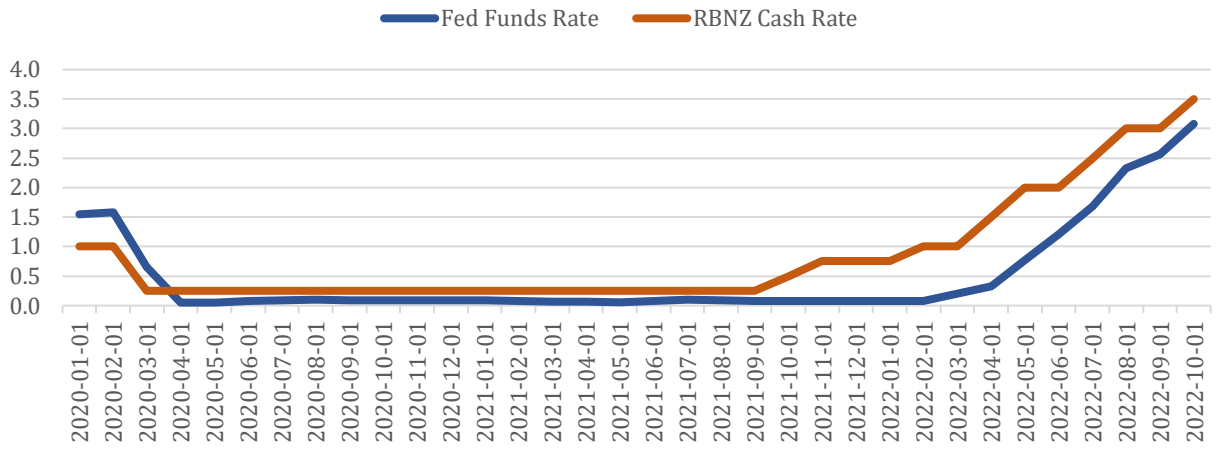
Similar to the RBNZ, the FPAS Central Bank of Armenia also demonstrated agility in adjusting potential meaningfully downward during this period. The justification for this downward adjustment, as communicated in its Monetary Policy Report, was partly related to the pandemic-related factors that were applicable for most countries globally (as described above). More importantly, this adjustment also reflected country-specific factors, including the increase in uncertainty in the wake of the 2020 Nagorno-Karabakh War, which was expected to lead to things like reductions in the planning horizon, increases in country risk premium, less investment, and non-optimal allocation of goods, all of which would be expected to lead to a decrease in productivity. In addition to this conceptual understanding, these results were also supported and communicated with the help of an analytical satellite model that aided in demonstrating the impacts of this heightened uncertainty.[9]

Although we do not have real-time estimates for the output gap from the Fed directly (considering that the Tealbook is published with a 5-year delay), an analytical note authored by Scott Wolla[10] in

[9] Refer to the Q1 2021 Monetary Policy Report of the Central Bank of Armenia. https://www.cba.am/Storage/EN/publications/DVQ/Inflation%20report-I-2021.pdf.
[10] Refer to Wolla (2021).

2021 may shed some light on the institutional conception of the output gap during this period, which essentially mirrors the CBO's view. If this is the case, then this could help explain why the RBNZ was several months early in raising interest rates from the ELB. The CBO's implied perspective—that potential GDP or the NAIRU are slow-moving trend variables and cannot dramatically change given rapid changes in economic conditions (e.g. during COVID or the GFC)—can impart significant bias into the analysis that disregards the core concepts of those two unobserved variables, most importantly in the context of the role these variables play in informing good policymaking decisions. The contrasting case of the RBNZ and the Fed highlights precisely why it is so critical to not only have correct estimates of the NAIRU and output gap, but more importantly, to be willing to make adjustments to the estimates in times of volatility and uncertainty, where good policy is dependent on assessments of where the economy is and what the underlying forces are. The CBO's (and the Fed's implied) absence of adjustments to these estimates may have misled them to believe that the amount of economic slack was much larger than it actually was, and therefore, necessitated a massive expansion in monetary policy in order to close the gap. This failure to adjust these estimates also could have led to an underestimation of the inflationary implications of the monetary expansions, the consequences of which we clearly see playing out today.

Figure 4: Monetary Policy Comparison, the Fed vs. the RBNZ



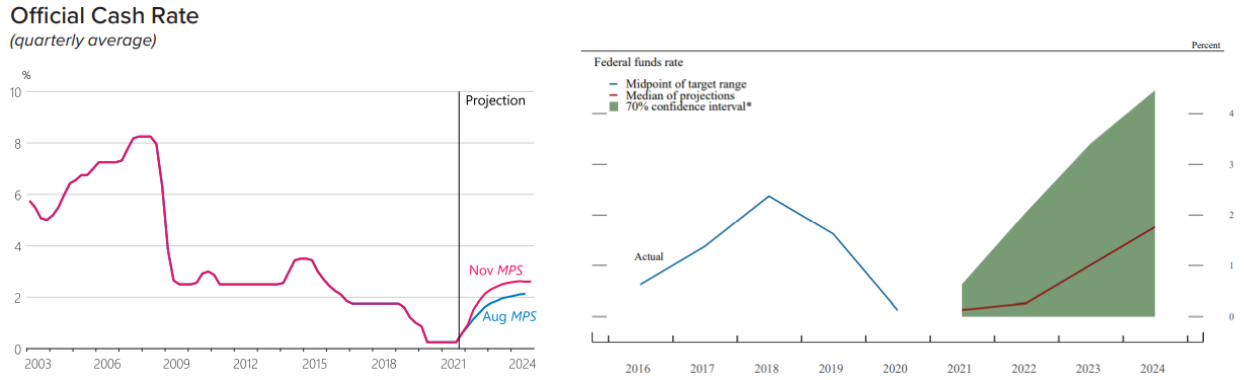
Source: Fed, RBNZ

Although the RBNZ was not aggressive in the pace of its tightening, by lifting rates away from the ELB, it signaled to markets that the era of easy monetary policy was coming to an end. Importantly, as a well-seasoned FIT FPAS Mark I central bank, the RBNZ transparently communicated this new reality in its Monetary Policy Statement before it even began raising interest rates.[11] This occurred as early as the Summer of 2021, when debates about whether inflation was persistent or transitory were raging, and many advanced-economy central banks (including the Fed) were "behind the curve" in continuing to believe that inflation was transitory and failing to appreciate how much aggregate demand was pushing up against aggregate supply—and therefore monetary policy could continue to

[11] For a discussion of the role of transparent communications in effective policymaking, particularly in times of uncertainty, see the work of Kostanyan and others (2022a). The CBT-IT index they develop highlights the best practices of FPAS Mark I central banks, and underscores the vital role this plays in incentivizing central banks to "do the right thing" and make good policy—including a commitment to an essential principle of monetary policy: raising interest rates sufficiently aggressively to meet the policy objective.

remain loose, against the better judgment of people like Blanchard and Summers. Figure 5 illustrates how future policy was being considered where one-year ahead rates were exceeding 2% in New Zealand, while the Fed was still communicating rates near the ELB (Figure 5).

Figure 5: Forward Guidance Comparison, the Fed vs. the RBNZ



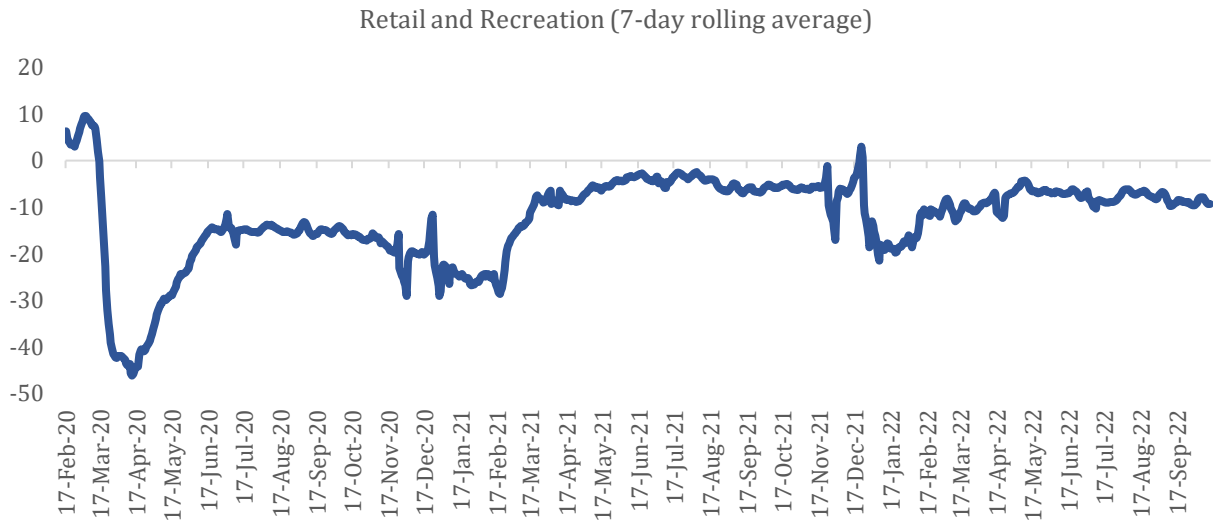
Source: RBNZ. Monetary Policy Statement. November 2021, Fed. Summary of Economic Projections. September 2021

Our initial adjustment to potential GDP in 2020 reflects a similar stance to the RBNZ in the context of the US economy, but of course, the precision is open to deeper analysis. The primary contribution of this analysis is to develop motivating real-time indicators and analysis that allow us to make an extraordinary adjustment to a variable that most consider a "long-term" trend, and which the conventional wisdom suggests requires overwhelming evidence in order to change it. Although this perspective may serve some periods well (particularly in periods of stability), extraordinary times tend to require extraordinary treatments of certain variables, especially latent variables. In fact, the essence of good policy lies at least partly in how well it manages times of extreme uncertainty and risk, and prevents slides toward Blanchard's "dark corners," where the greatest macroeconomic threats, including stagflation, lurk. A hands-off approach that resists making real-time adjustments to these variables—even in the face of overwhelming empirical evidence and logical, qualitative judgment—can impede good policymaking, and contribute to policy inertia that leads to slides toward dark corners.

Our analysis to adjust potential GDP, and correspondingly the NAIRU, in near real-time in successive period in 2021, relies on Google Mobility data as a proxy for thinking about the dynamics of the shock, although such analysis again comes with significant uncertainty. Retail and recreation saw the baseline foot traffic at these locations decline by around 18% in 2020 and recovered to a still negative 9% in 2021. The negative shock to potential GDP that we apply in 2020 recovers by about 50% in 2021 in line with the dynamics of the Google mobility data.[12] Of course, we emphasize that the data cannot be the sole basis for making adjustments to these variables. Rather, the role of good judgment—of thinking critically about where the economy is today and what the underlying forces are that are driving the economy, piecing this together through critical thinking and narratives that are the hallmark of good economics—is critical to this process. We explicitly articulate this judgment in the preceding paragraphs. This judgment, combined with data including what is shown in Figure 6, provide a clearly communicable rationale for adjusting these variables.

[12] Another perspective for evaluating this data could include looking at the Beveridge Curve, referring to the ideas presented in Alichi and others (2019).

Figure 6: Google Mobility Data Illustrating the Response of Social Distancing, % Change



Source: Google

IV. APPLYING THIS FRAMEWORK

Within the FPAS Mark II policymaking framework, we develop an example of an illustrative "soft landing" scenario that represents one interpretation of the above considerations. However, we emphasize that this is not a baseline projection, but rather, an illustrative scenario that is one of several possible interpretations and estimates. In presenting this example, we underscore that we have also considered a range of plausible estimates that were higher or lower than what is presented in Box 1 below, as well as, importantly, what impact these interpretations would have on understanding the short-run macroeconomic dynamics and their medium-term implications for a fairly comprehensive set of observable macroeconomic variables such as real GDP, unemployment, capacity utilization, and inflation as well as short-term and long-term interest rates. In terms of the range of plausible estimates that we at the Global Forecasting School considered, we evaluated variation of +/- 1 percentage points in our NAIRU estimates as well as their short-run and medium-term implications.

We emphasize that getting this judgment right is critical for making good policy. The clearest illustration is the early stages of Covid, where an unwillingness to adjust estimates of the output gap led to an overestimation of its magnitude, which pushed monetary policymakers to enact immensely expansionary policies in order to close the gap. Moreover, failing to adjust the output gap estimates in these times led policymakers to underestimate the inflationary implications of their expansionary policies. It is important to understand that the role of such analysis is to assist policymakers in thinking critically about the three most important questions: where is the economy now; what are the underlying forces driving the economy; and how do policy instruments need to be adjusted to reach policy objectives? This is essential for adopting a risk-management approach to policymaking that helps avoid slides into "dark corners" and helps prevent tail risks from materializing. Researchers within the FPAS Mark II network, including at the Central Bank of Colombia, have been working on expanding the methodologies we use to measure potential output by allowing for shocks that can have much larger effects than the types of shocks that are typically responsible for historical normal variation in potential.[13]

Box 1 provides a graphical illustration of the key outputs of the MPMOD analytical framework, and table 1 provides a succinct overview of two key variables in the MPMOD analysis, as compared to CBO estimates: the output gap, and the NAIRU.

Table 1. CBO and MPMOD Estimates of Output Gap and NAIRU

	CBO			MPMOD		
	2019	2020	2021	2019	2020	2021
Output Gap	0.4	-4.9	-0.5	0.3	-1.9	-0.3
NAIRU	4.5	4.5	4.5	4.6	6.9	5.5

Source: Congressional Budget Office; Author calculations

The MPMOD estimates of the output gap in 2020 are significantly less than in the CBO estimates. Whereas we estimate an output gap of -1.9, the implied CBO output gap is -4.9, which is a significantly

[13] See De Castro-Valderrama and others (2021). Nicolás Moreno-Arias, one of the authors, presented this work and these ideas at a Better Policy Project seminar on March 30, 2022.

larger gap. This, of course, reflects the CBO not adjusting its estimates of potential output in the face of COVID-19. Because they do not model in this downward level shift in potential output, the CBO results would imply to policymakers and anyone reading the results "with a blind eye" and in real-time in 2020 that there is an immediate and pressing need to close the gap. However, had the estimates of potential been adjusted downward to reflect the level shift that the pandemic caused, as is the case with MPMOD, then policymakers might have understood that the aggressive monetary expansion that they undertook to close this gap was not necessitated. A similar story emerges with NAIRU, where the CBO estimates once again fail to acknowledge that the natural rate would have shifted upward in 2020 in response to the massive shocks created by the COVID-19 pandemic and the resulting lockdowns and social distancing requirements. While the impacts of these measures would be expected to dissipate over time, it would be unreasonable to assume that they would disappear entirely post-COVID, as some of the changes in labor market participants' attitudes and preferences would be expected to remain well into the future. The MPMOD estimates reflect precisely this judgment, rising significantly during COVID to 6.9 but then leveling out in the 5.0-5.5 percent range, whereas the CBO estimates remain unchanged and constant at 4.4-4.5 percent. This illustrates precisely why good estimates of these variables that are updated in real time are essential for policymakers to be able to make the right decisions.

We additionally note that the forecast largely reflects the current market expectations, where US economic growth begins moderating in 2023, supply-side disinflation rules the day, and upward demand pressures are not so persistent, meaning that a terminal Fed funds rate of about 5 percent is sufficiently restrictive to rein in inflation without a deep recession. This is what is meant by a "soft landing" scenario. To condition the estimates on a plausible near-term forecast, it is assumed that in 2022 there is a modest degree of excess demand (0.8%) in the goods market informed by our broad interpretation of the shocks to the NAIRU during the COVID pandemic.

Future publications by the Global Forecasting School will continue to draw upon and expand this modeling framework to construct a number of other scenarios that incorporate different plausible underlying assumptions about where the economy is situated that would necessitate a tighter as well as looser policy stance than what is currently priced in financial markets. For example, the next releases of "Not the Teal Book" will include a further elaboration of estimates of potential and the NAIRU.[14] "Not the Teal Book" is the Global Forecasting School's simulation of a state-of-the-art macroeconomic analysis and streamlined monetary policy note with limited resources, applied to the case of the United States. It serves as a testing ground for applications of the FPAS Mark II framework—including real-world applications of some of the ideas explored in this and other recent working papers of the Global Forecasting School of the Central Bank of Armenia. represents a simple and accessible working application of the FPAS Mark II framework that incorporates uncertainty, nonlinearities, and Alan Greenspan's 2004 formulation of "monetary policy as a risk management exercise."

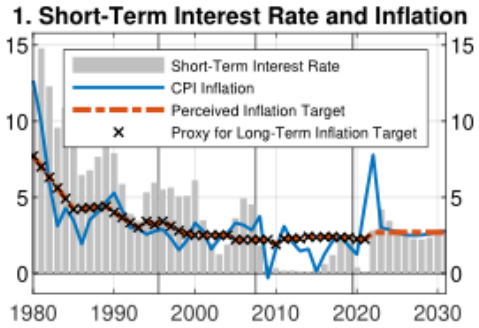
In addition to the above, Box 1 also provides a complete historical analysis and narrative, which allows the reader to contextualize the key points of the paper in the context of the broader macroeconomic narrative of the past four decades. The charts begin in the 1980s with the Volcker disinflation, where there were recessionary costs to bringing down inflation, and several years were required for inflation to come back down and for long-term inflation expectations to decline. Only in the 1990s do we finally see long-term inflation expectations in the bond market suggest that expectations were becoming anchored at the long end. Medium-term inflation expectations were adjusting less to shocks, as evidence that wage and price setters' behavior was changing. Amidst all

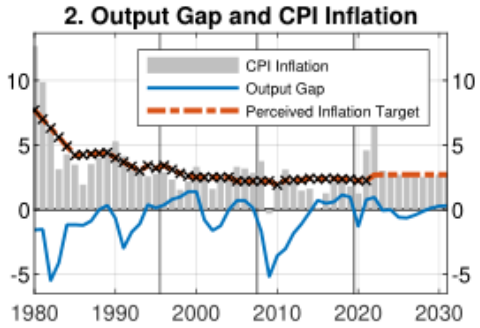
[14] See Papikyan and others (2022b, 2023a-h).

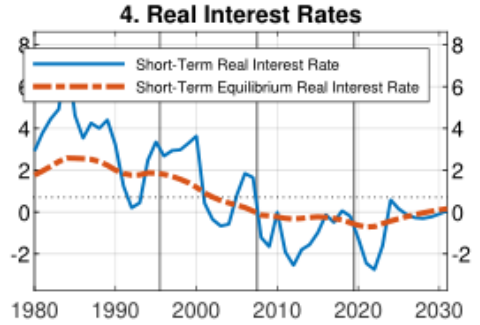
this, important processes were emerging, including globalization and China's massive boom and ascension to the World Trade Organization, which acted as a sequence of positive supply shocks. In addition, despite the fact that there was a large financial cycle at play, the United States did not experience much inflationary pressure, because there were good skill mixes in the labor market. For example, the inflationary implications of the massive boom in the US housing market were contained because of access to labor from emerging markets in Latin America and cheap goods from China and elsewhere. In some sense, this sowed the seeds of the Global Financial Crisis, as policymaking institutions were unsuccessful at both warning about the GFC and providing sensible solutions. In this comprehensive macroeconomic story, where inflation is tamed and then it takes years to re-anchor long-term inflation expectations to target levels, the term premium on 10-year bonds declined massively from the extremely high levels of the late 1970s/early 1980s. The estimates of the term premium are particularly interesting, because they embody a model-based view of the monetary policy transmission mechanism, where expected short-term interest rates in the long-run converge to the neutral rate. The model also provides time-varying interpretations of the equilibrium real short-term interest rate. All these variables are depicted graphically in the box, allowing economic historians and econometricians to assess the empirical plausibility of the estimates, as well as to evaluate how they compare to model-based projections in the future. In fact, one very important use of the analytical framework is to assess the role of judgment that is added onto pure model-based scenarios. The graphical presentations of these stories can be very useful for helping people understand if the estimates are broadly consistent with the empirics of US trends and business cycles.

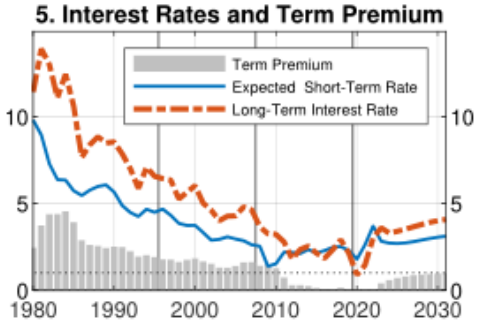
Box 1: MPMOD Detailed Results: Illustrative "Smooth Landing" Scenario

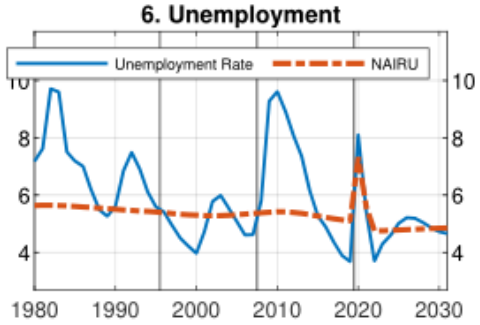
1980-1995 – Period 1. Anchoring Long-Term Inflation Expectations
1996-2007 – Period 2. The Great Moderation
2008-2019 – Period 3. The Global Financial Crisis and Fighting Economic Slack
2020-2021 – Period 4. The COVID pandemic
2022-2031 – Outlook

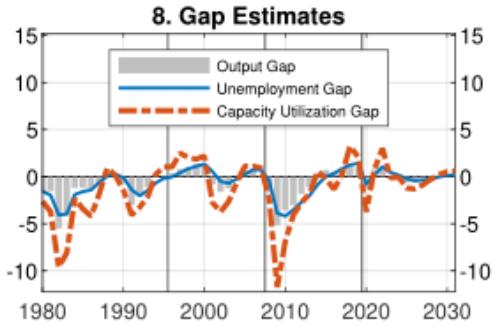












V. CONCLUSION

This paper provides an update of the MPMOD approach covering the COVID pandemic period and a 10-year outlook to 2031. The key insight of this paper concerns how to incorporate analysis during a highly volatile period where latent variables such as potential GDP and the NAIRU are likely jumping around based on the extreme conditions presented by the pandemic and its associated policies connected to lockdowns and social distancing. In such scenarios, institutions tend to be reticent of "aggressively" changing these "trendy" variables, even though their qualitative statements and narratives about where the economy is today and what the underlying forces are indicate that, by all measures, these variables do need to be adjusted fairly aggressively. The RBNZ exemplifies an institution not afraid to make such adjustments in service of their dual mandate of inflation and maximum sustainable employment, which implicitly requires attentive care to thinking about latent variables such as the NAIRU and potential output on a regular basis. The advantage of MPMOD is that it uses a structured economic framework that includes information about the labor market, capacity utilization and economic relationships such as the Phillips Curve and Okun's Law, and importantly allows for short-term judgment of latent variables and provides a path for policy based on those judgmental implications. This paper should serve as a practical example for central banks and fiscal authorities on how to use this framework in a volatile period connected with COVID-related shocks and its implication on managing the short-run output inflation tradeoff.

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