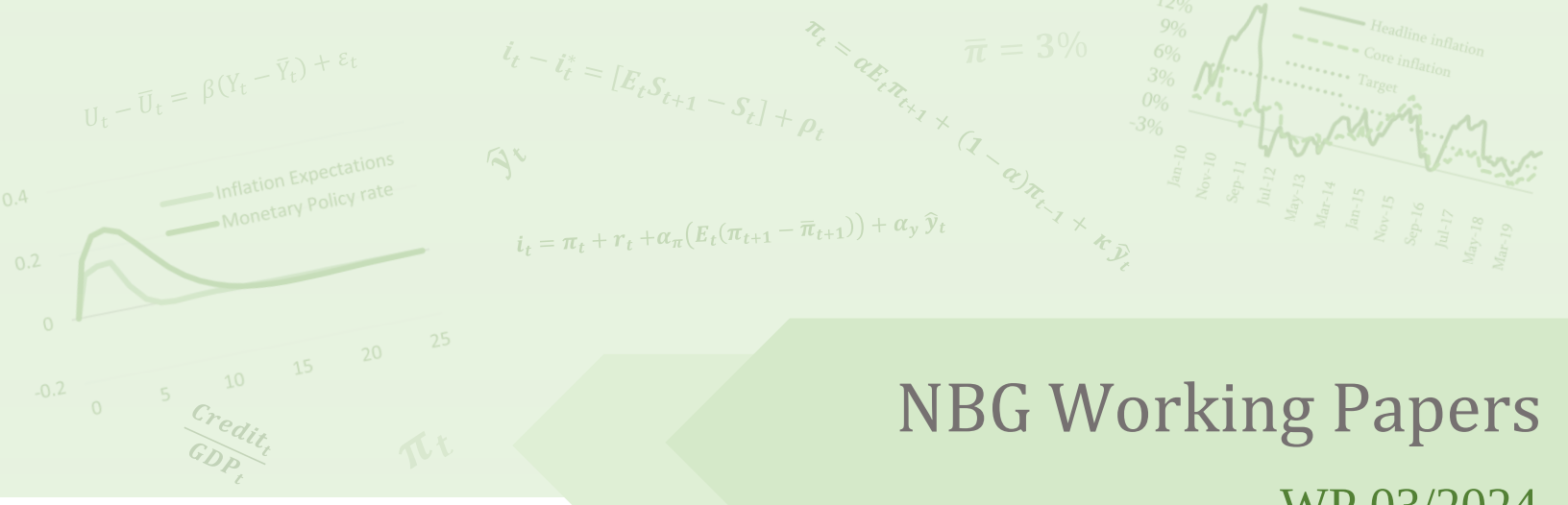

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By Mariam Tchanturia, Jared Laxton, Douglas Laxton and Shalva Mkhatrishvili

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Covid-19 and the Return of the 3-Star Consumption Functions in the US

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Abstract

COVID-19 was an unprecedented event that led to an extraordinary fiscal and monetary stimulus that resulted in a doubling in the S&P and over 50 percent increase in property prices in the US. These increases in asset prices combined with financial saving resulted in a 45 trillion dollar increase in US household net worth between 2020Q1 and 2023Q4, over twice the value of all goods and services produced by the US economy in 2019 (annual GDP was 21 trillion dollars in 2019). We believe this macroeconomic backdrop will play a prominent role in how the economy is going to evolve in the post-COVID-19 world. Our analysis begins with looking at the drivers of US consumption pre-COVID-19 and during COVID-19. We carry out a 2-step regression analysis by estimating the US consumption function in different periods with distinct features and incorporating different variables at each step to achieve stability in the parameters during the COVID-19 period. We use this analysis as a jumping off point for thinking about potential macro-financial risks caused by imbalances in the economy and whether monetary policy has been sufficient to reign in real economic activity. Our analysis suggests that the lower post-COVID-19 saving rate will likely persist until the economy experiences a tightening in financial conditions and large correction in equity and house prices.

JEL Codes: E20, E21, E43, E52

Keywords: Consumption Function, Monetary Policy, Neutral Rate

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Acknowledgement

Work on this topic commenced in 2021, a period marked by significant pandemic-related restrictions and heightened economic uncertainty, which posed substantial challenges for policymakers. Our working paper (WP) synthesizes our perspectives and the outcomes of extensive discussions. We would like to express our gratitude to Olivier Blanchard for his valuable insights and comments on our work. Additionally, we extend our thanks to the team members of the Central Bank of Armenia—Diana Nazaryan, Svetlana Saghryan, Vazgen Poghosyan, Haykaz Igityan and etc. —for their contributions to the topic and their assistance in enhancing the graphical representations. Finally, we would like to mention that the work and analysis presented here, originally focused on the United States, which has substantial spillovers on the global economy, is also relevant for replication in countries like Georgia. Thus, our future research will extend to conduct similar analyses for other countries as well.

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Introduction

The COVID-19 pandemic marked a seismic shift in the global economy, thrusting us into an era of heightened uncertainty. The pandemic era was characterized by substantial fiscal expansions and monetary accommodation that ultimately manifested in high levels of underlying inflationary pressures. During this unprecedented period, conventional macroeconomic relationships faced considerable threats, challenging what had been regarded as reliable empirical regularities, discernible even through rudimentary regression analyses. Among these relationships, real consumption correlated with real disposable income, real net wealth, and real interest rates, stood out prominently. Prior to the pandemic, the symbiotic interplay between these variables was unmistakable, characterized by an almost-perfect fit.

The idea behind such a perfect fit lies in endogenous money creation.[2] Departing from the longstanding perspective of the "loanable funds theory," under endogenous money creation, the modern financial system facilitates widespread access to credit by households and firms. During normal times, consumption, permanent income and wealth are highly correlated as households have sufficient access to credit to buy the goods they desire, and firms have access to sufficient credit to produce the goods consumer's desire. The almost-perfect historical fit observed in the standard consumption function is a clear product of this endogeneity in economies with modern liberalized financial systems. This is the lens through which we analyze consumption, however, the pandemic caused significant disruptions, breaking this near perfect historic fit which we rectify with the use of COVID-19-related data. Ultimately, the analysis aims to provide better insight into how consumption will evolve in the post-COVID-19 era.

Literature Review

Research into consumption functions have a rich history perhaps most famously put forth by Friedman (1957) describing a basic consumption function expressed as a percentage of income with permanent income and precautionary saving elements included which lay the foundation for conceptualizing the consumption function. However, we want to highlight more recent attempts at analyzing consumption, especially during COVID-19 along with a brief tangential aside on the role that different types of modeling methodologies play within a broader analytical framework meant to help answer policymakers' basic questions.

Muellbauer (2020) develops an elaborate version of the consumption function that incorporates a credit channel, wealth, discount rate and precautionary saving. The consumption function that we estimate is best viewed as an empirical regularity or series of empirical regularities as described by Campbell and Mankiw (1989) instead of a structural relationship with fixed parameters. Much time has been wasted estimating these types of equations based on econometric criteria whereby the final estimated equations belong as candidate equations in a fully structural model. Proponents of this style of backward-looking econometric modeling treat economic analysis as an evolving series of misspecification errors to be adjusted over time. This type of methodology was quite common decades ago before models with forward-looking behavior were developed.

[2] Endogenous money creation has been known for a while but development of the necessary tools to help policymakers navigate its implications are shallow. The Central Bank of Armenia has begun developing analytical tools such as making an important distinction between monetary policy relevant and financial cycle output gaps, Kostanyan, Laxton and Nurbekyan (2023) as well as employing better filtering techniques to derive credit-to-GDP gaps, Avagyan, Avetisyan, and Galstyan (2023).

In fact, Hendry and Muellbauer (2019) argue that it is time to bring this econometric style of modeling back into policymaking institutions. Their argument is that this is justified by claims that DSGE models are unreliable.

We agree that standard DSGE models are simply not ready for prime-time use, and it was a mistake for many central banks to implement them as core production models such as the Bank of England. However, in our view, DSGE models suffer from the same high-level problem of reduced-form econometrics which typically lead to "model says", techno-analytical cultures. As people such as David Hendry have recognized and referenced by John Kay and Mervyn King in their book, Radical Uncertainty: Decision-Making Beyond the Numbers, have rightly argued that the world is nonstationary. And in their experience, macroeconomic analysis has underappreciated this fact. However, non-stationarity is something that has been known for a very long time which is why the Forecasting and Policy Analysis Systems (FPAS) developed by the IMF is predicated on a core semi-structural approach which clearly delineates its assumptions, and particularly its assumptions about expectations which separates it from both econometric and DSGE types of models.

When the IMF developed its DSGE modeling infrastructure[3] and conducted technical assistance to central banks on DSGE modeling, the philosophy was teaching DSGE economics where developing DSGE models can be useful exercises for helping economists think about certain aspects of the economy such as the behavior of different agents in the economy or nominal vs real rigidities and other types of distortions. However, it was never the intention for DSGE models to become the core macroeconomic model for central banks to organize their resources to derive the key insights for policy makers. Full-fledged DSGE models were always taught alongside their semi-structural counterparts with an application of Bayesian estimation methods. There are numerous successful examples of semi-structural models being used to help raise the analytical capacity at central banks around the world.[4] Why are semi-structural models so successful? Because they are fit-for-purpose. From an analytical perspective, they are flexible enough to incorporate insights outside the model and they are malleable enough to incorporate new features without the need of a highly specialized researcher. From a policymaker's perspective semi-structural models help provide an intuitive summary statistic such as the output gap to help policymakers describe the rationale behind their decisions when it comes to the output inflation tradeoff and achieving their objectives. Blanchard (2017) identifies five kinds of general equilibrium models, each with their strengths and weaknesses. The semi-structural approach is meant to help marry some of the insights provided by these different types of models under a single roof.

The final piece of a well-functioning analytical framework is the treatment of judgment. Although, *The Rebuilding Macroeconomic Theory Project* by David Vines and Samuel Willis focused on how to improve the core modeling apparatus within macroeconomics, the whole exercise of surveying different perspectives illustrates what a healthy analytical culture looks like and that is in fact what we should be searching for. This is one of the "innovations" within the FPAS Mark II initiative[5] that attempts to establish a culture of

[3] Laxton and Pesenti (2003) argue that DSGE models have way too strong assumptions in them, in particular, the expectational channel connected to rational expectations. Furthermore, these types of models can miss important non-linearities that good macroeconomic analysis must consider such as endogenous money creation and policy reaction functions. Benes, Kumhof and Laxton (2014) present a nonlinear DSGE model with endogenous money creation and forward-looking behavior as a useful application of DSGE models for studying macro-financial linkages however, we would never suggest that this style of model form the core of any analytical framework.

[4] India: Benes and others (2017), Indonesia: Harmanta and others (2011), the Global Projection Model: Carabenciov and others (2013)

[5] See Archer, Galstyan and Laxton (2022)

adversarial collaboration that incentivizes thinking about alternative ways in which the world could develop. Searching for that omniscient model that Stanley Fischer's classmate in university thought[6] we would develop one day remains a rather fruitless endeavor because it misses the reality that underlying economic conditions are always changing and requires fresh ideas to analyze in real-time. When models are not built to prescribe precise solutions, judgment becomes necessary, if not, the most important component to insightful analysis.

A good example of judgment would be at the onset of the COVID-19 pandemic when both aggregate supply and aggregate demand were heavily affected. Given the general treatment of aggregate supply or potential output as a slow-moving process, there was no model that would be able to reliably estimate the volatility in potential output caused by the lockdowns and re-openings in real-time. Instead, the best analysis at the time would need to begin with high-level economic reasoning such as the idea that both aggregate demand and supply have collapsed as a consequence of the lockdowns, but demand probably declined by more with deflationary implications hence the forceful response by monetary and fiscal policy. However, as the economy re-opened, aggregate demand would naturally respond faster and periodically rub up against a constrained aggregate supply curve resulting in acute price increases. This critical type of analysis would have to be done almost entirely judgmentally by shifting the real-time estimate of potential output.[7]

Mervyn King seems to emphasize the role of judgment in his discussion on Monetary Policy in a World of Radical Uncertainty and thinking "Beyond the Numbers" where he uses a simple question as a jumping off point for the analytical process:

> "John Kay and I (King) recommend always asking the question "what is going on here?" At first sight this may seem trivial, but it is in fact immensely helpful in interpreting economic data." King, 2022.

This question is not uninteresting because of its seemingly triviality but rather that it is unhelpful for informing or having a coherent discussion about risk and uncertainty unless you are in the mind of John Kay or Mervyn King and know how they think about the macro economy. Judgmental analysis or inference must also have some structure to it otherwise it just breeds chaos. This is precisely why it is so important that central banks publish an "FPAS" paper so that we are not reliant on the insights of a single individual. Such a document serves as a strategy for which productive analytical discussions about judgment can happen on an institutional level rather than individually and is useful further when engaging the public. Instead of the question proposed by Kay and King, we suggest that a much better set of questions any analyst should ask when advising policymakers is:

- Where is the economy today?
- What are the underlying forces that can drive the economy in different directions?
- What do I have to do with my instruments in these scenarios to achieve my objectives?

Due to the absence of expectations within the reduced-form econometric methodology, that school of thought cannot answer the third and most essential question. This was a common roadblock in the history of developing analytical frameworks to support Inflation Targeting at central banks around the world that were dominated by this style of economic training and education. For example, central banks such as the Bank of Canada, the Reserve Bank of New Zealand, and the Czech National Bank were attempting to anchor inflation

[6] https://www.federalreserve.gov/newsevents/speech/50f93e5451e342848b2b9b5e775bf9ae.htm

[7] A few examples of central banks doing this type of potential output analysis include the National Bank of Georgia, the Central Bank of Armenia, the Reserve Bank of New Zealand, the Bank of Canada, and the Czech National Bank to name a few.

to a long-run objective (2%) that was historically below the long-term average and something a backward-looking econometrician would struggle to provide useful insights for a policymaker trying to implement a new paradigm.

It is somewhat disconcerting that people would recommend returning to econometric models that ignore any forward-looking ingredients which have been "profoundly altered by the rational expectations revolution in macroeconomics" (Campbell and Mankiw, 1989). Virtually all central banks abandoned old-style econometric models decades ago as they wasted incredible resources given their failure to answer real-world policy questions. The examples are numerous, but a good example is how the Norges Bank described the motivation behind their new modeling framework of the Norwegian economy (NEMO) that replaced the previous econometric-style analysis:

> "The key question in the new regime is: What should interest rates be today and in the future in order to best achieve our objectives? To provide a good basis for answering this question, analytical tools with a number of prerequisites are needed. First and foremost, monetary policy must have a clearly defined role in a model designed to support inflation targeting. The model framework must be such that it is possible and necessary for monetary policy to act to bring inflation back to target following economic disturbances. For the model to be of practical use in the policy process, it should reflect the policymakers view about the workings of the economy. In particular, the role of expectations has to be taken seriously. "(Brubakk et al., 2006)

Norges Bank recognized that their modeling framework needed to be fit for the purpose of Inflation Targeting whereby the central bank should provide a credible path of the policy rate that anchors the economy to its inflation target.

Faust (1997) provides a more thorough critique of the Hendry methodology that also pulls from the Cowles Commission under Tjalling Koopmans which underpins the development of macroeconomic modeling standards.

> "Statistical inference unsupported by economic theory applies to whatever statistical regularities and stable relationships can be discerned in the data. Such purely empirical relationships when discernible are likely to be due to the presence and persistence of the underlying structural relationships, and (if so) could be deduced from a knowledge of the latter. However, the direction of this deduction cannot be reversed--from the empirical to the structural relationships--except possibly with the help of a theory which specifies the form of the structural relationships, the variables which enter into each, and any further details supported by prior observation or deduction therefrom." (Koopmans, 1953, p.28)

This may appear as a tangent to the overall purpose of the analysis presented in this paper, however, due to large forecast errors during COVID-19 among central banks, central bank modeling frameworks have come under intense scrutiny. Blanchard provides a nice segue from his critique of DSGE models back to the topic at hand of consumption:

> "Take the consumption example…rather than looking for repairs, DSGE models should build on the large amount of work on consumer behavior going on in the various fields of economics, from behavioral economics to big data empirical work, to macro partial equilibrium estimation. This work is ongoing and should indeed proceed on its own, without worrying about DSGE integration. But this

> body of work should then be built on to give us a better model of consumer behavior, a sense of its partial equilibrium implications, perhaps a sense of the general equilibrium implications with a simplistic general equilibrium closure, and then and only then be integrated into DSGE models. This would lead to more plausible specifications and more reliable Bayesian priors...", Blanchard (2017).

We want to reiterate this point that the estimated consumption functions presented in this paper are best viewed as reduced-form empirical relationships that may contain useful insights from time to time. The insight we expect to glean from this analysis is simple: to bolster the analysis around thinking about the consumption function as the economy exits the COVID-19 economy and the possible implications for monetary policy and whether higher interest rates would be necessary to bring the economy to a more sustainable place.

Stylized Facts

COVID-19 presented many challenges from an economic-modeling perspective to do insightful real-time analysis. For instance, there was a strong movement towards alternative data sources to help estimate the economic impact of lockdown policies in a timely fashion as the economy was changing very rapidly. We also employ alternative data in our analysis to help explain the COVID-19-related era to maintain consistency in our estimated parameters prior to COVID-19. In a nutshell, we estimate the US household consumption function over different periods to maintain stability in our parameter estimates and incorporate an important wealth element to the function to help understand post-COVID-19 consumption.

Furthermore, amidst subsequent global shocks, high uncertainty has put massive pressure on policymakers. In a highly uncertain environment, policymakers need to establish more transparent forms of communication to strengthen credibility to fulfill their mandate but in a macro-consistent manner. Thus, sticking with the world as one of the most possible – baseline- scenarios becomes highly irrelevant for policy making. Herein, the Global Forecasting School (GFS) [8] has worked on adjusting the Forecasting and Policy Analysis System (FPAS) Mark II, which suggests a case study approach instead of a baseline-alternative scenario approach. Students at the GFS consider Cases A, B and X(Y), without assigning specific probabilities to them and consider the relevant policy reactions under each case. [9]

- Case A: scenarios where the policy rate path would need to be higher than what the market currently expects. In other words, a plausible hawkish scenario.
- Case B: scenarios where the policy rate path would need to be lower than what the market currently expects. In other words, a plausible dovish scenario.
- Case X(Y): tail risk scenarios as well as scenarios that incorporate avoiding the Dark Corners of monetary policy; high and variable inflation, or a low inflation trap.

We will analyze consumption in a similar manner using the debate about the future of interest rates by Lawrence Summers and Olivier Blanchard as the source of the case study.[10] Why? A major macroeconomic driving force over the last few decades has been the development of the non-Ponzi game condition. Ever since our understanding about the banking sector shifted from a loanable funds model to endogenous money

[8] Global Forecasting School (GFS) created by the collaboration of Better Policy Project and Central Banks of Armenia and Georgia
[9] See Archer, Galstyan, Laxton (2022)
[10] https://www.piie.com/sites/default/files/2023-03/2023-03-07transcript-summers-blanchard.pdf

creation, it has become clear that understanding the financial sector is critical for understanding the underlying risk in the economy. Financial shocks have become more commonplace since the 1980's and a regular source of recessions over the past forty years. As the economy matures over time under this system and debt grows, the potential impact of the next financial shock is likely larger than before.

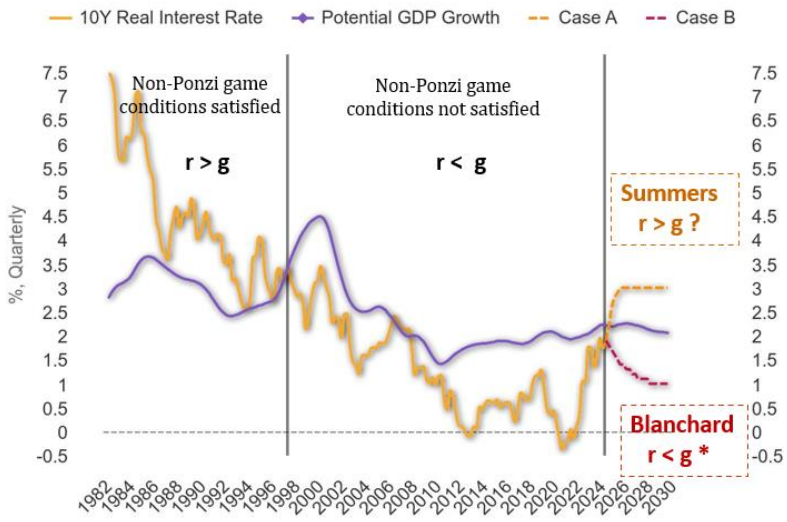
Since the GFC, we continue to live in an era of what Mohamed El-Erian refers to as tremendous economic and financial distortions that have yet to be resolved[11]. El-Erian is looking at these distortions through the lens of equity and real estate prices which indeed look overvalued to this day relative to their pre-pandemic levels. These conditions typically incentivize bubbles in asset prices to form which we can see in the explosion in net worth among households that dwarf the height of the GFC. The potential for an asset price correction is clear.

However, in our view, these distortions are broader and run a gamut of different areas but ultimately begins with the aftermath of the GFC and the era where the non-Ponzi game condition was not satisfied i.e. the real interest rate was below the real growth rate or $r-g < 0$. But where are interest rates headed? The debate between Summers and Blanchard offers a nice case study for the different perspectives with Summers arguing why interest rates may need to rise in the future and Blanchard arguing for why interest rates are headed lower. Historically, there is an unmistakable downward trend in real rates. However, the recent performance of the US economy suggests that rates may need to go higher at least in the interim especially when looking at equity prices which feeds into our consumption function in the form of a wealth effect. Since the beginning of the COVID-19 era, equity prices have skyrocketed. This increase in equity prices has helped raise the net worth of US households to the tune of $45 trillion as of 2023Q4 compared to 2020Q1.

Furthermore, we believe that the combination of large expansionary fiscal policy, easy monetary policy and the rapid rise in equity and house prices can create a dangerous mix for a potential financial crisis over the medium term if the massive buildup in wealth is used as collateral to finance even higher levels of leverage in the economy. As US household net worth increases rapidly amid strong stock market performance, it can push consumer demand higher in the medium term and if real interest rates remain below the growth rate of the economy, then there would be incentives for households to start borrowing excessively.

[11] https://markets.businessinsider.com/news/stocks/stock-market-outlook-bonds-cash-mohamed-el-erian-top-economist-2022-9

Figure 1: History of r and g



Case A: r > g

Persistently strong growth raises the probability that the neutral interest rate has materially increased. The market requires more compensation for the risks of higher interest rates i.e. the term premium.

Case B: r < g

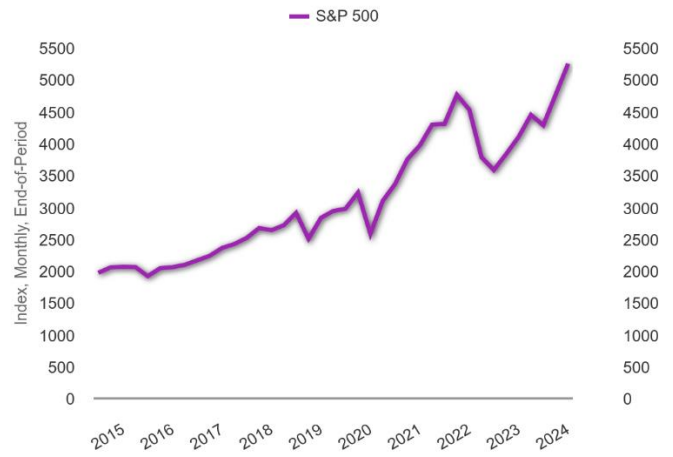
Despite potential triggers, markets remain resilient, but higher term premium certainly could result in the perception of explosive debt dynamics, a crash in equity prices and large recession.

Source: FRED

Note: Blanchard, O. (2023). Fiscal policy under low interest rates. MIT Press

If this period of high asset prices and consumption were to metastasize into higher leverage and borrowing then it would satisfy the two ingredients typically associated with major financial crises, and it is this risk down the road that we want to highlight with this analysis as it can eventually lead to a deflationary dark corner. However, the analysis around this topic is much broader than the scope of this paper. The following analysis is concerned with one element, consumption, which can help illuminate some of the more immediate concerns for the post-COVID-19 economy.

Figure 2: Irrational Exuberance in Equity Markets?



Expansionary fiscal and monetary policies pushed long-term real interest rates negative contributing to a bubble in equity prices.

Average federal government primary fiscal deficit >10% in 2020 and 2021. This combined with a primary deficit above 3% has pushed government debt to almost 100% of GDP.

Fed cut the policy rate to zero and held it there far too long, allowing medium-term inflation expectations to ratchet upwards.

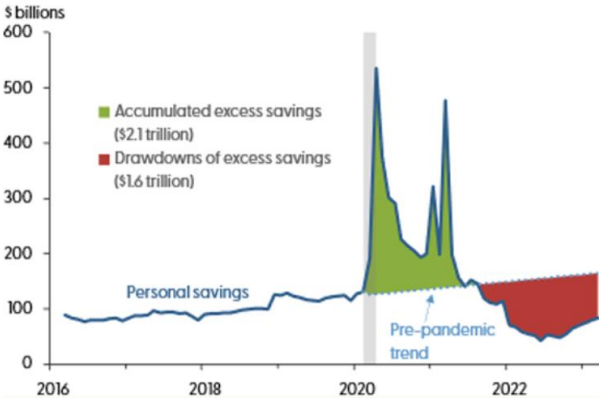
Source: FRED

Amid the pandemic-induced economic lockdowns, a tangible contraction of consumer spending ensued, amplified partly by massive uncertainty. This downturn was accompanied by persistent fiscal and monetary stimulus, which led to a surge in personal savings. However, as savings increased, consumption also fell dramatically given the specific nature of the pandemic shock and the associated lockdown policies. The increase in the savings rate is explained by the fact that the lockdown policies led to a subsequent rise in

unemployment and high uncertainty about the prospects of the economy and an increase in precautionary savings. This large accumulation of savings has been coined as "excess savings"; a methodology based on comparing the pre-COVID saving rate with COVID era saving rates. And given that the saving rate has since dipped below pre-pandemic levels (Figure 3, Panel A), this analytical framing has been interpreted as households draining their excess savings. The recent estimates provided by the April 2024 IMF WEO suggest that excess savings have been completely depleted in the US (Figure 3, Panel B). And this idea forms the basis of the IMF WEO narrative that the depletion in excess savings will have a cooling effect on consumption going forward which they say is also consistent with the expectation of a decline in interest rates.

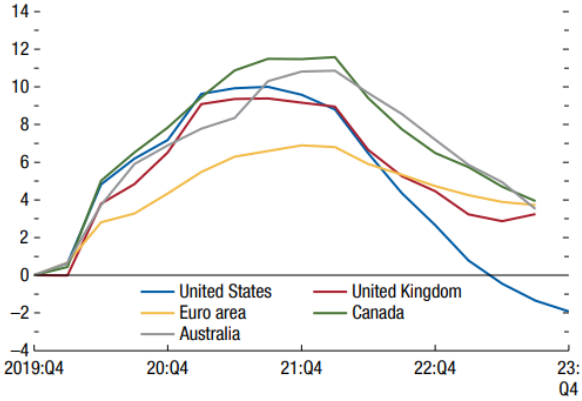
Figure 3: Excess Savings: Research to Application

Panel A: Abdelrahman, Hamza, and Luiz E. Oliveira. 2023



Source: Bureau of Economic Analysis and authors' calculations.
Note: Excess savings calculated as the accumulated difference in actual de-annualized personal savings and the trend implied by data for the 48 months leading up to the first month of the 2020 recession as defined by the NBER.

Panel B: Savings from the Pandemic Declining (Percent of GDP)



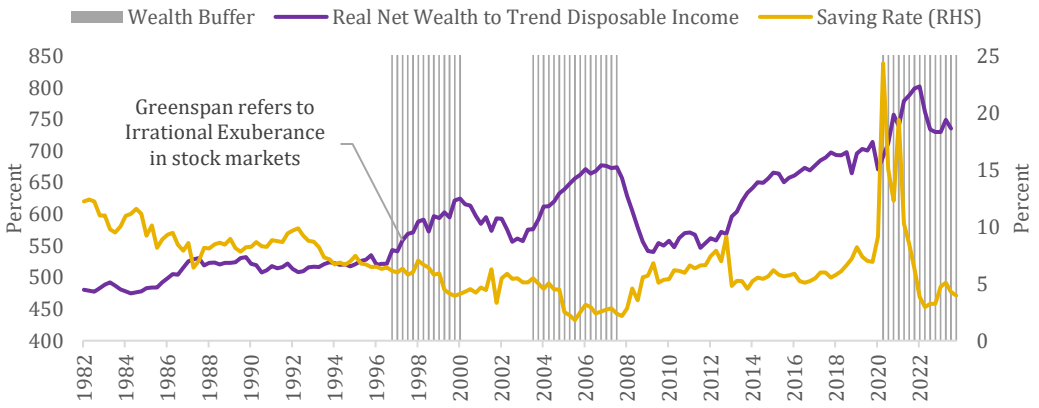
Source: April 2024 IMF WEO, de Soyres, Moore, and Ortiz 2023; and IMF staff calculations.
Note: Excess savings are calculated as the deviation from the predicted saving rate using a Hamilton trend. Accumulation starts in the first quarter of 2020. Euro area comprises France, Germany, Italy, and Spain.

Although this could be the case, we believe the analysis is missing the important role that wealth plays in forming household behavior and consumption preferences. We do not view wealth as having a large direct impact on consumption, but it should act as a buffer for households to feel more confident to spend more of their income. Therefore, scenarios with higher saving and cooler consumption going forward would probably be dependent on a correction in asset prices which has not yet materialized. That said, the prominent authors of the excess savings research (Abdelrahman, Oliveira and Shapiro (2023)) have also performed a similar type of analysis to derive an excess wealth measure. And to their credit, they recognize in their analysis the interaction between wealth and consumption, but because the analysis in these studies is done separately, the application for current analysis as exhibited by the latest IMF WEO is prone to missing what we believe is the most important insight for thinking about consumption moving forward as we exit the COVID-19 period. Our analysis does not attempt to estimate the total effect that wealth may have on consumption. The point we are making is that by putting the role of wealth in consumer behavior front and center removes the ambiguity of the key insight.

For instance, when we analyze the current period, we believe it is reminiscent of past periods when equity-based wealth rapidly increased and it had a dampening effect on household saving. These periods include the eras prior to the Dotcom and GFC stock market corrections where there were noticeable and persistent

declines in household saving rates (Figure 4) until wealth corrected downward. This is what we refer to as the wealth buffer that can help explain households' confidence to spend more of their income and keep consumption elevated.

Figure 4: History of a Wealth Buffer and Saving Rates

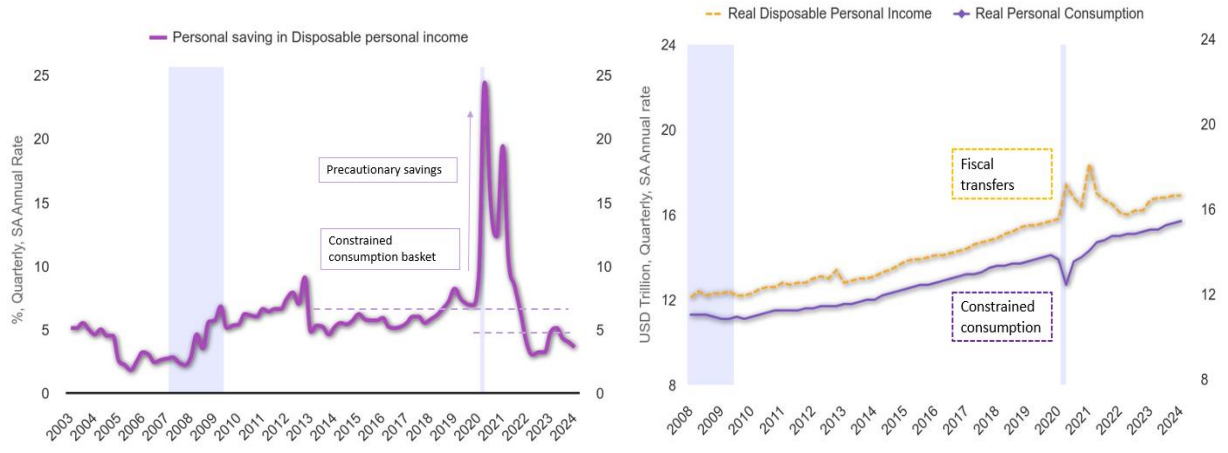


Note: Last data for net worth is 2023Q3 which has presumably increased from equity prices reaching new highs
Trend Real Disposable Income uses a univariate Kalman Filter estimate of real disposoable income

Regression Analysis

During the pandemic we observed a scenario where consumption receded, while almost all its explanatory variables increased significantly, unsettling the traditional tenets of the consumption function, and necessitating a fresh perspective to analyze it. Furthermore, we observe that some of the transitory movements in real disposable income do not show up in consumption but over time are highly correlated to one another. Our regression analysis seeks to use explanatory variables that can better clarify the dynamics of consumption, thereby restoring empirical regularities, even amidst the pandemic's turmoil.

Figure 5: History of Saving, Consumption and Income



Source: FRED

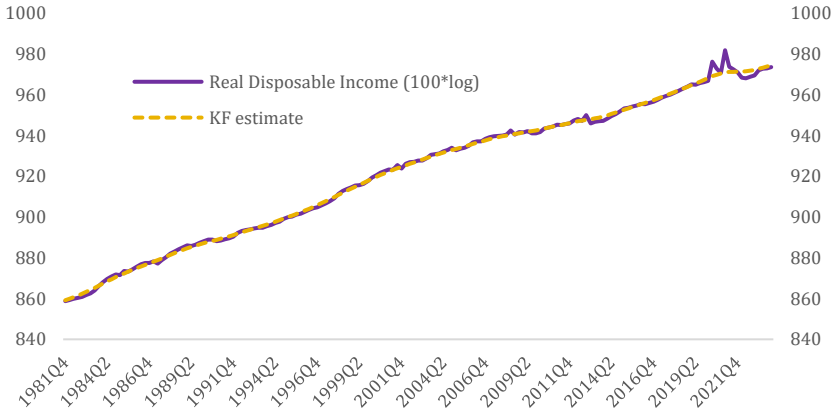
The analysis was done in 3 stages:

1. Estimate the historical consumption function using traditional variables such as permanent component of real disposable income, real wealth, and real interest rate.
2. In the second stage of the analysis, we look at alternative data and pandemic time dummies to help explain the residuals in our first model.
3. The final stage of the analysis is for thinking about potential issues and scenarios in the post-COVID-19 economy.

Pre-COVID-19 era: Consumption Function Basics

The first stage began with an estimation of a consumption function using traditional variables such as real disposable permanent income, real financial net wealth and real interest rate in quarterly terms starting from 2003 up to 2019. In our analysis, we have elected to estimate the consumption function within the paradigm of permanent income theory. To this end, we have employed a univariate two-sided Kalman filter estimate of real disposable personal income, using its trend as our unobserved variable for permanent income (Figure 6). We justify the use of the two-sided filter to reflect the transitory nature of the large government transfers during COVID-19 that increased household income. In real time it was reasonable to assume that the transfers were a temporary policy and not associated with changes in permanent income.

Figure 6: Kalman Filter Estimate of Trend Real Disposable Income



Source: FRED, Authors estimates

In essence, our approach encapsulates a distilled representation of the variables under consideration. The canonical consumption function is expressed in a 100-times the natural logarithm to interpret the results as elasticities. Moreover, we incorporated the lagged ratio of wealth to the proxy of permanent income, where the resultant estimation denotes semi-elasticity. Hence, the standard consumption function we estimated at first stage is stated as follows:

$$\boldsymbol{LRCON_t = \alpha_0 + \alpha_1 * LagLRCON + \alpha_2 * LRPI_t + \alpha_3 * LagWoTDI + \alpha_4 * RR_t + \epsilon_t}$$

Table 1: Variable Description

Variable	*Description*
$LRCON_t$	Natural logarithm of real personal consumption expenditures multiplied by 100; Source: FRED;
$LagLRCON$	One-period lag of natural logarithm of real personal consumption expenditure multiplied by 100;
$LRPI_t$	Permanent component (trend) of real disposable income; Source: FRED;
$LagWoTDI$	One-period lag of real net worth divided by the permanent component (trend) of real disposable income and multiplied by 100; Source: FED;
RR_t	Market Yield on U.S. Treasury Securities at 10-Year Constant Maturity, Inflation-Indexed Source: FRED;

It is important to consider that the prolonged zero-level bound interest rate environment during the evaluation period rendered an assessment of its effect illogical. To extract a relevant estimate for the real interest rate it would be necessary to go further back into history, such as the early 1980s or 1990s when monetary policy was adjusting interest rates to reduce inflation. Therefore, we adopt an elasticity assumption consistent with this type of historical analysis and can be found in models such as FRB/US (Brayton and Tinsley, 1997). Hence, the estimated consumption function took the following form:

$$LRCON\_ADJUSTED_t = LRCON_t + 0.25 * RR_t$$
$$= \alpha_0 + \alpha_1 * LagLRCON + \alpha_2 * LRPI_t + \alpha_3 * LagWoTDI + \epsilon_t$$

The regression depicted is almost a perfect fit, exhibiting sensible elasticities and an exceptionally low residual standard error of 0.31 (see Table 2). Specifically, the income elasticity was observed to reach 0.32. Regarding the wealth semi-elasticity, a value of 0.01 was obtained. It is important to acknowledge that the coefficient of this indicator tends to decrease in the regression results over the longer period, aligning logically with changes in demographic factors, notably increased life expectancy.

Table 2: Summary statistics. Estimated between 2003Q1-2019Q4.

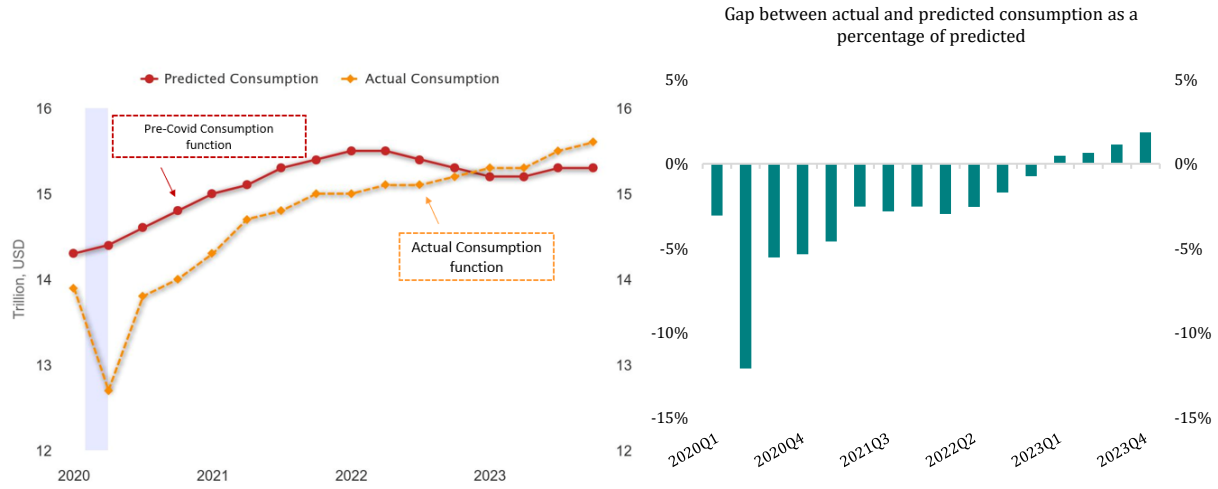
	Dependent Variable: Real Consumption
Lagged Real Consumption	0.62 *** (0.05)
Permanent Component of Real Disposable Income	0.32 *** (0.04)
Lagged Real Wealth: Permanent Component of Real Disposable Income	0.01 *** (0.001)
Constant	54.01*** (7.18)
R2 (Adjusted)	0.99 (0.99)
Residual Std. Error	0.31

Now an econometrician may look at this and consider taking the first-difference because they are concerned with spurious correlation however, we rely on this relationship being an empirical regularity. Of course, there are issues with estimating such an equation since all variables in this analysis are affected by a common factor that stems from the concept of endogenous money creation. The demand for loans rises as household's leverage against their income and accumulated wealth, which in turn helps fuel consumer spending. In this world, we are not particularly interested in searching for exogenous factors to explain consumption.

The issues we do identify with this analysis are that it is incomplete in the sense that the desired level of consumption is a function of disposable income and wealth but also real interest rates which are important in the endogenous money creation world. Furthermore, liquidity constrained households and uncertainty may be a key determinant for explaining some of the large sharp changes in consumption however, the trend in the level of real consumption have a stable relationship with real disposable income and real wealth.

We use the estimated function, and we start "predicting" consumption at the beginning of the COVID-19 crisis. As expected, we generated large errors over this historic period. However, the analysis is not simply about finding ways to reduce our prediction errors. Sometimes "errors" in models can shed light on important concepts that help us anticipate dynamics going forward. Herein, we viewed the difference between the counterfactual prediction and the actual values as a rough estimate for the unobserved concept of foregone consumption, which has recently transitions into some "revenge spending" manifested in the positive gaps in the latest periods (see the Figure 7).

Figure 7: Predicted Consumption



Sources: Authors' calculations

COVID-19 era: Explaining the Residuals

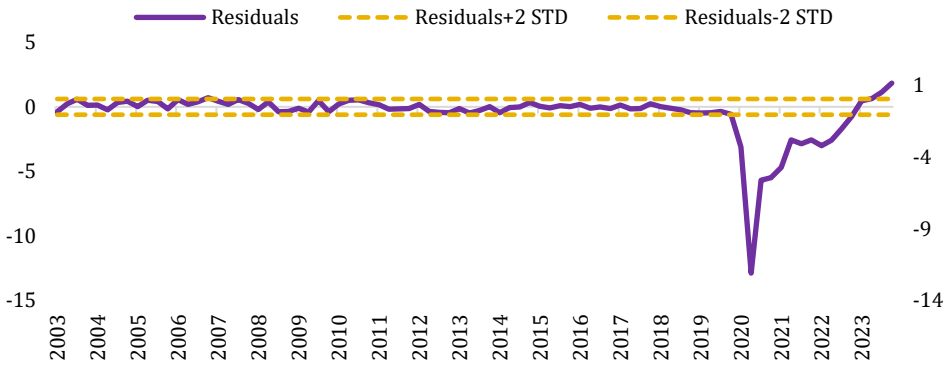
Subsequently, we sought to estimate the consumption function solely with these traditional variables with the COVID-19 period as part of the estimation sample. The results depicted a logical picture, exhibiting changes in elasticities (see Table 3). This does not show a break in the empirical regularity but rather necessitates economic judgment to explain these consumption shifts.

Table 3: Summary statistics. Estimated between 2003Q1-2023Q4.

	Dependent Variable: Real Consumption
Lagged Real Consumption	0.63 *** (0.07)
Permanent Component of Real Disposable Income	0.28 *** (0.06)
Lagged Real Wealth: Permanent Component of Real Disposable Income	0.01 *** (0.003)
Constant	70.80*** (17.52)
R2 (Adjusted)	0.99 (0.99)
Residual Std. Error	1.3

Thus, in the next phase, we delved into the pandemic-related indicators to describe consumption dynamics and stark changes in the residuals (see Figure 8). Accordingly, we selected variables reflecting mobility restrictions, indicative of economic activity constraints, and variables portraying households' apprehension about the future, denoting heightened uncertainty. With these criteria in mind, we chose unemployment searches on Google (see Figure 9) and Google's mobility data for retail and recreation (see Figure 10). To focus on the COVID-19 period, we treat Google mobility for retail and recreation and Google searches of unemployment as dummy variables by assuming them to be zero before 2020.

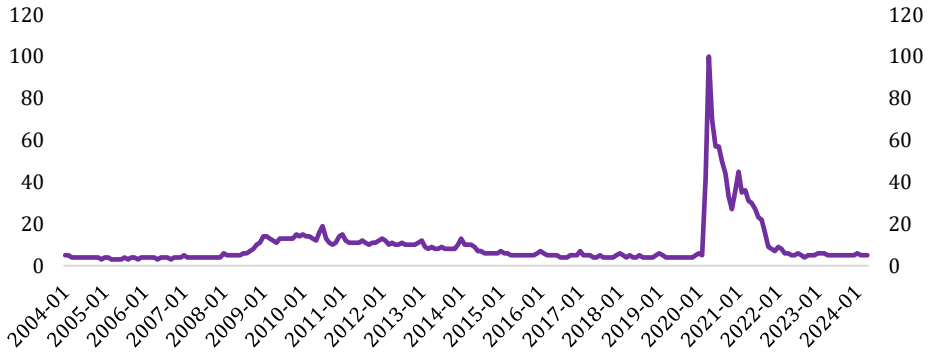
Figure 8: Residuals



Source: Authors' estimations

As the trend in Google searches for unemployment rises, this helps account for the decline in real consumption that is not explained by the basic consumption function. Again, this is meant to proxy for the impact of the enormous uncertainty the pandemic must have caused households in terms of their employment outlook leading to precautionary saving.

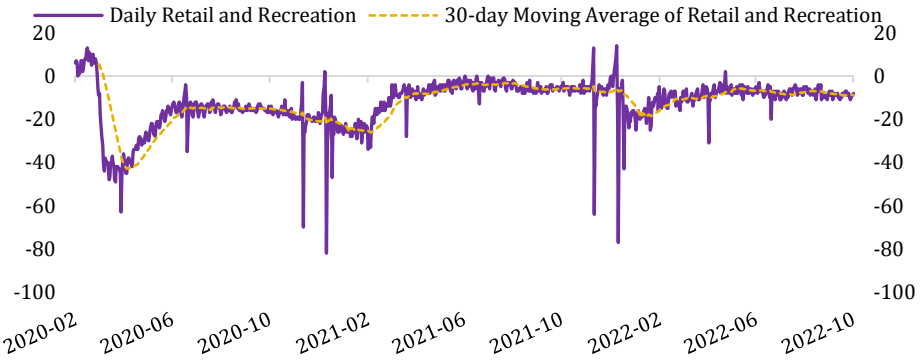
Figure 9: Google Trend of Unemployment Searches



Source: Google

Likewise, as Google mobility for retail and recreation locations falls so does consumption. This is typically on account of some lockdown measures instituted by the government as well as personal preferences to social distance based on rising COVID-19 cases. Of course, most can substitute their shopping from brick-and-mortar shops to online but unlikely to do it with the same intensity given the broader economic environment.

Figure 10: Google Mobility Retail and Recreation



Source: Google

Additionally, the beginning of COVID-19 was duly accounted for through time dummy variables introduced for each quarter of its occurrence, spanning from the first quarter of 2020 to the fourth quarter of 2022. Consequently, after refining the consumption function over the pandemic period with these dummies, we observed the re-establishment of the original elasticities (see Table 4).

Table 4: Summary statistics. Estimated between 2003Q1-2023Q4, Including Covid Time Dummies (Not reported here)

	Dependent Variable: Real Consumption
Lagged Real Consumption	0.61 *** (0.05)
Permanent Component of Real Disposable Income	0.32 *** (0.04)

Lagged Real Wealth: Permanent Component of Real Disposable Income	0.01 *** (0.001)
Google Searches of Unemployment	0.01*** (0.003)
Google Mobility: Retail and Recreation	0.04 (0.04)
Constant	54.35*** (7.10)
R2 (Adjusted)	0.99 (0.99)
Residual Std. Error	0.30

Post-COVID-19 Scenarios

The final stage of the analysis is for thinking about potential scenarios in the post-COVID-19 economy that would be candidate scenarios under the FPAS Mark II framework and regularly applied to the Not the Fed Tealbook series published by the Central Bank of Armenia.[12] Here we are thinking about the broader economic context of overvalued stock prices and the associated impact that will have on consumption as well as the potential for households to increase their leverage. It is typically these two factors: high equity prices and private sector leverage, that lead to financial crises and the one we are monitoring in this analysis could dwarf the magnitude of the GFC if certain conditions are satisfied, namely rising credit.

In our view, we see two ways how our analysis of the US household consumption function could evolve over the coming years, but the central premise is that there is a bubble in equity prices and this bubble has contributed to an enormous increase in household wealth.

Case A (Higher Interest Rate Scenario)

Asset prices continue to rise in 2024. End-of-year asset price valuations surpass the previous year by more than 10%, thereby raising nominal net wealth. The direct wealth effect on consumption is miniscule as per our estimation, however, the buffer which comes from higher wealth gets transmitted via a lower savings rate keeping consumption elevated similar to the environment before the Global Financial Crisis. The real economy keeps performing above most measures of potential output and underlying inflation remains elevated, suggesting the neutral real interest rate could be substantially higher than currently assumed. Consequently, the mitigation of such pressures coming from stronger consumption necessitates a higher Fed funds rate than is currently reflected in market pricing. Apart from current market conditions, there is plausible doubt that the neutral has risen given some fundamentals. For instance, fiscal issues, also the rapid growth of artificial intelligence (AI), which has the potential to significantly boost productivity. This productivity surge could, in turn, elevate the neutral rate and concurrently validate the substantial increases in equity prices.

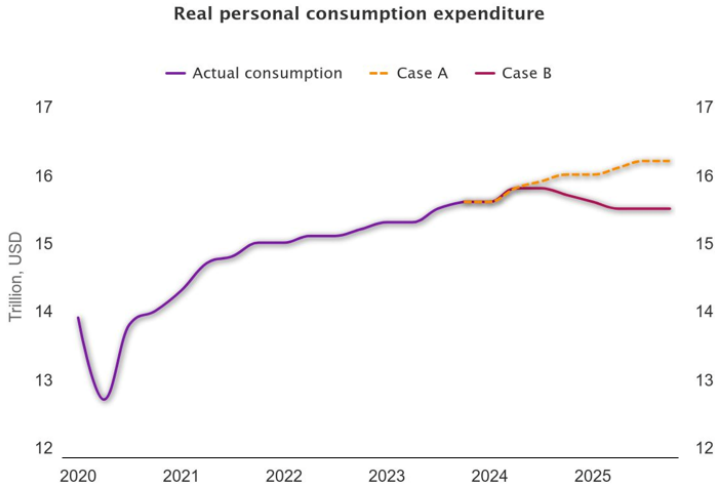
Case B (Lower Interest Rate Scenario)

Predicting when a bubble will burst is notoriously difficult, but it is simply hard to fathom that the increase in household wealth coming from the extreme increase in equity prices since the COVID-19 pandemic lows

[12] This is a joint effort among the central banks of Armenia and Georgia to use the US economy as an analytical playground to do relevant research with current analysis implications. In particular, this consumption analysis has already been applied to a few Not the Fed Tealbook editions, Papikyan and others (2023/2024).

is not a bubble. We have had several potential flashpoints that could have precipitated a correction in equity prices the past year i.e. US regional banking crisis, US commercial real estate, China's real estate downturn but so far financial markets have weathered the storm. Still the storm clouds are present, and the aforementioned issues could deteriorate at any time. Under the Case B scenario, the stock market is projected to correct, experiencing a decline of approximately 30% by the end of 2024. This downturn is anticipated to erode the wealth buffer that households were accustomed to during the pandemic. The trajectory of permanent income initially dampens growth but eventually translates into an outright decline by the latter half of 2024. Consequently, consumption would moderate, alleviating the need for a hawkish stance by the Fed. Case B would be a sizable recession, embodying kind of the hard landing outcome the Fed seeks to avoid (see Figure 11).

Figure 11: Case A and Case B scenarios



Case A

Asset prices rise, boosting nominal **net wealth,** but direct impact on consumption is small. Economy remains strong, despite **elevated inflation**, suggesting need for higher Fed funds rate.

Case B

Predicting bubbles is tricky, but the post-COVID **equity surge** suggests one. A sizeable equity correction is necessary to slow down consumption and consistent with lower interest rates.

Source: FRED, Authors' calculations

Case Y (Deflationary Scenario Not Depicted)

Worst case. The Case A scenario materializes however the Fed is slow to respond to a higher neutral interest rate and as the real economy accelerates, households begin taking out more leverage in response to a perceived permanent increase in their wealth and income similar to the pre-GFC period. The bubble bursting under these conditions would be far more severe than the Case B given the change in the financial position of households.

Conclusion

We believe the work done here is a useful application of the US household consumption function that adds to the literature by incorporating the effects from the COVID-19 pandemic. The estimation of these variables to explain the COVID-19-related shock to consumption helps stabilize the estimation of the standard consumption function that is likely to hold as we exit the COVID-19 impacted world.

This analysis also aims to stimulate discourse surrounding consumption within the framework of endogenous money creation. Within this paradigm, the burgeoning leverage of households, coupled with potential asset price bubbles, poses significant risks for the future. The Fed's attempt to engineer a soft landing within an endogenous money creation world may soon backfire and reaccelerating consumption could exacerbate underlying inflationary pressures. Such endeavors tread a precarious path amidst two prominent precursors

to financial crises: an overvalued stock market devoid of fundamental support and escalating household leverage. Undoubtedly, addressing these challenges through monetary policy alone raises the risk of a financial crisis materializing. Therefore, in this process, the integration of macroprudential measures with monetary policy, complemented by the pivotal roles of fiscal policy, becomes paramount. Specifically, fiscal policy has a clear role to help smooth the transition to the post-COVID-19 economy but continued large fiscal deficits are in our view counterproductive and raise such risks rather than mitigate them.

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Appendix

Figure 12: Fitted vs actual consumption values based on the regressions using standard macro variables estimated over 2003Q1-2019Q4

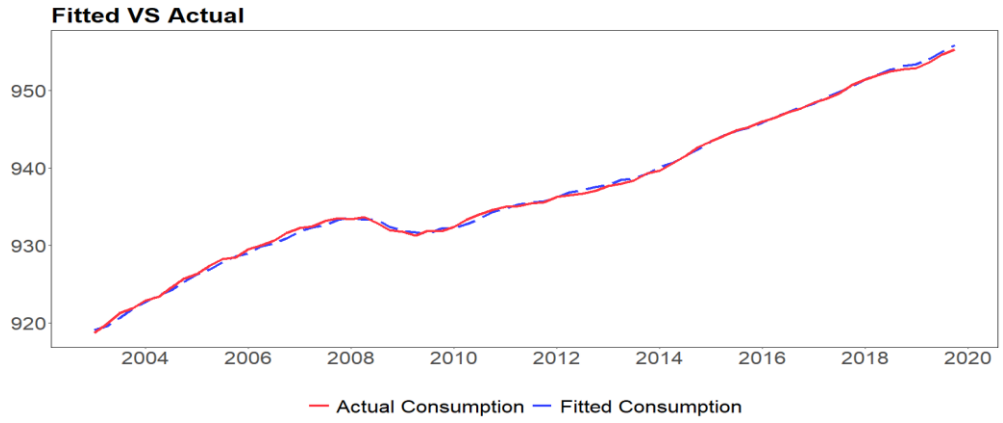


Figure 13: Fitted vs Actual consumption values based on the regression estimated over 2003Q1-2023Q4 without pandemic-related dummies

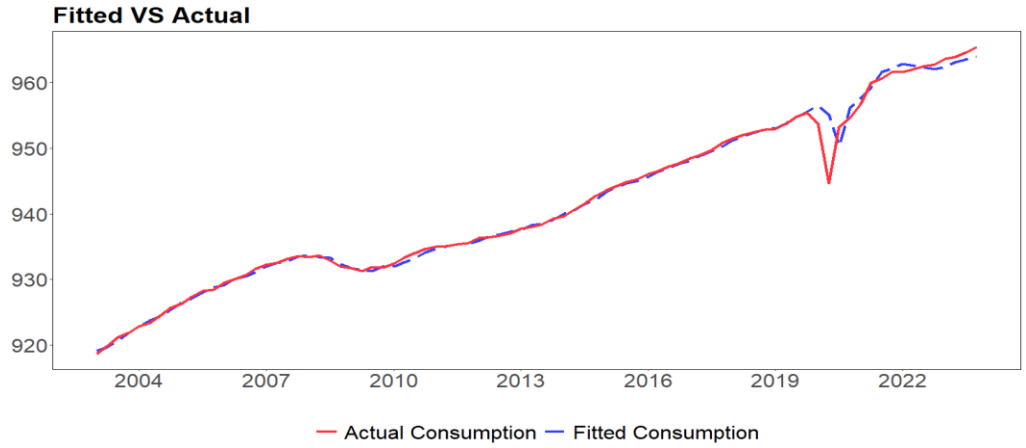
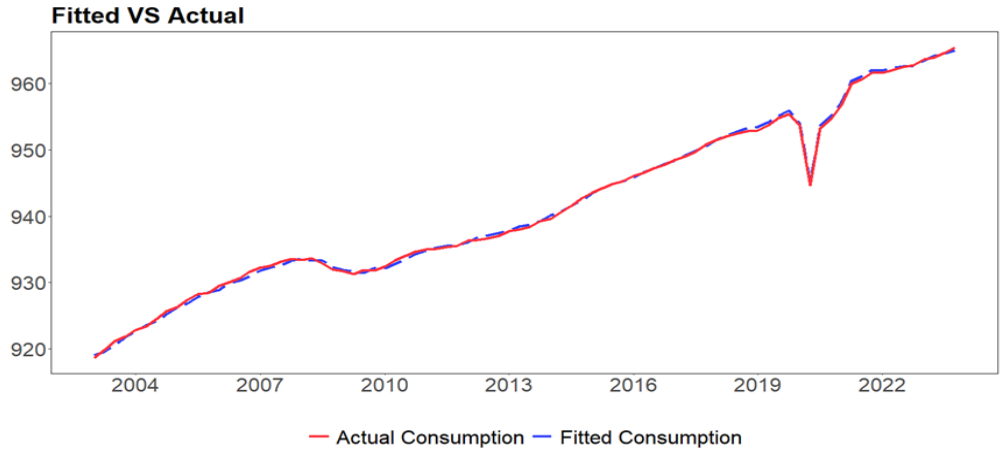


Figure 14: Fitted vs Actual consumption values based on the regression estimated over 2003Q1-2023Q4 using pandemic-related dummies



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