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MACROECONOMIC ASSET ALLOCATION TO SOLVE PROBLEMS OF UNCERTAINTY IN THE MEDIUM-TERM INVESTMENT HORIZON IN GEORGIA

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Abstract

Purpose. *The author targets the creation of an analytical investment framework by merging existing statistical techniques. The paper aims to introduce a framework constructed for the Georgian economy that can assist investors in analyzing the medium-term implications of different macro scenarios. For this, a tactical and strategic asset allocation decision-making framework was developed to optimize portfolios by employing a Balanced Portfolio approach, with the help of forecasted macroeconomic variables using econometric techniques (VECM – Vector Error Correction Model; Taylor rule estimation with OLS – Ordinary Least Squares). The author also intends to lay the foundations for future research regarding the investment characteristics of the emerging market.*

Design/methodology/approach. *The first forecasts of inflation and policy rate are obtained with the Vector Error Correction and Taylor rule models. Macroeconomic forecasts/projections are then applied to link asset price developments derived from Monte Carlo simulations. Finally, the Balanced Portfolio approach is utilized to optimize asset weights given different scenarios.*

Findings. *The results show that this approach lowers risk in all assumed scenarios and obtains better returns compared to plain vanilla efficient-frontier optimization. Portfolios have better risk-return profiles than before optimization with this approach. These results were obtained by using the macro model described in the paper.*

Originality. *The paper aims to introduce a framework that is a combination of multiple well-established macroeconomic and investment models in the academic community, which is tailored for a developing economy such as Georgia. Thus, the originality of the research rests*

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in the method of choosing specific techniques, variables, and connections between different models to best estimate the optimal portfolio given the objective of the investment.

Keywords: *simulation, asset price, financial markets, asset allocation, risk return, forecasting returns*

JEL: *E47, E40, E44, G11, G17*

1. Introduction

Although investment techniques are evolving and many different alternatives are available on the market, emerging economies are an exception in this regard. Developing countries have different macroeconomic characteristics, and research papers on these differences are needed to understand investment trends and guide investors' decisions with well-tailored frameworks. The list of problems which this research intends to solve is as follows:

1. With this information, investors can create a Balanced Portfolio allocation for many emerging economies.
2. A Balanced Portfolio framework enables the creation of sophisticated risk-based allocation given an analysis of possible scenarios.
3. Investment funds can assess risk based on macroeconomic feedback to the portfolio, and can evaluate the diversification of allocation given different scenarios.

Despite portfolio allocation techniques differing across investment styles, most conventional investors need to determine capital market assumptions – i.e., future views of return, correlation and risk. Recent decades have posed challenges to all types of investment views, suffering large losses from the increased asset price volatilities during the 2008 financial crisis and 2020 COVID-19 pandemic. In-between these two worldwide events, the oil price shock in 2014, globalization and multiple regional conflicts were significant drivers of capital market assumptions. Long-term investments are the safest options during an uncertain and changing landscape, as is the case now. However, a long investment horizon does not guarantee better or worse results in terms of risk-adjusted returns compared to different investment styles.

A crucial factor when evaluating the results of different long-term investment funds is a Strategic Asset Allocation (SAA) exercise that has a large contribution in generated returns. The foundations of SAA are based on academic literature from the 1960s (Mean Variance, etc.). More recent papers are combinations of literature from academia and the investment sector itself, which has generated papers based on practice and theory (Black-Litterman Model, Risk Parity, Balanced Portfolio etc.). More exotic types of SAA (Strategic Asset Allocation) could also employ Machine Learning algorithms such as Neural Networks and different types of clustering. However, this approach has not gained academic ground yet as investment literature very much depends on actually realized time series, which need to be at least 10 years in length to be considered worthy.

The speed of the changing economic landscape and corresponding changes to investment theory are very much different. New knowledge reveals and is added to academic literature only years after economic changes take place. Thus, simulations gained ground in investment literature, and practitioners use them frequently. Simulations and other statistical techniques are dependent on the quality and length of data, which in many emerging economies are not satisfactory. Moreover, using only statistical methods cannot bring alpha from a long period of time, as technical innovations are rapidly spread across competitors in the investment industry, which reduces the returns generated by individual funds using a certain statistical method. Thus, most investment funds try to generate alpha via the extensive and continuous research of ongoing investment trends through investing in human capital.

There exist only quantitative funds, but most frequently we meet funds that use a combination of statistical methods and research into investment trends to bring alpha for investors. We concentrate on the method that uses knowledge generated by Bridgewater which spans over 30 years of research in the investment industry, offering an investment formula for lowering risk given that return stays optimal compared to the traditional frontier technique. This method allows for a combination of statistical methods (Monte Carlo simulation) and derives capital market assumptions based on investor views. We will combine already existing statistical methods and knowledge of emerging economies to derive a procedure for long-term investors, aiding in portfolio optimization. We leverage statistical tools to reduce errors caused by the small range of the time series, which is characteristic of emerging economies. Adding expert judgement on economic developments, we improve the estimations of capital market assumptions.

In our research, we will focus on the biggest institutional investor in Georgia, which is the State Pension Agency, and we will challenge its Benchmark Portfolio to understand the implications of different asset allocation decisions (Pension Agency of Georgia, 2021). As a result of these observations, the long-term investor will have the technical and analytical capacity to analyze and assess the adequacy of both strategic and tactical asset allocation decisions through a macroeconomic lens.

In times of uncertainty and amid a changing political landscape, it is crucial to evaluate risks stemming from economic and political circumstances. Georgia remains a small, developing, open economy that is highly dependent on regional turbulence, which increases the need for understanding local capital markets given different scenarios. This research derives a framework that will benefit long-term investors exposed to GEL (the Lari, the Georgian currency) securities and enable policymakers to assess the risk-return profile of local institutional investors. In the near future, our framework can be used by many different investors in Georgia, both institutional and non-institutional.

2. Literature Review

The two core blocks that this research builds on are our macroeconomic modeling and the balanced asset allocation approach, which combined to create a complete framework of top-down asset allocation for long-term investors. Flavin and Wickens (2003) showed that macroeconomic variables help to improve estimations of asset volatility, which in turn is a crucial factor for deriving optimal portfolio allocations either via a traditional approach or through the more exotic type of balanced portfolio framework (Shahidi, 2015) which is employed in this research. A more recent paper by Sebastian and Gebbie (2019) argued that macroeconomic variables help to explain equity market trends in the case of South Africa. Further research by Aithal et al. (2019) on Indian stock market indices showed that macroeconomic variables combined with modern data science techniques predict index movements with 87%–92% accuracy. The influence of macroeconomic variables on financial market trends is easy to justify. However, one should be careful in choosing explanatory variables for a specific economy, especially in the case of developed markets where the economic literature is small. We concentrate on the existing chain of papers produced by Maliszewski (2003) and the NBG working group, which are related to the Georgian economy specifically. For asset allocation purposes, we chose a balanced portfolio framework that arrives at a better risk-return profile than the current allocation of the pension fund portfolio, and shows that by balancing risk across different scenarios, funds can narrow the volatility of an investment portfolio.

This research concentrates on two-stage asset allocation diverting from the conventional methods that assume constant volatility and, as a result, a continuous efficient frontier. Timmermann and Blake's (2005) estimate improved after including the time-varying factor and showed that pension funds lost –0.2% per annum during market timing, based on a large panel of UK funds. A recent paper on the time-varying nature of risk by Díaz and Esparcia (2021) suggested deriving risk aversion parameters from time-varying risk premiums. More precisely, to take the time-varying nature of the frontier into account, this research estimates two portfolios derived from the different lengths of time for forecasting key variables. Using this approach, we are able to construct a conditional covariance matrix given the forecasted macroeconomic states in different scenarios.

With the current approach, portfolio risk is reduced by two fundamental factors: the time-varying covariance matrix; and balancing risk through possible scenarios (Shahidi, 2015). In multi-currency portfolios, it is possible to reduce risk by taking appropriate currency forward contracts (Topaloglou, Vladimirou, & Zenios, 2008). However, the Georgian currency market provides limited and expensive hedging instruments with forward contracts. Thus, we avoid this discussion as it cannot be practically replicated in our universe of asset classes. According to Topaloglou, Vladimirou, and Zenios (2008), besides reducing risk, multistage models also outperform single-stage models in terms of return. Another paper by Xiaoyue, Uysal and Mulvey (2022) showed that multistage models with risk parity and a mean-variance framework outperform fixed benchmarks on a risk-adjusted basis.

Moreover, these authors showed that a risk parity framework conceptually similar to our choice of balanced portfolio framework dominates mean-variance with a better sharp ratio (Xiaoyue, Uysal, & Mulvey, 2022). Finally, we chose a multistage model in a Balanced Portfolio framework that allows for a short-term tactical portfolio reacting to current macroeconomic developments and long-term target asset allocation that assumes the convergence of the economy to its steady state. As a result, long-term investors can choose the optimal allocation and short-term deviations of asset weights due to exogenous shocks in the economy.

The macroeconomic model consists of multiple components from which inflation and monetary policy paths are target variables for forecasting. Beltratti and Morana (2006) argued that inflation volatility is one of the key drivers of the breaking process in stock volatility. The inflation model rests on Maliszewski's (2003) paper, which underpinned price development dynamics and constructed a theoretical model for the Georgian economy. Although multiple other econometric models exist and could be integrated into this framework, we understand the implications of a small open economy that is well captured in the Maliszewski inflation forecasting model. As emerging markets are defined by specific characteristics, monetary policy channels are impaired; thus, the inflation rate reacts in particular ways. Montiel et al. (2010) indicated that emerging markets are characterized by weak institutional frameworks and the reduced role of securities markets. This causes key monetary policy channels to be impaired (Montiel, Spilimbergo, & Mishra, 2010). In this regard, the bank credit channel is dominant in most emerging countries due to low financial market development and the importance of bank lending to the private sector. This causes monetary policy rates to affect not only short-term rates, but also real economic variables (Abukaa, Alindaa, Minoiub, Peydrócd, & Presbiteroef, 2019). On the other hand, Barajas et al. (2018) argued that the mechanism of monetary policy transmission through credit channels could be weakened by remittance inflows that are likely to happen in emerging markets. Moreover, the efficiency of monetary policy in gouging inflation to its target depends on financial openness and economic globalization (Mendonça & Nascimentob, 2020). However, for emerging economies, it is a difficult task to manage external price shocks due to the high share of imports in trade balance and FX volatility. Recent literature has debated the notion that the difficulty for emerging economies in gouging inflation is derived from the fact that external price shocks have significant effects on domestic prices (Ha, Ivanova, Montiel, & Pedroni, 2019). Effiong et al. (2020) showed that a possible solution for better monetary transmission could be deepening financial sector development.

Technically estimating the monetary transmission mechanism for a small open economy is challenging. Therefore, we chose to follow the existing literature on the Georgian economy (Li, Adam, Berg, Montiel, & O'Connell, 2019). Another reason to use the Maliszewski model is derived from our goal of achieving the best possible estimate of monetary policy rules that the National Bank of Georgia (NBG) employs (NBG, Monetary Policy Reaction Function, 2016). This will allow better estimation of possible monetary policy dynamics given the forecasted inflation path in any given scenario. As a result, the ability to evaluate asset allocation decisions in different scenarios will be improved (Flavin & Wickens, 2003). Recent literature employing error correction mechanisms shows that stock market prices and macroeconomic indicators are in a long-run relationship (Kotha & Sahu, 2016; Lee & Brahmasrene, 2018; Misra, 2018).

3. Methodology

3.1. The Balanced Portfolio framework

Three fundamental factors mainly drive general principal asset class volatilities:

- Shifts in expected policy rate path (non-diversifiable).
- Shifts in investor risk appetite (non-diversifiable).
- **Shifts in the macroeconomic environment (diversifiable).**

As the first two sources of volatility are not diversifiable, long-term investments should seek diversification of macroeconomic factors that will result in the development of balanced returns over the investment horizon. The possibility of diversification of economic conditions is derived from the fact that different asset classes have different price responses to changes in unanticipated macroeconomic conditions, which appears not to be the case for Georgian capital market securities that are limited due to the early stage of development of the financial sector. The pricing function of every asset class incorporates expectations of GDP (gross domestic product) growth and inflation; thus, if what the market expects is not realized, then the price should change and reflect the new reality where economic conditions are different. Based on these two fundamental macro variables, we establish four different scenarios relative to market expectations, which are illustrated in Figure 1.

First, we assume that markets are functioning well and expected future economic environments are priced well into any asset class, which is why any realization of the future that was not expected will change asset class pricing. Even in the case of Georgia, where we have incomplete markets and low liquidity, there are still key players who are forming expectations about future economic conditions and affecting the pricing of assets. NBG is one of these players that affect the pricing of all GEL asset classes by forming expectations of future economic conditions and disclosing policy rate paths over medium-term horizons. If economic conditions change in a way that was not anticipated by NBG when setting the policy rate path, it will adjust its expectations and change the policy rate direction, which will alter the pricing of all GEL asset classes, including the Treasury and the Certificate of Deposit (CD).

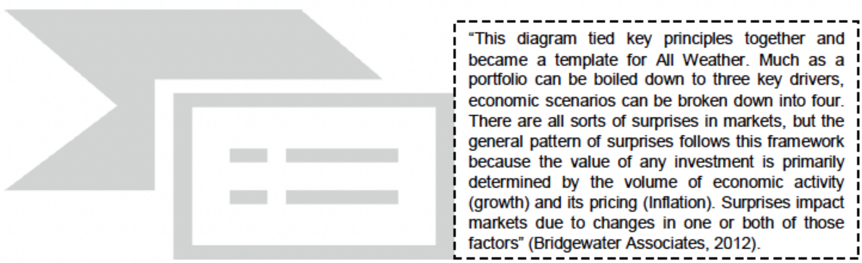

Figure 1. *Possible economic conditions based on a Balanced Portfolio*

Source: *Bridgewater Associates, 2012*

It is now essential to learn how different unanticipated economic conditions will affect different asset classes. This is where we get the opportunity to diversify and balance our investment portfolio. First, we show the general examples of asset class performance across different unanticipated economic conditions (inflation and growth scenarios). Then, we move closer to GEL securities for investment portfolios to decompose return structure and attach macroeconomic links to see the effects of different macro scenarios. This will help us to explore the opportunities for possible diversification even under such limited eligible assets.

A general example will include plain vanilla securities: Long-Term Treasury, Long-Term Treasury Inflation-Protected Securities (TIPS), Equity, and Commodities. Below, four tables (Table 1, Table 2, Table 3 and Table 4) summarize asset price movements given the realization of this scenario based on Balanced Portfolio research.

Table 1. *The effects or unanticipated economic conditions on Long-Term Treasury pricing*

Relative to market expectations	Treasury price feedback
High inflation	Declines
Low inflation	Rises
High growth	Declines
Low growth	Rises

Source: *Bridgewater Associates, 2012*

Table 2. *The effects of unanticipated economic conditions on Equity pricing*

Relative to market expectations	Equity price feedback
High inflation	Declines
Low inflation	Rises
High growth	Rises
Low growth	Declines

Source: *Bridgewater Associates, 2012*

Table 3. *The effects of unanticipated economic conditions on TIPS pricing*

Relative to market expectations	TIPS price feedback
High inflation	Rises
Low inflation	Declines
High growth	Declines
Low growth	Rises

Source: *Bridgewater Associates, 2012*

Table 4. *The effects of unanticipated economic conditions on Commodity pricing*

Relative to market expectations	Commodity price feedback
High inflation	Rises
Low inflation	Declines
High growth	Rises
Low growth	Declines

Source: *Bridgewater Associates, 2012*

3.2. The Balanced Portfolio's edge

The securities described above have different price responses to the unexpected economic scenarios realized. Therefore, investors implementing a balanced portfolio framework can construct an asset allocation strategy that will be neutrally balanced to changes in economic conditions. This can be achieved first by selecting the counterbalancing asset allocation classes and second by selecting balanced weightings between asset classes so that when the same macroeconomic environment causes one asset class to underperform, there are other asset classes in the portfolio that outperform its average returns so that it adequately compensates the portfolio loss. The key task left is to understand the market consensus view about economic conditions and how GEL-denominated asset classes are affected by different economic scenarios. This will allow for the selection of assets and respective weights to neutralize the effects of unexpected economic conditions. The remainder of the research describes how the consensus view about the economic conditions can be understood and linked to the performance of our investment portfolio.

3.3. Macroeconomic links to Benchmark Portfolio

To understand how the Macro Model is developed, we first deconstruct the Benchmark Portfolio into different return components and attach macroeconomic links to it, which are crucial for projecting possible portfolio performance across different scenarios.

To test our Macro Model, we took the current Benchmark Portfolio of the Georgia State Pension Agency for eligible asset classes: global equity (MSCI), GEL treasuries, and GEL CDs. We chose this Benchmark Portfolio because, first of all, it is actually in use, and its benefits are connected to millions of Georgian citizens who are members of the Funded Pension Scheme in Georgia.

3.4. Equity return macro channels

The global equity MSCI (Morgan Stanley Capital International) return part of the portfolio consists of the capital return (i.e., price appreciation/depreciation and dividend distribution) and FX (foreign exchange market; GEL exchange rate movement) components. It is easy to see that the capital return component completely depends on global economic trends and company valuations. At the same time, FX is derived from domestic and regional economic developments. The GEL exchange market reacts to market movements generated by both domestic and regional agents. Later, we will demonstrate how NBG reacts to these market activities (only in its mandate to protect price stability), and how it is therefore a crucial player to be incorporated into our macroeconomic forecasting model. These relationships are summarized in Figure 2.

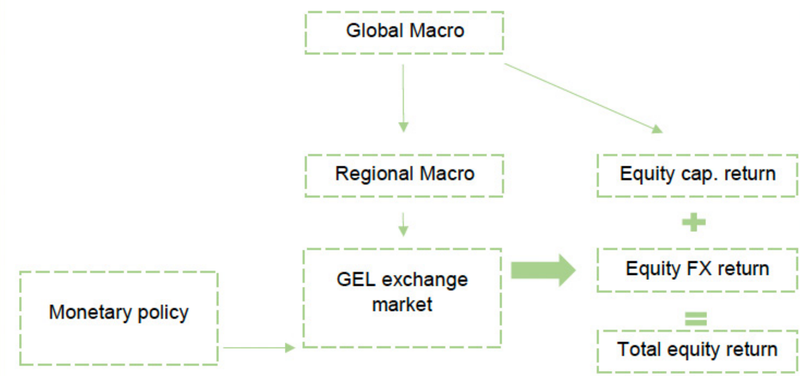

Figure 2. *Equity return macro channels*
Source: *Author's model description*

3.5. Treasury and CD return macro channels

The next more significant part of portfolio return is generated by GEL Treasuries and CDs, which are interconnected by credit risk premium. The role of market pricing in CD valuation also needs to be clarified. It is safe to assume that treasury prices are a function of the expected monetary policy rate and banks' liquidity objectives due to the REPO (repurchase agreement) agreement with NBG. The first part of the treasury pricing function depends on monetary policy objectives, which respond to the short-term expected inflation path and current economic activity in the form of an output gap. This component is explicitly modeled by estimating the monetary policy response function that outputs a forecasted medium-term policy rate path, which is further explained in the next section of this paper. The second part of treasury pricing is harder to estimate as it depends on banks' liquidity preferences due to the REPO operations for which treasuries are used.

For CD pricing, if we follow the book value principle, which mechanically "shuts down" volatility, then the macro-economic environment affects CDs through the credit risk factor. However, if we analyze CDs on a fair value basis then the following holds true: a) in a rising inflation and rising GDP growth environment, on the one hand, interest rate are rising which negatively affect CD prices. However, credit risk premium is declining, which, on the other hand, might have a positive effect. Therefore, the net effect between the two shall be analyzed; b) under rising inflation and falling GDP growth, this is certainly negative for CD prices, while there are rising interest rates and rising credit risk premiums; c) under falling inflation and falling GDP growth, interest rates are falling, which is on the one hand positive. However, credit risks are increasing, so here it also depends on the net effect; d) under falling inflation and rising GDP growth, there is also a net effect between GDP growth rate (a positive effect on credit risk premiums) and falling inflation rates (a negative effect through the interest rate channel).

Finally, inflation enters this model by affecting the total real return of all portfolio assets. It is crucial to understand that inflation not only narrows real return but also affects the interest rate path by altering the NBG response function. The effect of FX rate on inflation and monetary policy response is another important relationship to estimate in the model. These described macro channels are summarized in Figure 3.

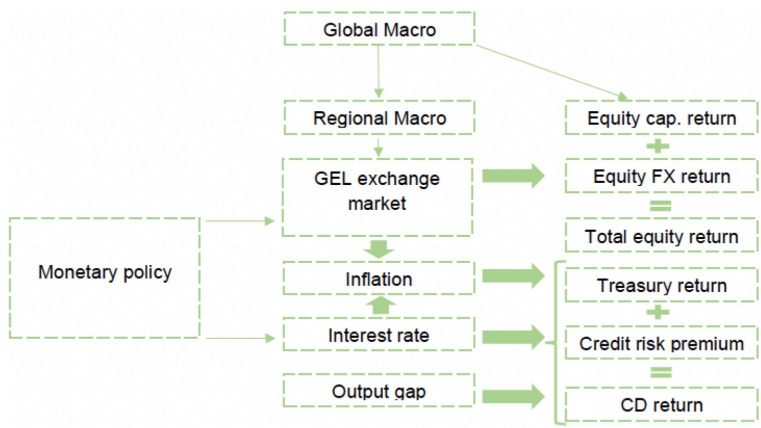

Figure 3. *Treasury & CD return macro channel*

Source: *Author's model description*

3.6. Framework overview

1. Inputs from the macroeconomic model are used to derive asset price developments for two horizons – one year and five years – and four different scenarios.
2. The resulting asset prices are then used to calculate the risk and return of assets in each scenario.
3. Calculated risk is used to balance risk in each scenario by taking asset weights to equalize weighted risk for every asset in the given scenario.
4. In this way, we receive four portfolios in each scenario that are each balanced in their respective scenario. These portfolios are assigned weights in such a way as to equalize the weighted risk of each portfolio.

5. We calculate final weights by multiplying the resulting weighted risk from steps 3 and 4 for each asset. This gives the final asset weights of the Balanced Portfolio, which is balanced in each scenario.

Inputs from the macroeconomic model:

$Inf_{t,s}$ – Monthly inflation

$MPR_{t,s}$ – Monetary policy interest rate

$FX_{t,s}$ – USD to GEL exchange rate

Here $t = 1, M$, where $M = 12$ *or* $M = 60$ denotes elements in a monthly time series and

$s = 1,4$ refers to distinct macroeconomic scenarios.

Selected benchmark grade asset classes:

1. Georgian Zero-Coupon Certificate of Deposit (CD) with 24 months of maturity.
2. Georgian Zero-Coupon Certificate of Deposit (CD) with 60 months of maturity.
3. Georgian Treasury Note with 60 months maturity.
4. Foreign equity – iShares MSCI World ETF (URTH).

The selected example follows the current low-risk benchmark portfolio of the Pension Agency of Georgia.

Other inputs for the Monte-Carlo simulations

$YC_{t,n}$ – the Georgian Lari Yield Curve

$CDYC_{t,n}$ – the Georgian CD Yield Curve

$PE_{t,n}$ – Equity prices in USD

Here $t = 1, M$, where $M = 12$ *or* $M = 60$ denotes elements in monthly time series and $\boldsymbol{n}$ is the index of instance in the Monte-Carlo simulation.

Both the Georgian Lari Yield Curves and the Georgian CD Yield Curves are represented using the Nelson-Siegel parametric model:

$$y(m) = \beta_0 + \beta_1 \frac{1 - \exp(-m/\tau)}{m/\tau} + \beta_2 \left(\frac{1 - \exp(-m/\tau)}{m/\tau} - \exp(-m/\tau) \right) \quad (1)$$

With the fixed value of $\tau = 1.39237$ and m being the maturity in years.

The link between forecasted macroeconomic parameters and the Monte-Carlo simulations

While the forecasted USD to GEL exchange rate is directly used to convert simulated equity prices into GEL, forecasted monthly inflation is used to obtain inflation-adjusted real returns:

$$Rr_{t,s} = \frac{Rn_{t,s}}{1 + Inf_{t,s}}$$

here $Rr_{t,s}$ and $Rn_{t.s}$ are the real and nominal returns for the $t-th$ month and s scenario, respectively.

We empirically estimate the average difference between the monetary policy interest rate and the Georgian Lari yield at 1-week maturity, and obtain 0.002695. To apply the forecasted scenarios to the simulated Georgian Lari yield curves and Georgian CD yield curves, we adjust β_0 (in equation (1)) for each yield curve as follows:

$$\hat{\beta}_0 = \beta_0 + MPR - YC(m) + 0.002695 \quad (2).$$

Here, $\hat{\beta}_0$ is the adjusted value of β_0 and $YC(m)$ is the Georgian Lari yield at 1-week maturity.

Constructing the balanced portfolio:

Using the Monte-Carlo simulations, we calculate standard deviations $\sigma_{i,s}$ and returns $r_{i,s}$ for each asset class in each scenario.

Next, we define the weights of asset classes in each scenario to allocate equal risk to each selected asset class:

$$W^a_{i,s} = \frac{\frac{1}{\sigma_{i,s}}}{\sum_{i=1}^{n} \frac{1}{\sigma_{i,s}}} \quad (3)$$

Here, $W^a_{i,s}$ is the normalized asset class weights, and n is the number of selected assets $(i = 1..n)$.

Once we have the weights of each asset class, we use the Monte-Carlo simulations for each portfolio with different scenarios and obtain returns r^p_s and STDs σ^p_s.

The next step toward finding a balanced portfolio within all scenarios is to define the weights of each scenario, so that risk allocation within scenarios is equalized:

$$W^p_s = \frac{\frac{1}{\sigma^p_s}}{\sum_{s=1}^{4} \frac{1}{\sigma^p_s}} \quad (4),$$

Where W^p_s is the normalized weight of s scenario.

Then, the weights of assets in final balanced portfolio W_i are calculated as follows:

$$W_i = \sum_s W^a_{i,s} \cdot W^p_s . \quad (5)$$

3.7. The macroeconomic model

From the macroeconomic channels developed in the previous section, we see key economic variables and their interconnected relationships that are important to project portfolio performance. Besides careful treatment of the macroeconomic forecasts of each variable, it is crucial to understand that their relationship should be taken as one whole organism and not as separate parts of one structure, since we often observe circular references in macroeconomic theory. A good example of this could be inflation and economic activity, which are interconnected by virtue of the macroeconomic constructs that we know at this point.

The starting point of forecasting is first to understand the current economic stance and analyze possible medium-term developments from that standing. Based on this view, we first developed a quarterly macroeconomic report that helps to analyze key macroeconomic trends and relationships. In the previous section, we described target macroeconomic variables that affect benchmark portfolio performance, and that are listed below:

a) Global macro – affects equity markets and regional economies from which it transmits to the Georgian economy.
b) GEL exchange market – affects equity FX return, inflation rate, and thus monetary policy, while monetary policy decisions are affected by foreign flows and monetary policy.
c) Inflation – affects the real return of all assets and formulates the inflation expectations that are key variables for the monetary response function. It is affected by the FX rate and interest rate channels through monetary policy, while also being influenced by domestic economic activity.
d) Output gap – a proxy for economic activity and the cyclical position of the economy. The final structural view of this relationship is described in Figure 4.

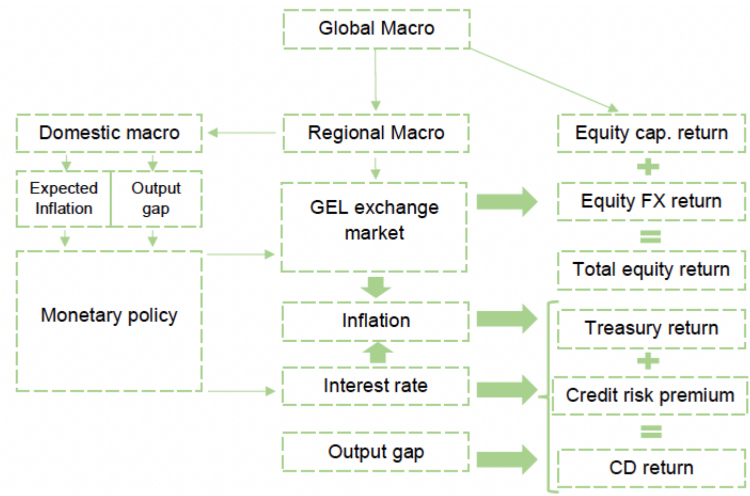

Figure 4. *The final structure of macroeconomic links to our investment portfolio assets*

Source: *Author's model description*

3.8. Estimating the monetary policy response function

At this point, domestic macro developments are the most important for analyzing return projections as the portfolio is 80% exposed to GEL securities. From the domestic macro, we first focus on monetary policy as it influences both interest rate path and, indirectly, FX rate (when pressure on prices is high), which finally has an effect on real interest rates through inflation. We take the Taylor Rule type function described by NBG (NBG, Monetary Policy Reaction Function, 2016) equation 6 below to forecast the policy rate path. To estimate equation 6, we need to forecast inflation after four periods (i.e., expected inflation π_{t+4}) and estimate the output gap ($\hat{Y}$).

$$i_t = \gamma_1 i_{t-1} + \gamma_2 i_t^N + \gamma_3(\pi_{t+4} - \pi_t^{tar}) + \gamma_4 \hat{Y}_t + \varepsilon_t \quad \textbf{(6)}$$

- i_t is the policy rate (Target variable estimated using OLS procedure in Python)
- i_t^N is a neutral policy rate
- π_{t+4} is expected inflation after four periods (forecasted with VECM model in Python)
- π_t^{tar} is target inflation
- $\hat{Y}_t$ is the output gap (currently estimated with HP filter in R, which will be updated later with a semi-structural Kalman filter)

Despite realizing the importance of a full structural model that reflects all important macroeconomic relationships, we first start with a semi-structural vector error correction model. VECM equation 7 is based on NBG (NBG, FPAS, 2016) and IMF (International Monetary Fund) working papers (Maliszewski, 2003). There are a few reasons for choosing the VECM model: first and foremost, it is developed by NBG modeling documentation, which is important in reflecting the expected inflation that monetary authorities project, which will help to estimate the monetary policy response function (Taylor Rule). Secondly, structural model development takes more time, and these models need more accuracy in terms of short-term forecasting versus VECM models that are efficient in short-term forecasting. Finally, we combine VECM with a Taylor Rule type function and an output gap estimated by a HP filter (this can be updated by a semi-structural Kalman Filter with New-Keynesian Philips Curve). In this setup, we forecast the next 24 months' inflation based on VECM and estimate the monetary policy response function where we input forecasted inflation that finally yields a policy rate projection. All models are built in Python and excel, which helps to maintain flexibility in estimation techniques.

$$\Delta p_t = \sum_{i=1}^{k} p_i^p \, \Delta p_{t-i} + \sum_{i=1}^{k} p_i^m \, \Delta m_{t-i} + \sum_{i=1}^{k} p_i^e \, \Delta e_{t-i} + p^f \, \Delta p^f{}_t + p^o \, \Delta p^o{}_t + \mu * ecm_{t-1} + \sum_{i=1}^{k} D_i + u_t \quad \textbf{(7)}$$

- $\sum_{i=1}^{k} p_i^p \, \Delta p_{t-i}$ describes the dependence of prices on their own lagged changes.
- $\sum_{i=1}^{k} p_i^m \, \Delta m_{t-i}$ describes the dependence of prices on the lags of change in money supply (Δm_{t-i}).
- $\sum_{i=1}^{k} p_i^e \, \Delta e_{t-i}$ describes the dependence of prices on the lags of change in the effective exchange rate (Δe_{t-i}).
- $p^f \, \Delta p^f{}_t$ describes the dependence of prices on the current period change in relative food cpi (Δp^f).
- $p^o \, \Delta p^o{}_t$ describes the dependence of prices on the current period change in relative oil price index (Δp^o).
- $\mu * ecm_{t-1}$ is a short-term adjustment factor of prices to the long-term equilibrium after the previous period's deviation.
- $\sum_{i=1}^{k} D_i$ is a dummy variable to adjust the seasonality of data in the model.

3.9. Macroeconomic scenario analysis

Macroeconomic scenarios are chosen to first cover the most likely/consensus scenario (baseline) for next year and then deviations from it based on economic activity and the possible depreciation of the Georgian Lari.

3.9.1. Baseline scenario

As a result, the baseline forecast reflects the consensus view that economic activity will continue to strengthen in 2023, and global commodity price pressure will persist during 1H23. Also, one-off factors such as the utility subsidy effect on inflation during 1Q22 are included in all scenarios. Thus, model inputs of exogenous variables (real growth, commodity price & oil price) are calibrated according to the market view. This method is also used for subsequent scenarios. In the baseline scenario, high inflation continues at the end of 2022 and in 1Q23, and then declines rapidly as one-off factors (utility subsidy, commodity price pressure) fade away, as shown in Figure 5. As a result, tight monetary policy is maintained during 1H23, which then declines gradually, shown in Figure 6.

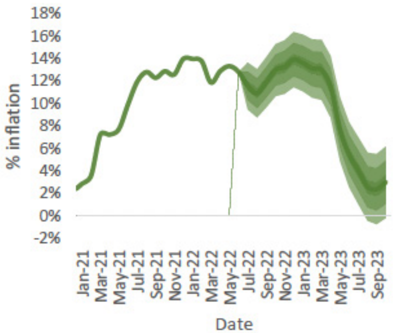

Figure 5. *Inflation forecast (baseline)*
Source: *NBG*

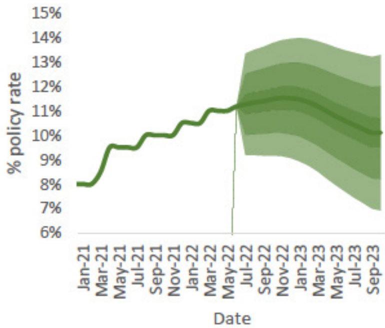

Figure 6. *Policy rate forecast (baseline)*
Source: *NBG*

3.9.2. High inflation and high growth scenario

The following scenario assumes higher-than-expected (baseline) growth, thus pushing prices slightly higher than in the baseline. In the Balanced Portfolio framework, this scenario constitutes higher-than-expected growth and inflation, shown in Figure 7. This can be justified by improved business/consumer confidence due to improved credit activity and better-than-expected inflows. As a result, the monetary policy forecast yields higher values for 1H23 and starts to decline later than in the baseline, shown in Figure 8.

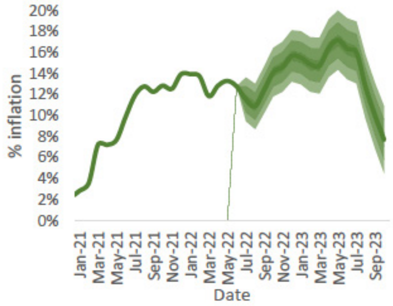

Figure 7. *Inflation forecast (high inflation–high growth)*
Source: *NBG*

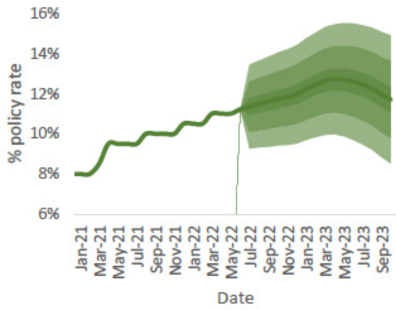

Figure 8. *Policy rate forecast (high inflation–high growth)*
Source: *NBG*

3.9.3. High inflation and low growth (FX) scenario

Similar to the high growth and high inflation scenario, we could assume another FX depreciation and forecast inflation and policy rate given this assumption, as shown in Figure 9 and Figure 10. This serves another purpose of generating high inflation, low growth economic conditions, and evaluating portfolio performance according to the Balanced Portfolio framework. Also, it reflects our belief that continued CA (Cash Account) deficit and corresponding pressure on FX and on prices will continue in the next decade, which will be reflected in the volatility of both inflation and FX rate.

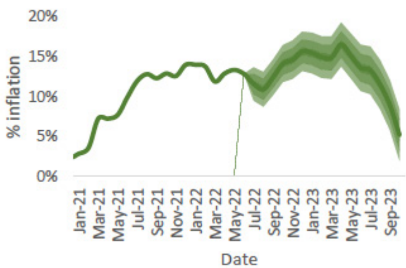

Figure 9. *Inflation forecast (high inflation–low growth-FX)*
Source: *NBG*

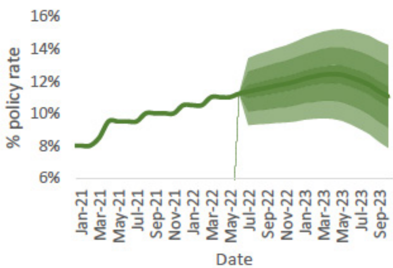

Figure 10. *Policy rate forecast (high inflation–low growth-FX)*
Source: *NBG*

3.9.4. Low inflation and low growth scenario

The last scenario assumes lower-than-expected growth, thus a faster decline in prices and, accordingly, a fast exit from tight monetary policy as shown in Figure 11 and Figure 12. This scenario is useful to evaluate asset class performance in a low inflationary and growth environment, finally allowing us to see room for diversification, if any.

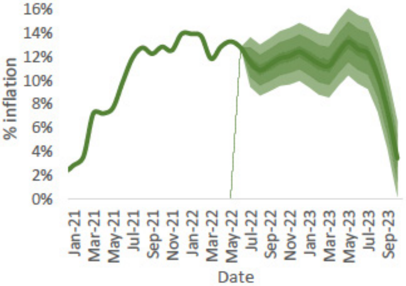

Figure 11. *Inflation forecast (low inflation–low growth)*
Source: *NBG*

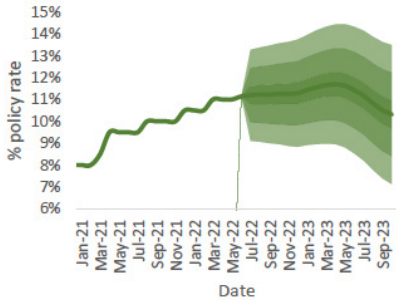

Figure 12. *Policy rate forecast (low inflation–low growth)*
Source: *NBG*

4. Results

4.1. The results of scenario analysis with a Benchmark Portfolio

To use macroeconomic scenarios in the Monte-Carlo simulation, the forecasted policy rate was taken as the average of simulated GEL yields. In this way, we gauged simulation around the forecasted policy rate. Inflation was directly linked to simulated asset prices during real return calculation. At the same time, the projected FX rate was used when converting the MSCI simulated price to the GEL equivalent. FX rate is the extra source of income, as GEL rates are volatile due to the continued CA deficit.

Before presenting results, we list eligible assets and their performance expectations across different scenarios:

- **Georgian government treasuries** – a) under a rising inflation and rising GDP growth environment, treasuries tend to underperform, while there are expectations of raising interest rates; b) under rising inflation and falling GDP growth, again expectations of raising interest rates drive its underperformance; c) on the other hand, under falling inflation and falling GDP growth, treasuries tend to overperform, while interest rate expectations are declining; d) the same overperformance holds true under falling inflation and rising GDP growth.

- **CD** – if we follow the book value principle, which mechanically "shuts down" volatility, then the macro-economic environment affects CDs through the credit risk factor. However, if we analyze CDs on a fair value basis, then the following holds true: a) under a rising inflation and rising GDP growth environment, on the one hand, interest rates rise, which negatively affects CD prices. However, the credit risk premium declines, which, on the other hand, might have a positive effect. Therefore, the net effect between the two shall be analyzed; b) under rising inflation and falling GDP growth, this is certainly negative for CD prices, while there are rising interest rates and rising credit risk premiums; c) under falling inflation and falling GDP growth, interest rates are falling, which is on the one hand positive. However, credit risks are increasing, so here it also depends on the net effect; d) under falling inflation and rising GDP growth, there is also a net effect observed between GDP growth rate (a positive effect on credit risk premiums) and falling inflation rates (a negative effect through the interest rate channel).
- **GEL-denominated international equity** – here, it shall be highlighted that foreign equity prices themselves are neutral to the Georgian macro-economic environment and, therefore, only through FX can macro conditions affect the Benchmark Portfolio. If inflationary pressures are brought by the FX channel into the economy, then this works as a positive diversifiable in the portfolio. On the other hand, if inflationary pressure is caused by high real GDP growth, this is the time when the other FX effect can be neutral or even negative due to the appreciation effect.

4.2. The performance of the Benchmark Portfolio in the baseline scenario

Looking at the results, we can derive what types of relationships between asset classes and macro variables hold true. Despite similar outcomes, portfolio performance is evaluated for two investment horizons – 1-year and 5-year – and the final results show risk-return characteristics which differ in scale only. The baseline scenario forecasted increasing inflation during 2H22–1Q23 that negatively affects return, but an important consideration is the high initial interest rates at which the portfolio will be constructed. Therefore, despite tight monetary policy during 2H22, declining rates have a stronger positive return factor than high inflation at the start of the investment horizon. This is why the benchmark portfolio outperforms the baseline scenario (First bar on Figure 13, Figure 14, Figure 15, and Figure 16).

4.3. The performance of the Benchmark Portfolio in a high inflation low growth (FX) scenario

In this scenario, benchmark performance is second best due to higher-than-expected inflation pushing the policy rate slightly higher than the benchmark. Here, high inflation stems from FX depreciation paired with low economic activity. However, it is interesting that FX depreciation, which drives inflation up, positively affects portfolio performance through Global Equity (MSCI) FX return. This diversification gives a slight edge over the 4.3 scenarios during the 1-year horizon, while in 5 years it results in similar returns as 4.3. With political instability and weak foreign flows (a persistent CA deficit), it is crucial to treat FX diversification carefully as the next decade might not be too different for the Lari.

4.4. The performance of the Benchmark Portfolio in a low inflation low growth scenario

In terms of return, this scenario is the second worst for benchmark portfolios, while risk results are slightly mixed due to different shock effects in the first years and then convergence to a neutral policy rate. It should be noted that in the longer horizon return in this scenario improves due to declining rates.

4.5. The performance of the Benchmark Portfolio in a high inflation high growth scenario

This scenario is similar to the previous one and is underperforming due to high inflation and a faster increase in interest rates compared to the baseline. This means that introducing diversifiers such as local FX-denominated equity, fixed income, and commodity could be beneficial as they overperform in strong growth environments and could balance the decline of portfolio return in this scenario, which is also due to the FX effect.

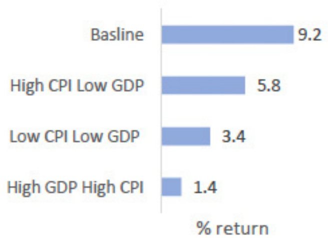

Figure 13. *Benchmark portfolio performance across macro scenarios (1-year returns)*

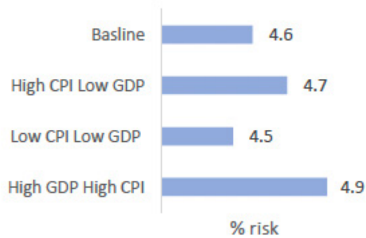

Figure 14. *Benchmark portfolio performance across macro scenarios (1-year risk measures)*

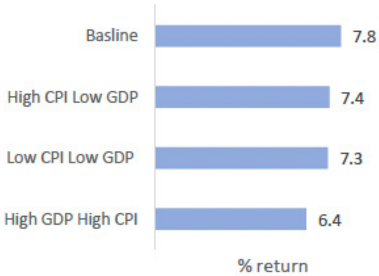

Figure 15. *Benchmark portfolio performance across macro scenarios (5-year returns)*

Source: *Author's calculations*

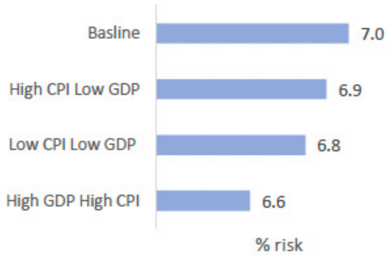

Figure 16. *Benchmark portfolio performance across macro scenarios (5-year risk measures)*

To test the credibility of our macro model and corresponding Monte-Carlo simulation results, we looked at similar periods of high inflation and high growth with corresponding FX depreciation in 2017 and derived back-testing results. From Table 5, we can observe that the diversification effect that we discussed exists in real data and shows a similar 1% improvement over a non-MSCI portfolio. Moreover, we validated that a low inflation, low growth environment conclusively beats a high inflation, high growth environment, which was one of the worst scenarios in the Monte-Carlo generated results.

Table 5. *Back-testing results of the Benchmark Portfolio:*

Back-testing results for 2017 (high inflation, high growth with FX depreciation)		Back-testing results for 2012 (low inflation, low growth)	
Assets	**Return**	**Assets**	**Return**
CD60% + GOV20%	6.7%	**CD60% + GOV20%**	22.4%
CD60% + GOV20% + MSCI20%	7.6%	**CD60% + GOV20% + MSCI20%**	20.5%
CD	5.9%	**CD**	22.0%
GOV	9.3%	**GOV**	23.8%
MSCI	10.6%	**MSCI**	13.1%

4.6. Deriving a Balanced Portfolio

As we see in the results of the Benchmark Portfolio, it has high volatility across different economic scenarios that results in the unfair distribution of gains to participants due to large differences when withdrawal occurs. To narrow risk for all economic scenarios and obtain a better return profile, we derived two portfolios that will be compared to the current Benchmark Portfolio in different scenarios and in the historical context. Balanced Portfolio 1 is optimized by looking at one-year look-ahead data, while Balanced Portfolio 5 is constructed using a five-year look-ahead. The resulting weights are shown in Figure 17 and Figure 18:

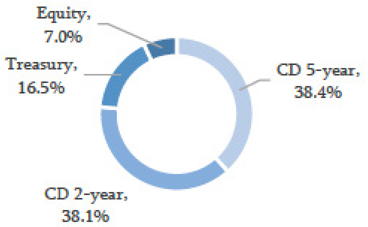

Figure 17. *Balanced Portfolio 1 weights*
Source: *Author's calculations*

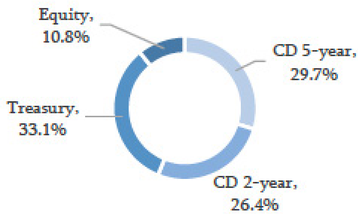

Figure 18. *Balanced Portfolio 5 weights*
Source: *Author's calculations*

In the figures below, we see that both balanced portfolios outperform the benchmark. In the short-run tactical allocation case, Balanced Portfolio 1 has a lower risk in all scenarios and dominates on returns except in the high inflation low GDP case (Figure 19 and Figure 20). Thus, it creates a better risk-return profile and is the dominant benchmark in all scenarios. In the long-run asset allocation case, Balanced Portfolio 5 has lower risk and dominates based on return in all scenarios, without exception (Figure 21 and Figure 22). In the historical context, while both balanced portfolios outperform the benchmark slightly, it is evident that the volatility of the benchmark is larger, which would have resulted in an unfair allocation of gains to participants withdrawing at different times (Figure 23).

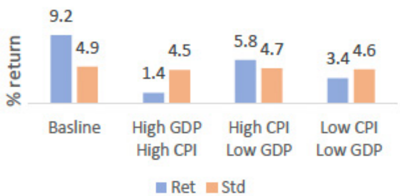

Figure 19. *Benchmark Portfolio performance across macro scenarios (1-year)*
Source: *Author's calculations*

Figure 20. *Balanced Portfolio 1 performance across macro scenarios (1-year)*
Source: *Author's calculations*

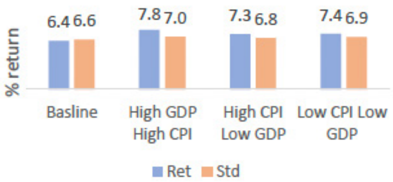

Figure 21. *Benchmark Portfolio performance across macro scenarios (5-year)*

Source: *Author's calculations*

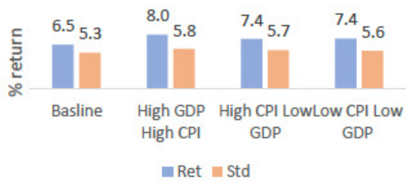

Figure 22. *Balanced Portfolio 5 performance across macro scenarios (5-year)*

Source: *Author's calculations*

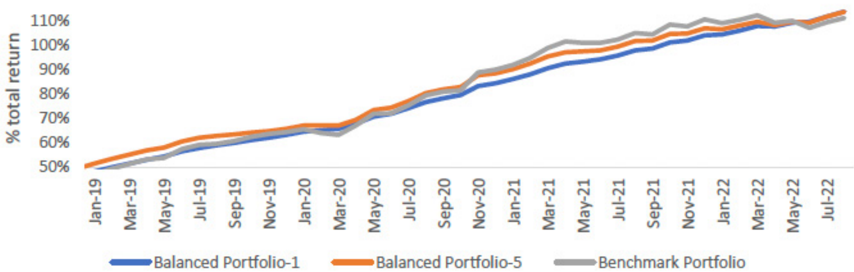

Figure 23. *Portfolio historical performance*

Source: *Author's calculations*

5. Discussion

5.1. Recommendation

From the results of Balanced Portfolio comparisons, it is evident that the benchmark could be improved even in the current asset mix. First of all, a tactical allocation exercise should allow for maintaining optimal tilting versus long-term strategic allocations, which will improve the risk-return profile of the portfolio. Secondly, looking from the risk side and balancing across scenarios shows that the equity part of the Benchmark portfolio is weighted too strongly; thus, lower allocation in that direction can improve the portfolio.

5.2. Future research directions

We accept that the nature of forecasting is not an exact science and depends on both expert judgment and the careful use of economic models. That is why projected variables should stand on a mixture of structural and plain vanilla econometric models. At this point, we have developed a framework that estimates the policy rate path and corresponding forecasted inflation rate. Currently, real GDP is projected by taking a ballpark consensus view of yearly growth and distributing it across months based on previous data on economic activity. This can be replaced by an econometric model based on Principal Component Analysis across different methods of GDP calculation. As a result, economic activity will be forecasted based on multiple models, which will improve forecast accuracy. The next steps can also involve replacing the HP filter with a semi-structural Kalman-Filter that can be used for output gap estimation. In the future, we also see the need for developing individual company risk assessment frameworks that could be a mixture of Bloomberg and Fitch risk models. This can help to improve counterparty risk valuation and credit risk premium estimation for CD securities. All of the above techniques will improve estimation accuracy and might be a good source of validation for this research. The natural continuation of this paper is to test the framework across different developing markets and understand the similarities/differences of this group. In this research direction, key points could involve the effects of different monetary policy regimes (tightening/expansionary) that very much determine the returns of domestic market instruments. Another interesting topic for future research in the area of emerging market securities is to understand the effects of FX volatility on the multi-currency portfolio – i.e., estimate the correlation between domestic and foreign currency denominated assets to achieve optimal diversification benefits from asset allocation.

6. Conclusion

Performance across different scenarios exposed the weaknesses of the current Benchmark Portfolio, which tends to perform poorly during a higher-than-the-market-expected growth environment. The underperformance of this portfolio in the high growth scenario can be balanced by introducing asset classes that perform well in these settings. It appears that a high growth scenario is favorable for GEL corporate fixed income, domestic FX-hedged equity (TBC & BOG) and international instruments (TIPS, Commodity, etc.). During a "High inf. (FX)" scenario, increasing exposure to FX denominated assets could be a balancing factor due to the frequent GEL depreciation that benefits a foreign asset portfolio, while corresponding high inflation benefits GEL securities through monetary policy tightening. Thus, domestic FX-hedged equity can balance portfolios in both high inflation-growth and high inflation-FX depreciation cases. Also, the introduction of GEL inflation-linked securities to the market can bring a slight edge to the return, and improve the balance of the portfolio.

Possible diversification factors and their performance in different macroeconomic conditions are listed below:

- Georgian Corporate Fixed Income – has similar performance as CDs. Moreover, cause-effect channels on credit risk premiums are much more direct.
- Ref-rate linked deposits – this is difficult. Results depend on the net change between nominal rates and inflation. Thus, in inflationary scenarios, nominal interest rates rise. However, this does not have any effect on bond prices in nominal

terms. However, if inflation is rising at a higher rate, then the net effect will be negative. In addition, GDP growth positively affects this while credit risk premiums are decreasing and there is a fixed credit risk premium. On the other hand, GDP decline affects this through the credit risk channel.

- FX-hedged Georgian Equity (TBC and BOG) – a) inflation growth has a negative effect, while the cost side, through an increase in the FX effect and a rise in the IR effect, increases; b) GDP growth is positive while the cost of risk is decreases and repayments increase.

Although the Georgian market is in its first stages of development in terms of liquidity and the variety of its instruments, institutional and retail investors can replicate the same portfolio due to the base cost being very low for both investor types, thus benefiting from the insights that result from this paper. The modernization of the market around the globe and the reduction of fees for international instruments is reflected in Georgian markets, as brokerage companies provide low-cost trading platforms (partnered with SAXO BANK, DriveWealth etc.). For domestic securities, local brokerage companies provide channels for retail investors with low fee structures. The accessibility of instruments and taxation benefits are partly a result of the country's policy objective of financial market development, declared both by the Georgian Ministry of Finance and the National Bank of Georgia.

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