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Theoretical Exploration of Generative AI Applications in Economic Forecasting During Global Pandemics

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ABSTRACT

The COVID-19 pandemic has underscored the importance of advanced predictive models in understanding and mitigating the global economic disruptions caused by health crises. This review paper explores the application of Generative Artificial Intelligence (GenAI) techniques for macroeconomic forecasting during pandemics, focusing on its ability to predict economic slowdowns, job losses, and stock market volatility. Through an in-depth analysis of recent research, we discuss various approaches, including Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and other machine learning algorithms, used to model the complex economic behaviors witnessed during pandemics. GenAI models have demonstrated significant potential in capturing the dynamics of pandemic-induced recessions, simulating economic disruptions such as unemployment spikes, shifts in GDP, and changes in global trade. Notably, these models can generate realistic data by simulating numerous pandemic scenarios, allowing policymakers to assess various economic interventions. The ability of GenAI to integrate diverse datasets — including healthcare, labor market data, and fiscal measures — enhances its forecasting accuracy, providing more granular insights into specific regions and sectors affected by global health crises. While GenAI has shown promise in improving the accuracy and adaptability of macroeconomic forecasts, challenges remain in terms of model interpretability, data integration, and the limitations of historical data, particularly in highly uncertain environments. Nevertheless, the findings suggest that these technologies can offer valuable tools for proactive financial measures, informing policy decisions related to fiscal stimulus, labor market interventions, and recovery plans in the wake of global pandemics. This paper concludes by outlining the future directions for the development of GenAI-based forecasting systems and their integration into economic policy planning.

Keywords – Artificial Intelligence, Data Integration, Economic Forecasting, Generative Adversarial Networks, Generative AI, Global Pandemics.

I. INTRODUCTION

The global economy is highly susceptible to disruptions caused by various factors, and among the most impactful of these disruptions are pandemics. In recent history, the COVID-19 pandemic has underscored the vulnerabilities in economic systems, leading to widespread economic slowdown, job losses, shifts in consumer behavior, and unprecedented volatility in financial markets. The ability to forecast these disruptions accurately is essential for governments, financial institutions, and organizations to take timely and effective measures, minimizing long-term economic damage. However, traditional macro-economic forecasting methods, which rely on historical data, linear models, and expert judgment, often fall short during such highly uncertain and unprecedented events like global pandemics [1].

In this context, Generative Artificial Intelligence (GenAI) has emerged as a promising tool for modeling and predicting macro-economic trends during global crises. GenAI encompasses advanced machine learning techniques that can generate synthetic data and model complex relationships within data sets, making it a valuable tool for capturing the dynamic and often nonlinear effects of pandemics on the economy [2]. By leveraging large-scale data from diverse sources, such as health data, financial market data, government policies, and consumer behavior, GenAI can generate realistic economic scenarios that take into account a wide array of factors that traditional models might miss [3].

The application of GenAI in macro-economic forecasting during global pandemics offers several key advantages. First, it can simulate a broad range of economic outcomes, providing decision-makers with multiple potential scenarios and insights into the effects of various policy interventions. This proactive approach enables governments and organizations to prepare for a range of possible futures and adopt timely, data-driven strategies to mitigate economic damage [4]. Second, GenAI models can integrate and process large volumes of heterogeneous data—ranging from financial market trends and job market indicators to social mobility patterns and healthcare data—allowing for a more comprehensive understanding of how pandemics impact various sectors of the economy [5]. Finally, GenAI has the potential to improve forecasting accuracy, as it can adapt and learn from real-time data and continuously refine its predictions [6].

Despite its promising potential, the application of GenAI in macro-economic forecasting during pandemics also presents challenges. These challenges include the need for high-quality, real-time data; the difficulty in modeling the wide range of unpredictable human behaviors; and the ethical considerations surrounding data privacy and the responsible use of AI [7]. Moreover, as GenAI models are inherently complex and sometimes difficult to interpret, understanding the underlying factors influencing economic trends becomes a challenge for policymakers who rely on these models for decision-making.

This paper aims to review the emerging role of Generative AI in macro-economic forecasting during global pandemics, with a focus on its capabilities, applications, challenges, and potential for shaping economic policy during times of crisis. By examining the current literature, case studies, and ongoing advancements in AI and economics, this review will explore how GenAI can be harnessed to improve economic forecasting in future global health crises, thereby providing a more resilient foundation for addressing the socio-economic impacts of pandemics.

II. The Role of Generative AI in Economic Forecasting

2.1 Overview of Generative AI

Generative AI (GenAI) refers to a subset of artificial intelligence that focuses on creating new data based on learned patterns from existing datasets. Unlike traditional machine learning models, which primarily focus on classification or regression tasks, GenAI models have the ability to generate realistic data points, scenarios, and predictions that mimic real-world phenomena. At the core of GenAI lies the ability to understand and replicate the complex, nonlinear relationships found in large and diverse datasets, making it an ideal tool for macro-economic forecasting during global disruptions like pandemics [8].

GenAI has gained significant attention in various fields, from art and entertainment to healthcare and economics, for its potential to simulate and predict outcomes under uncertain conditions. By utilizing deep learning algorithms such as Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformer-based models, GenAI can generate realistic economic forecasts that are more dynamic and adaptable to rapidly changing conditions [9].

In the context of economic forecasting, GenAI can model various complex relationships, such as the interplay between health data, government policies, and economic indicators. This capability is particularly useful during pandemics, where the interplay between these factors is not well understood and traditional models may fail to capture the full scope of the economic impact [10].

2.2 Applications of Generative AI in Macroeconomic Forecasting

Generative AI offers several key applications in macro-economic forecasting, especially during global pandemics. Some of these applications include:

2.2.1 Predicting Economic Slowdown and Recovery

One of the most important aspects of macro-economic forecasting during a pandemic is predicting the extent and duration of economic slowdowns. GenAI can model various economic scenarios by generating synthetic data that simulates the effects of different levels of pandemic severity on GDP growth, inflation rates, and employment levels. For example, GenAI can simulate how various regions might be affected differently by a pandemic, based on historical data, demographic factors, and government interventions. These predictions allow governments and organizations to anticipate economic downturns and develop mitigation strategies such as stimulus packages or public health measures aimed at reducing the economic impact [11].

2.2.2 Forecasting Job Losses and Labor Market Trends

The labor market is one of the sectors most heavily impacted by global pandemics, as businesses close, workers are furloughed, and unemployment rates spike. GenAI can predict job losses across different sectors of the economy, allowing policymakers to respond more effectively. By generating synthetic labor market data based on real-world employment trends, education levels, and industry shifts, GenAI models can project unemployment rates and identify sectors that may be at risk. Additionally, GenAI can simulate the impact of various policy interventions, such as unemployment benefits or job training programs, to determine their effectiveness in mitigating job losses and fostering labor market recovery [12].

2.2.3 Modeling Financial Market Behavior

Financial markets tend to exhibit extreme volatility during global pandemics, driven by uncertainty and shifting investor sentiments. GenAI models can be used to simulate stock market trends and asset price fluctuations by analyzing historical data and generating realistic predictions of market behavior during crises. These models can take into account variables such as investor sentiment, government policies, and the state of global trade, providing financial institutions and investors with valuable insights into how markets may react to

the pandemic's unfolding. Moreover, GenAI can help assess the impact of different recovery scenarios, from V-shaped rebounds to prolonged economic stagnation [13].

2.2.4 Scenario Planning for Policy Interventions

Governments and organizations need to assess various potential policy interventions during a pandemic to minimize the long-term economic impact. GenAI allows for the generation of multiple scenarios, simulating the effects of different policy measures such as lockdowns, travel restrictions, fiscal stimulus, and healthcare investments. By running these scenarios, GenAI models can help policymakers understand the trade-offs between public health and economic outcomes, providing them with a clearer picture of how various actions may shape the recovery process [14].

2.3 Advantages of Generative AI in Economic Forecasting

Generative AI provides several significant advantages in the context of macro-economic forecasting during pandemics:

- **Enhanced Forecasting Accuracy:** Traditional economic forecasting methods often rely on historical data, which may not fully capture the complexities and rapid changes that occur during global health crises. GenAI can generate predictions based on dynamic, real-time data, improving the accuracy of forecasts. It can also adapt to new data, making it more resilient to changes in the economic landscape, such as shifts in public behavior or new government interventions [15].
- **Handling Complex and Nonlinear Relationships:** Pandemics affect the economy in complex ways that traditional models may not fully capture. For instance, the relationship between healthcare outcomes, government policies, and economic indicators may be highly nonlinear. GenAI's ability to generate synthetic data from large and diverse datasets allows it to model these complex interactions, producing more realistic and accurate economic predictions [16].
- **Proactive Decision-Making Support:** GenAI's ability to simulate multiple economic scenarios and outcomes offers decision-makers the ability to plan proactively, rather than reactively. By understanding a range of potential future scenarios, policymakers can implement strategies that minimize negative economic consequences and accelerate recovery. This capability is especially crucial during a pandemic, where the future remains highly uncertain, and timely interventions can have a significant impact on mitigating long-term damage [17].

2.4 Challenges in Using Generative AI for Macroeconomic Forecasting

While Generative AI offers considerable promise in economic forecasting, its application also presents challenges that need to be addressed:

- **Data Quality and Availability:** The success of GenAI in economic forecasting is heavily dependent on the quality and availability of data. During a global pandemic, real-time data can be fragmented, inconsistent, and incomplete. Ensuring that the data used for training GenAI models is accurate, comprehensive, and up-to-date is crucial for generating reliable predictions [18].
- **Model Interpretability:** Generative AI models, especially deep learning models, can be highly complex and difficult to interpret. This lack of interpretability makes it challenging for policymakers and economists to understand the underlying reasons for the predictions generated by these models. Ensuring transparency and explainability of GenAI models is vital for their broader acceptance and use in economic decision-making [19].
- **Ethical Considerations and Bias:** The use of AI in economic forecasting raises ethical concerns, particularly related to bias and fairness. If the training data used for GenAI models contains biases—

whether from historical inequalities or systemic issues—these biases may be perpetuated in the forecasts. This can lead to unequal policy interventions and reinforce existing disparities in the economy. Addressing these ethical concerns is essential to ensure that AI-driven forecasts support fair and equitable decision-making [20].

III. Case Studies of Generative AI in Macroeconomic Forecasting during Global Pandemics

This section delves into real-world case studies where Generative AI (GenAI) has been used to model and forecast macroeconomic trends during global pandemics, with a particular focus on the COVID-19 crisis. The COVID-19 pandemic introduced unprecedented challenges to both global health systems and economies, making the need for adaptive, real-time forecasting tools more crucial than ever. Generative AI models, particularly those built using advanced machine learning techniques like Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Transformer-based models, became essential tools for predicting various economic indicators during this global health crisis. These case studies serve as a critical examination of how GenAI can be leveraged to simulate economic outcomes, providing policymakers and organizations with actionable insights for decision-making during uncertain times.

The case studies examined here not only showcase the success of GenAI but also underscore the challenges and limitations encountered when applying AI in macroeconomic contexts. By understanding these practical applications, we can refine AI models for future pandemics and other global disruptions.

3.1 Case Study 1: COVID-19 Economic Forecasting with Generative AI Models

The COVID-19 pandemic served as a severe stress test for global economies. Governments, financial institutions, and organizations required accurate and real-time economic forecasts to mitigate the impact of the pandemic and facilitate recovery. Generative AI models were used extensively to simulate multiple economic scenarios under various pandemic conditions. These models helped forecast GDP growth, unemployment rates, and stock market fluctuations, offering valuable insights for policymakers and economists.

3.1.1 Approach and Methodology

In this case study, multiple institutions employed Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) to simulate economic outcomes based on historical data, pandemic statistics, and government policy interventions. Models were trained using data from global markets, healthcare systems, and government fiscal policies. For example, different lockdown intensities, vaccine rollout speeds, and stimulus measures were incorporated to simulate their impact on GDP, inflation, and employment across countries. The models were used to generate multiple future scenarios to help governments prepare for best-case, worst-case, and moderate-case outcomes [21].

3.1.2 Key Findings and Insights

The results revealed significant regional variations in economic performance during the pandemic. For example, countries that imposed strict lockdowns and provided timely fiscal interventions fared better in terms of GDP contraction compared to those that delayed or imposed milder restrictions. The models also demonstrated the economic resilience of certain sectors, such as technology and healthcare, which continued to perform well even amidst widespread lockdowns. On the other hand, industries like tourism, retail, and hospitality saw severe contractions, leading to massive layoffs and closures [22].

Additionally, the models predicted the type of recovery each region would experience. Countries that implemented rapid vaccination campaigns and effective public health policies experienced a V-shaped recovery,

while regions that struggled with vaccine distribution or prolonged lockdowns faced a slower, U-shaped recovery [23].

3.1.3 Lessons Learned

This case study highlighted the importance of high-quality, real-time data and the need for continuous model recalibration. While GenAI models were effective in generating predictions, the uncertainty in early pandemic data required constant updates to model parameters. Moreover, the models illustrated the need for integrating both economic and non-economic factors—such as healthcare data, social distancing policies, and consumer behavior—into the forecasting process to capture the full scope of the pandemic's impact on economies [24].

3.2 Case Study 2: Using GenAI for Predicting Job Losses and Labor Market Trends during COVID-19

The labor market was one of the most severely impacted sectors during the COVID-19 pandemic. Unemployment rates soared as businesses closed and layoffs became widespread. Generative AI models were utilized to predict employment trends across various industries, allowing governments and organizations to plan targeted policy interventions to mitigate job losses.

3.2.1 Approach and Methodology

In this case study, GANs and recurrent neural networks (RNNs) were applied to predict job losses and employment trends in different sectors. These models were trained on historical labor market data and pandemic-related factors such as government interventions (e.g., wage subsidies, furlough schemes), industry disruptions, and shifting consumer behaviors. The models generated predictions of unemployment rates and employment shifts in various industries, such as retail, hospitality, technology, and healthcare. They also simulated the impact of different policy responses on the labor market, such as the extension of unemployment benefits or the introduction of job training programs [25].

3.2.2 Key Findings and Insights

GenAI models revealed significant disparities in job loss rates between industries. For example, sectors like travel, hospitality, and retail experienced dramatic employment declines, while healthcare, technology, and logistics saw a demand for more workers, especially as the global economy adapted to remote working and digital services. The models also highlighted that specific policies, like wage subsidies and job support schemes, could help prevent mass unemployment, particularly in sectors that were temporarily affected by lockdowns [26].

Moreover, the models predicted shifts in the nature of work. The pandemic accelerated trends such as remote working and digitalization, which were expected to persist even beyond the recovery period. This insight was critical for long-term workforce planning and investment in technology infrastructure [27].

3.2.3 Lessons Learned

One key lesson from this case study was the value of including external factors, such as government fiscal responses and sector-specific policy measures, in predicting labor market outcomes. However, the models also faced challenges due to data inconsistencies and delays in reporting unemployment statistics. Regular updates and calibrations were required to ensure accurate predictions. Additionally, as labor market behavior can shift rapidly, especially during a crisis, the need for fast adaptation of models to real-time data became evident [28].

3.3 Case Study 3: Stock Market Behavior Forecasting with GenAI Models during Global Pandemics

Financial markets are often highly volatile during global crises, and the COVID-19 pandemic was no exception. Investor behavior, market sentiment, and government interventions all influenced stock prices in unpredictable ways. Generative AI models were used to predict market behavior and help investors make more informed decisions.

3.3.1 Approach and Methodology

For this case study, Transformer-based models (such as BERT and GPT) were used to forecast stock market behavior. These models were trained on a combination of historical market data, real-time pandemic-related news, government policy announcements, and macroeconomic indicators. The goal was to simulate the impact of global health events and economic recovery scenarios on various stock indices and assets, such as commodities, real estate, and equities [29].

3.3.2 Key Findings and Insights

The GenAI models successfully forecasted extreme market volatility, as well as shifts in investor sentiment. For instance, technology and pharmaceutical stocks, which were seen as essential during the pandemic, experienced significant gains. On the other hand, industries such as travel, energy, and manufacturing saw sharp declines in stock prices. The models also indicated that government interventions, such as fiscal stimulus measures and vaccine development, had a direct impact on investor confidence, leading to market rebounds in certain sectors [30].

Furthermore, the models demonstrated the importance of sentiment analysis in forecasting stock market behavior. News articles, social media posts, and government announcements were integrated into the models to gauge market sentiment, which was crucial for understanding market movements [31].

3.3.3 Lessons Learned

The primary takeaway from this case study was the importance of incorporating real-time, non-structured data such as news articles and social media into market forecasts. The ability of GenAI models to process and analyze such data allowed for more accurate predictions of market behavior. However, the volatility of the market during the pandemic posed challenges for long-term forecasting, highlighting the need for continuous updates and short-term prediction intervals [32].

3.4 Case Study 4: Scenario Planning for Policy Responses during the 2020 Global Recession

As the COVID-19 pandemic led to a global recession, governments worldwide implemented various policy responses to stabilize their economies. Scenario planning using Generative AI was instrumental in understanding the potential economic outcomes of these policy interventions.

3.4.1 Approach and Methodology

In this case, researchers used GenAI models to simulate the effects of different policy interventions, such as fiscal stimulus packages, unemployment insurance, and trade restrictions, on economic recovery. These models incorporated a wide range of global data, including public health measures, fiscal and monetary policies, and regional economic indicators. By simulating multiple policy scenarios, the models helped governments understand the potential outcomes of their decisions on GDP growth, unemployment, inflation, and other macroeconomic indicators [33].

3.4.2 Key Findings and Insights

The models demonstrated that early, large-scale fiscal stimulus packages were the most effective in promoting economic recovery, especially when combined with strong public health measures. Additionally, they showed that the recovery was highly dependent on the speed of vaccination rollouts and the containment of the virus. For instance, countries that imposed strict lockdowns early in the pandemic but failed to implement robust stimulus measures saw slower recoveries [34].

3.4.3 Lessons Learned

This case study emphasized the importance of timely, data-driven policy responses. While GenAI models provided valuable insights into the potential effects of different interventions, the accuracy of these predictions depended heavily on the quality and timeliness of the data fed into the models. Furthermore, the study

highlighted the limitations of forecasting during unprecedented global events, where model assumptions can be challenged by real-time developments [35].

The case studies reviewed in this section highlight the effectiveness of Generative AI in forecasting macroeconomic trends during global pandemics. By simulating various scenarios, GenAI models helped policymakers, financial institutions, and businesses understand the potential impacts of the pandemic on key economic indicators such as GDP, employment, and stock market behavior. However, these case studies also reveal the challenges faced when applying GenAI to dynamic, rapidly changing global environments. These challenges include data inconsistencies, model recalibration requirements, and the need for real-time updates. Nevertheless, the insights gained from these case studies are invaluable for improving future economic forecasting models.

IV. LITERATURE REVIEW

Table 1: Comprehensive Review of Recent Techniques in the Field of Generative AI for Macroeconomic Forecasting during Global Pandemics

Ref. No.	Objective	Methodology	Key Findings	Implications
[36]	Investigating the role of Generative AI in forecasting economic recessions caused by pandemics	GANs and VAEs used to simulate multiple economic scenarios based on health data and economic indicators	Found that GenAI models are capable of simulating realistic recessions, with a focus on GDP contraction and unemployment trends	GenAI models can assist policymakers in planning early-stage interventions during pandemics
[37]	Examining how AI-driven economic models predict recovery scenarios after pandemics	Machine learning models, including ensemble learning, used to analyze economic recovery trajectories post-COVID-19	The models predicted rapid recovery in sectors like technology, but prolonged stagnation in travel and hospitality	Highlights the need for targeted economic support for struggling sectors during recovery
[38]	Understanding the impact of government fiscal responses on economic recovery during a pandemic	Simulation models incorporating fiscal stimulus packages, public health measures, and labor market dynamics	Fiscal stimulus and healthcare interventions led to faster economic recovery, especially when combined with rapid vaccination rollouts	Governments should prioritize comprehensive stimulus packages and health policies to hasten recovery
[39]	Forecasting stock market behavior during pandemics using AI models	Transformer-based models (e.g., BERT, GPT) to forecast stock market volatility by integrating pandemic data	The models successfully forecasted increased volatility in the stock market, especially in sectors directly affected by the pandemic	Emphasizes the importance of real-time sentiment analysis and news incorporation in forecasting stock market behavior
[40]	Modeling labor market disruptions during pandemics	Recurrent neural networks (RNNs) applied to predict job	Job losses were disproportionately high in the retail and hospitality	AI-driven models can help design effective job retention policies

	and predicting job losses	losses and unemployment trends in various sectors	sectors, while tech and healthcare sectors saw minimal layoffs	and predict labor market recovery timelines
[41]	Evaluating the effectiveness of AI models in predicting economic shifts during COVID-19	Combined approach using deep learning and econometric models to predict key macroeconomic indicators	The study showed that GenAI outperformed traditional models in predicting unemployment rates, inflation, and GDP during the pandemic	Reinforces the superiority of AI-based forecasting tools over traditional econometric models in dynamic, crisis-driven scenarios
[42]	Predicting inflation trends during global pandemics using machine learning models	AI models, including deep neural networks (DNNs) and support vector machines (SVMs), to analyze inflationary pressures	Found that inflation predictions were more accurate when incorporating both supply chain data and pandemic-related economic disruptions	Shows how AI can improve inflation forecasting during periods of global economic instability
[43]	Analyzing global trade disruptions during pandemics through Generative AI	Generative adversarial networks (GANs) to simulate trade flow disruptions and predict post-pandemic recovery in trade sectors	The models identified a significant decrease in global trade volumes, with gradual recovery patterns observed in sectors like agriculture and manufacturing	Policymakers can use these insights to plan targeted support for trade-dependent industries
[44]	Understanding the role of Generative AI in creating dynamic economic recovery models	Integrating economic forecasting with real-time data updates to create adaptive recovery models	Found that models incorporating real-time data significantly improved recovery predictions	Emphasizes the importance of integrating real-time data and adapting models continuously to ensure accurate forecasting
[45]	Investigating the impact of social distancing on macroeconomic indicators using AI models	AI-based simulations of social distancing effects on GDP, unemployment, and inflation across different economies	Demonstrated that stringent social distancing policies led to significant GDP contractions, particularly in service-based economies	Calls for more nuanced policies to balance public health needs with economic sustainability
[46]	Evaluating the accuracy of AI-driven simulations in predicting pandemic-induced economic shocks	Hybrid model combining traditional economic theory with AI-based simulations	AI models provided more granular predictions, capturing specific regional economic shocks that were missed by traditional models	Highlights the need for AI integration into economic policymaking to improve precision in forecasting

[47]	Forecasting employment trends using AI in response to the COVID-19 pandemic	Use of GANs and VAEs to simulate employment shifts in response to government interventions like wage subsidies and furlough programs	The models predicted the mitigation effects of wage subsidies on unemployment in specific regions, especially in low-wage sectors	Policy implications suggest that targeted wage subsidies can be effective in maintaining employment during crises
[48]	Predicting the long-term economic impact of COVID-19 on global financial systems	Deep learning models used to analyze long-term shifts in financial markets and economic indicators	The models projected long-term shifts in investor behavior, with an increase in digital asset investment post-pandemic	Suggests that financial institutions need to prepare for long-term shifts in investment strategies, including a move towards digital assets
[49]	Using AI to predict macroeconomic trends during post-pandemic recovery phases	Multi-agent reinforcement learning models to simulate macroeconomic recovery paths	Found that different economic sectors had varying recovery timelines, with technology and pharmaceuticals leading the recovery	Encourages policymakers to develop sector-specific recovery strategies that consider the differing speeds of recovery across industries
[50]	Application of Generative AI in predicting supply chain disruptions during pandemics	AI-driven models to simulate global supply chain disruptions and predict recovery times based on pandemic intensity	The models showed that sectors heavily reliant on global supply chains, such as electronics and automotive, faced longer recovery times	Suggests the importance of diversifying supply chains and investing in digital infrastructure to reduce vulnerability to future global disruptions
[51]	Examining the role of AI in predicting macroeconomic behavior during the early stages of a pandemic	AI models applied to predict initial economic downturns during the early stages of COVID-19, using macroeconomic indicators and pandemic spread data	Models were able to forecast sharp contractions in global GDP within weeks of the pandemic's onset	AI can be crucial in providing early warnings for economic downturns, enabling faster policy responses
[52]	Forecasting global inflationary pressures using AI models during pandemic recovery	Machine learning models used to analyze inflationary trends by incorporating data from healthcare systems,	Predicted inflationary pressures that varied significantly across different economies, with supply chain disruptions	Highlights the importance of integrated data in predicting inflationary pressures and adjusting

		labor markets, and supply chains	being a key driver	monetary policies accordingly
[53]	Understanding the application of AI in long-term forecasting of unemployment trends post-pandemic	GAN-based models to simulate long-term unemployment trends and the effectiveness of various policy interventions	AI models predicted prolonged unemployment trends in sectors like hospitality and retail, with a gradual recovery expected in tech and healthcare	Suggests the need for long-term planning and targeted job retraining programs for displaced workers in affected industries
[54]	Predicting the effects of COVID-19 on global economic inequality using AI	AI models used to simulate the impact of COVID-19 on economic inequality across different demographics and regions	Found that the pandemic disproportionately affected low-income workers and marginalized groups, exacerbating global economic inequality	Calls for policies aimed at reducing inequality through targeted fiscal measures and social programs
[55]	Assessing the role of AI in predicting housing market behavior during global crises	Generative AI models used to forecast housing market trends during the COVID-19 pandemic and its aftermath	Predicted that housing markets in suburban and rural areas would see higher growth post-pandemic, while urban centers would experience slow recovery	Real estate markets should adjust to changing consumer preferences for remote work and space, focusing on suburban and rural investments

Despite the promising applications of Generative AI (GenAI) in macroeconomic forecasting during global pandemics, several limitations and research gaps persist in the field. One significant challenge is the interpretability of AI models, particularly with complex models such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), which are often seen as "black boxes." While these models provide high accuracy, their lack of transparency makes it difficult for policymakers to fully trust the forecasts or understand the underlying decision-making processes. Additionally, data quality and integration remain significant barriers. Many studies, such as those in [36], [37], and [41], highlight the difficulty in combining disparate data sources, including health-related data, economic indicators, and fiscal policy measures, to create accurate forecasts. Inaccurate, incomplete, or biased data can lead to misleading predictions, especially in unprecedented situations like the COVID-19 pandemic. Another limitation is the generalizability of these models. Many GenAI models were tested in the context of COVID-19, raising concerns about their applicability to future pandemics or other global crises that differ in nature or scale [42], [46]. Furthermore, while GenAI has shown potential in simulating economic disruptions, long-term forecasting beyond immediate recovery phases remains an area requiring more robust models. The literature, particularly from studies like [44] and [50], indicates that most AI models focus primarily on short- to medium-term predictions, leaving a gap in forecasting long-term economic behavior in a post-pandemic world. Lastly, sector-specific recovery predictions also remain underexplored. Many studies have provided general economic recovery predictions, but few have addressed the nuanced, sectoral variations in recovery patterns, as seen in the challenges faced by the retail, hospitality, and tech sectors [39], [47]. This highlights the need for more granular, sector-specific AI modeling

to improve the accuracy and relevance of predictions for various industries. Addressing these limitations and research gaps will be crucial for advancing the use of GenAI in macroeconomic forecasting, enabling more reliable, interpretable, and adaptable models for future global health crises.

V. CONCLUSION

The application of Generative AI (GenAI) in macroeconomic forecasting during global pandemics represents a transformative approach to understanding and managing the far-reaching economic impacts of health crises. This review has underscored the significant potential of GenAI models in predicting economic slowdowns, job losses, stock market fluctuations, and other macroeconomic indicators by leveraging diverse datasets and advanced machine learning techniques. By simulating complex economic behaviors induced by pandemics, these models offer invaluable insights for governments, policymakers, and businesses, aiding in proactive decision-making during crises. While the literature highlights the efficacy of models such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) in simulating recession scenarios, estimating the economic impact of fiscal interventions, and predicting labor market disruptions, several limitations and research gaps remain. Key challenges include the interpretability of GenAI models, which often operate as "black boxes," making it difficult to understand and trust their predictions. Data integration is another critical barrier, as economic forecasting requires the consolidation of diverse datasets — spanning healthcare, labor markets, and fiscal measures — that are often incomplete or biased. Furthermore, most GenAI applications have been tested primarily in the context of COVID-19, raising concerns about their generalizability to future pandemics with differing dynamics. Additionally, the current focus on short- to medium-term forecasting leaves long-term economic impacts and sector-specific recovery pathways underexplored. Addressing these limitations is crucial for enhancing the reliability and relevance of GenAI in macroeconomic forecasting. Despite these challenges, the potential of GenAI remains immense. One of its key advantages is the ability to integrate real-time data from multiple sectors, offering a holistic view of the economic landscape. This allows for more granular forecasting, such as identifying sector-specific disruptions and tailoring recovery plans for industries disproportionately affected by health crises, including hospitality, retail, and technology. Additionally, the use of GenAI for forecasting stock market behavior has shown promise in supporting informed decision-making by investors and financial institutions during volatile periods. To fully realize the potential of GenAI, future research and development must prioritize improving model interpretability, ensuring transparency and fostering trust among stakeholders. Further, developing techniques to mitigate biases in training data and enhance prediction accuracy in uncertain and unprecedented scenarios will be essential. Collaborative efforts between economists, data scientists, and policymakers are also necessary to align GenAI models with real-world economic realities and effectively guide financial measures. Long-term forecasting capabilities must be enhanced to simulate the sustained impacts of pandemics and support economic resilience. Generative AI offers a unique and powerful tool for macroeconomic forecasting in the context of global pandemics, enabling data-driven predictions that can mitigate economic disruptions and support strategic recovery planning. By addressing current limitations and fostering interdisciplinary collaboration, GenAI is poised to become a cornerstone in economic policy and planning, equipping global economies to navigate the challenges of the 21st century with greater resilience and adaptability.

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