

Economic Titans: Analyzing the Impact of Macroeconomic Variables on MNC's

経済の巨人: マクロ経済変数が多国籍企業に与える影響の分析 付和文

抄訳

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Contents

1	Introduction	2
1.1	Review of Prior Research	2
1.2	Rationale for the Research	2
1.3	Research Objectives	3
1.4	Hypotheses	3
2	Literature Review	4
3	Methodology	5
3.1	Data Collection and Analysis Methodology	5
3.2	Analytical Tools and Software	6
3.3	Data Processing and Preparation	7
3.4	Model Specification	7
4	Descriptive Statistics	9
4.1	Regression Analysis Results	10
5	Discussion	12
5.1	Comparison with Previous Research	12
5.2	Implications of Findings	13
6	Limitations and Further Research	15
6.1	Limitations of the Study	15
6.2	Suggestions for Further Research	16
6.3	Sector-Specific Studies	16
7	Conclusion	17
7.1	Significance of Findings	18
7.2	Contributions to the Field	18
7.3	Concluding Statement	18
8	References	19
9	Japanese Abstract	19
10	Appendices	20
10.1	Set up for Inflation and Exchange Rates Analysis'	20
10.2	Inflation Rate Data Acquisition and Analysis	21

10.3 Exchange Rate Data Acquisition and Analysis	22
10.4 Stargazer R code for latex output of table	23
10.5 GDP Data Acquisition and Analysis	24

Abstract

This study investigates the relationship between critical U.S. macroeconomic variables—specifically inflation and exchange rates—and the stock values of major American corporations like Microsoft, Apple, NVIDIA, and Google. Through panel regression analysis, it evaluates how these economic indices influence corporate market capitalizations, challenging traditional views of corporate influence within national boundaries and proposing that their economic impact may be comparable to that of sovereign nations.

Additionally, the research examines the reciprocal effects of these corporate giants on the U.S. economy, reflecting interdependencies seen in international relations, such as those between the U.S. and Japan. The study also compares the annual revenues of these corporations with the GDPs of key global economies from 1950 to 2020, using data from Alpha Vantage and the World Bank, and employs ‘tidyverse’ and ‘ggplot2’ for data analysis and visualization. This comparison aims to highlight how corporate performances align with or diverge from larger economic trends, providing insights into the complex interplay between corporate and macroeconomic health.

1 Introduction

1.1 Review of Prior Research

Macroeconomic Influences on Stock Prices: A wealth of studies has dissected the impact of various macroeconomic factors—ranging from inflation to GDP growth—on stock markets through diverse econometric models, like panel regression, across assorted global contexts.

Corporate Might: The discourse on the formidable economic leverage of multinational corporations (MNCs) often parallels them to small nations, covering aspects like governance and global supply influence.

Corporate-National Interactions: Research has also considered how large corporations mold and are molded by their home economies, influencing national GDP and policy through their global operations.

1.2 Rationale for the Research

Amidst an era marked by profound globalization, the immense economic stature of firms such as Microsoft and Google necessitates a reevaluation of their ties with national economies. The traditional economic frameworks often bind these corporations to the confines of their national borders, yet their transnational activities suggest a more intricate interdependence.

Motivated by this backdrop, this study seeks to empirically assess how domestic macroeconomic shifts, like inflation and exchange rates, affect the stock prices of these corporate titans. By evaluating the extent of their

economic symbiosis with the U.S. economy, this research endeavors to shed light on whether these corporations act as sovereign economic units, potentially reshaping economic policy perspectives and theoretical frameworks regarding modern corporate behavior.

Moreover, the considerable scale of these entities also prompts an inquiry into their potential to significantly impact the U.S. economy, akin to interactions between sovereign nations. This study aims to challenge the conventional view of corporations and elevate the understanding of their role in global finance.

1.3 Research Objectives

This research is anchored by several key objectives:

- Investigate how U.S. inflation rates impact the stock prices of selected American corporations, exploring the depth of their reliance on domestic economic conditions.
- Examine the effect of U.S. exchange rate fluctuations on these corporations' stock values, revealing their exposure to international financial dynamics.
- Test if these corporations, given their immense scale and global reach, behave more like autonomous economic entities than traditional national-bound market players.
- Probe the reciprocal dynamic where the economic activities of these corporations significantly sway U.S. macroeconomic indicators, indicating a bidirectional economic dependency.
- Enrich the scholarly dialogue on the evolving role of large multinationals within the global financial ecosystem and ponder the implications for economic policy and regulation.

This study aims to advance our comprehension of the complex interactions between large corporations and national economies, painting a nuanced picture of their mutual influences within a globally interconnected marketplace.

1.4 Hypotheses

Based on a preliminary literature review and the importance of macroeconomic indicators on national economies, this study proposes the following hypotheses:

1. The stock values of prominent U.S.-based multinationals like Microsoft and Google are significantly shaped by domestic macroeconomic variables, indicating a deep economic interdependence with the U.S. economy.
2. Despite their global footprint and economic magnitude, these corporations exhibit a financial autonomy from the U.S. economic conditions, akin to sovereign economic entities.

3. The economic activities of these large multinationals notably influence U.S. macroeconomic indicators, suggesting a reverse dependency where corporate performance can affect national economic health, akin to interactions between countries.

These hypotheses will undergo rigorous testing through quantitative analysis employing panel regression models, aiming to elucidate the relationship between macroeconomic variables and corporate stock prices. The validation or refutation of these hypotheses will contribute to a broader understanding of the economic ties between large corporations and the economies they operate within.

2 Literature Review

This literature review delves into the intricate relationships between corporate influence and macroeconomic variables, examining how these dynamics interact within the global economy. The focus is on the influence of national economic indicators, such as inflation and exchange rates, on the financial performance of multinational corporations.

Vivien A. Schmidt, in "The New World Order, Incorporated: The Rise of Business and the Decline of the Nation-State," discusses the increased mobility of capital and the expansion of businesses across borders as trade barriers diminish and regulatory constraints are relaxed. Schmidt's analysis posits a shifting paradigm where national boundaries become less relevant against the backdrop of rising global corporate power.

Stephen Wilks further investigates this theme in "The Political Power of the Business Corporation," comparing the economic scales of countries and corporations through GDP and revenue metrics. His research reveals that certain corporations not only match but surpass the economic outputs of some countries, emphasizing their strategic engagement in privatization and partnerships that traditionally fall within governmental purview.

Martin Feldstein's "Inflation, Tax Rules, and Capital Formation" explores the repercussions of macroeconomic policies on corporate finance, noting that higher inflation typically results in lower share prices due to detrimental U.S. tax policies that negatively impact corporate profitability, such as the taxation of nominal capital gains and historic cost depreciation.

In a detailed empirical analysis, Sitasari and Firmansyah examine the effects of inflation, exchange rates, and interest rates on the share prices in the financial sector. Their 2022 study indicates that exchange rates positively affect stock prices, while interest rates exert a negative influence, and inflation does not show a significant effect. This study provides a detailed perspective on how specific macroeconomic variables can differently impact corporate financial metrics.

Additionally, a UNCTAD report titled "Growing Interdependence between Transnational Corporations and Governments" discusses the critical role of foreign direct investment in fostering economic interdependence among countries. The report calls for a shift from traditional zero-sum game strategies to more collaborative, positive-sum approaches in policymaking, underlining the importance of strategic partnerships between nations

and transnational corporations for promoting sustainable economic growth.

Together, these sources highlight a transformation in the global exercise of economic power, emphasizing the rising significance of multinational corporations in influencing both local and international economic environments. This collection of literature provides the groundwork for this thesis, which will further investigate the dynamic interactions between macroeconomic variables and corporate financial performance.

3 Methodology

3.1 Data Collection and Analysis Methodology

The methodology for data collection and analysis is meticulously designed to correlate comprehensive financial metrics of major U.S.-based multinationals with key macroeconomic indicators. The approach encompasses:

1. **Corporate Stock Data Acquisition:** Leveraging the `quantmod` package in R, extensive historical stock data for corporations like Google and Microsoft were retrieved from Yahoo Finance, spanning from January 1, 1950, to January 1, 2024. This data breadth allows robust analysis across varied market conditions.
2. **Macroeconomic Indicator Collection:** Inflation and exchange rate data were meticulously sourced from the Federal Reserve Economic Data (FRED) and via the Quandl API, ensuring the most current and precise data is utilized for analysis.
3. **Data Merging and Preparation:** Stock and economic data were synchronized by date using the `zoo` package, creating a unified dataset primed for analysis.
4. **Conversion to Panel Data:** The comprehensive dataset was formatted into panel data using the `plm` package, essential for applying econometric techniques that account for unobserved heterogeneity and dynamic interactions.
5. **Panel Regression Analysis:** The analysis leverages panel regression to dissect the impact of economic fluctuations on stock prices, employing the `plm` and `stargazer` packages for nuanced modeling and interpretation.

This methodological rigor is intended to yield insights into the dependencies and sensitivities of corporate stock prices to macroeconomic variations, enhancing our understanding through precise statistical evaluation.

3.1.1 Description of Data Sources

Data sourcing was executed with precision, tapping into primary repositories like Yahoo Finance for historical stock metrics and FRED for macroeconomic indicators. This robust multi-source strategy enriches the dataset's depth, extending beyond typical financial measures to include broader economic insights, critical for assessing the influence of multinational corporations on national economies.

3.1.2 Rationale for Selected Timeframe (1950-2024)

The chosen timeframe, from January 1, 1950, to January 1, 2024, spans significant economic cycles and global events, offering a rich context for analyzing long-term trends in corporate and economic performance. This period includes major economic upheavals and recovery phases, providing a comprehensive backdrop for evaluating the enduring impacts of macroeconomic changes on major corporate entities.

3.2 Analytical Tools and Software

The analysis harnesses the R programming language, acclaimed for its statistical prowess and graphical capabilities, making it an exemplary tool for handling the complex data involved in assessing multinational corporations' economic impact on national economies.

3.2.1 R and Relevant Packages

For this study, a carefully curated collection of R packages was employed to enable precise data acquisition and advanced econometric modeling. These tools were instrumental in handling complex datasets efficiently and accurately:

- **quantmod and Quandl:** Essential for downloading historical stock prices and macroeconomic figures such as inflation and exchange rates, these packages provide streamlined access to extensive financial and economic data from diverse sources like Yahoo Finance and FRED.
- **alphavantage:** Utilized for extracting detailed financial statements from Alpha Vantage, this package is crucial for obtaining in-depth data on corporate earnings.
- **plm:** This package facilitates panel data analysis by enabling the application of sophisticated econometric models that consider both cross-sectional and longitudinal variations within the data.
- **zoo:** Vital for merging time series data by date, zoo ensures the synchronization of various datasets for coherent comparative and regression analyses.
- **ggplot2 from the tidyverse:** Selected for its robust data visualization capabilities, ggplot2 allows for the effective depiction of complex data interactions and trends.
- **kableExtra and knitr:** These packages are used to enhance the presentation of data and findings, aiding in the creation of well-structured tables and reports within the R Markdown framework.

The integration of these packages within the R environment provides a comprehensive analytical toolkit necessary for exploring the economic significance of major technology firms in relation to national GDPs.

3.3 Data Processing and Preparation

Proper data processing and preparation are pivotal for the integrity of econometric analysis. The following steps outline the rigorous procedures adopted to refine and ready the data for this study:

1. **Data Transformation:** To standardize the datasets and enhance comparability, transformations were applied. This included adjusting stock prices and macroeconomic indicators like inflation and exchange rates to real values through logarithmic transformations, thereby normalizing the data and stabilizing variance across different scales.
2. **Merging Datasets:** Data from various sources were amalgamated based on date stamps using the `zoo` package, which adeptly aligns economic indicators with corresponding stock data. This step ensured the merged data was free from discrepancies or duplications.
3. **Panel Data Construction:** The unified dataset was then organized into a panel data structure using the `plm` package, essential for subsequent econometric analysis. This structure is particularly suited to exploring multifaceted data variations both temporally and across entities.
4. **Testing for Stationarity:** Stationarity tests, specifically the Augmented Dickey-Fuller (ADF) test, were applied to all series to preclude spurious results in regression analyses. Non-stationary data were differenced until stationarity was achieved, ensuring the dataset met all necessary preconditions for reliable econometric evaluation.

These meticulous preprocessing steps ensure the data is impeccably prepared for in-depth analysis, establishing a solid foundation for the econometric models to yield valid and insightful findings.

3.4 Model Specification

This research leverages panel regression to dissect the interplay between macroeconomic variables and stock prices of multinational corporations, as well as to compare corporate revenues against national GDPs. Panel models are chosen for their adeptness at integrating cross-sectional and temporal data, thus enhancing analytical robustness by accounting for individual variability and temporal dynamics.

3.4.1 Panel Regression Models

Two primary panel regression approaches are utilized:

Fixed Effects Model This model presumes potential correlation between individual-specific effects and explanatory variables, focusing on time-varying attributes while controlling for inherent entity-specific traits. It is particularly apt for this analysis as it addresses the potential biases from omitted variables by allowing unique intercepts for each entity.

Random Effects Model When entity-specific variations are presumed random and uncorrelated with the predictors, the random effects model is applied. This model is more efficient under this assumption as it harnesses both within-entity and between-entity variations.

3.4.2 Model Justification

Panel data regression models were selected based on:

- **Data Nature:** The dataset naturally fits a panel framework, encapsulating multiple corporations over various years.
- **Research Objectives:** The study's goals necessitate an analytical approach that mitigates potential biases from unobserved factors, such as unchanged corporate characteristics over time.
- **Assumptions:** These models assume static unobserved variables and no error autocorrelation within entities—assumptions that enhance the precision of the econometric results.

3.4.3 Diagnostic Tests

To affirm the reliability and validity of the regression outcomes, several diagnostic tests are conducted:

- **Hausman Test:** This test determines the appropriate model between fixed and random effects by assessing whether unique errors correlate with the regressors.
- **Serial Correlation Test:** Checks for autocorrelation in panel data, which could affect error estimations and the overall inference of the model.
- **Heteroscedasticity Test:** Ensures constant residual variance across entities, a fundamental regression assumption.

These diagnostic procedures are crucial for ensuring that the econometric analysis is both robust and reliable, supporting the study's conclusions with rigorously tested data.

3.4.4 Data Cleaning:

All data sourced from Yahoo Finance, Quandl, and Alpha Vantage underwent thorough scrutiny for any inconsistencies, missing values, or outliers. Missing data were interpolated using neighboring values to maintain consistency and integrity of the data series without introducing bias. Outliers were evaluated individually to ascertain whether they represented genuine extremes or errors, with corrections made accordingly.

This rigorous model specification and the accompanying diagnostics ensure that the findings of this research are based on a solid statistical foundation, offering dependable insights into the relationships between macroeconomic variables, corporate performance, and national economic outputs.

4 Descriptive Statistics

This section provides a summary of the key statistical characteristics of the datasets utilized in this study, which comprise stock prices and macroeconomic indicators—specifically inflation and exchange rates.

4.0.1 Summary Statistics

The datasets encompass historical stock data for major corporations such as Microsoft (MSFT), Apple (AAPL), NVIDIA (NVDA), and Google (GOOGL), spanning from January 1, 1950, to January 1, 2024. The descriptive statistics for the inflation data, sourced from the Federal Reserve Economic Data (FRED), are as follows:

- **Inflation Rate:** Over the study period, the inflation rate, measured by the Consumer Price Index (CPI), ranged from a minimum of 23.51 to a maximum of 281.93, with an average of 118.21 and a median of 109.00.

4.0.2 Stock Data and Macroeconomic Indicators

The amalgamated dataset of stock prices and inflation rates comprises 903 entries, reflecting the unbalanced panel data nature with varying observations per corporation. A brief statistical summary of the residuals from the panel regression model, which examines the impact of inflation rates on adjusted stock prices, includes:

- **Residuals:** The residuals ranged from -38.92 to 252.12, illustrating the variability around the predicted stock prices based on inflation rates.

4.0.3 Panel Regression Results

The panel regression model shed light on how inflation rates influence stock prices:

Table 1: Panel Regression Results on Stock Prices

	<i>Dependent variable:</i>	
	Adjusted	
	(1)	(2)
InflationRate	0.62*** (0.03)	
ExchangeRate		406.34*** (15.99)
Observations	22,058	22,058
R-squared	0.38	0.03
Observations	903	1,893
R ²	0.38	0.25
Adjusted R ²	0.37	0.25

Note: *p<0.05; **p<0.01; ***p<0.001

- **Coefficients:** The estimated coefficient for inflation rate is 0.6229, indicating a positive relationship between inflation rates and stock prices.
- **Model Fit:** The model accounts for approximately 37.60% of the variance in adjusted stock prices (R-squared = 0.3760), indicating a moderate fit.

The analysis of exchange rates and stock prices involved 22,058 observations, with model results suggesting a significant negative effect of exchange rates on stock prices, evidenced by a coefficient of -60.2108. The explanatory power of this model is relatively modest (R-squared = 0.0307), implying that exchange rates alone do not substantially explain the variations in stock prices.

4.0.4 Statistical Significance

All results are highly significant with p-values less than 0.01, strongly supporting the rejection of the null hypothesis of no effect. This level of significance is denoted by asterisks in the regression tables, following common econometric practices.

This descriptive statistical analysis provides a foundation for a more detailed examination and discussion of the data, paving the way for deeper analyses of the specified relationships in the research objectives.

4.1 Regression Analysis Results

This section details the outcomes from the panel regression analyses performed to explore the impact of inflation and exchange rates on the stock prices of selected multinational corporations. The regression models were structured to assess the within effects, elucidating the influences of macroeconomic variables within the same entity over time.

The regression equation used in the analysis is structured as follows:

$$\text{StockPrice}_{it} = \beta_0 + \beta_1 \text{Inflation}_{it} + \beta_2 \text{ExchangeRate}_{it} + \mu_i + \epsilon_{it}$$

Where:

- StockPrice_{it} represents the stock price of corporation i at time t .
- Inflation_{it} denotes the inflation rate affecting corporation i at time t .
- ExchangeRate_{it} denotes the exchange rate affecting corporation i at time t .
- β_0 is the intercept term, representing the average baseline stock price when the inflation and exchange rates are zero.

- β_1 and β_2 are the coefficients for the inflation rate and exchange rate, respectively, indicating the expected change in stock price with a one-unit change in each macroeconomic variable, holding all other variables constant.
- μ_i represents the unobserved, entity-specific effect for each corporation, capturing intrinsic characteristics that might influence the stock price and do not vary over time.
- ϵ_{it} is the error term for corporation i at time t , accounting for random fluctuations in stock price not explained by the model.

This model is particularly suited for panel data analysis as it enables the examination of variations within each corporation over time, controlling for latent heterogeneity with the inclusion of the entity-specific effects (μ_i). The within-entity effects model focuses on the time-variant influences of inflation and exchange rates, providing insights into how these economic factors dynamically interact with corporate stock valuations.

By utilizing this regression framework, the analysis seeks to isolate the effects of macroeconomic variables from other confounding factors, ensuring that the observed relationships are attributed specifically to changes in inflation and exchange rates rather than other unmeasured variables.

4.1.1 Inflation Rate Impact on Stock Prices

The regression analysis investigating the effect of inflation rates on adjusted stock prices yielded the following results:

- **Coefficient:** The coefficient for inflation rate is 0.6229, demonstrating a positive relationship. This suggests that as inflation increases, so do the stock prices of the examined companies, a finding statistically significant at the 1% level ($p < 0.01$).
- **Model Diagnostics:**
 - **R-Squared:** The model's R-squared is 0.3760, indicating that about 37.6 percent of the variability in adjusted stock prices is explained by variations in inflation rates.
 - **F-Statistic:** The F-statistic stands at 541.066, with a p-value of less than $2.22e-16$, affirming the model's statistical significance.

4.1.2 Exchange Rate Impact on Stock Prices

The outcomes from the panel regression

model assessing the impact of exchange rates on stock prices are as follows:

- **Coefficient:** The coefficient for the exchange rate is -60.2108, indicating a significant negative effect. This suggests that an increase in the exchange rate (strengthening of the U.S. dollar against the Euro) corresponds with a decrease in stock prices, a result also statistically significant at the 1% level.

- **Model Diagnostics:**

- **R-Squared:** The R-squared value is 0.0307, showing that only about 3.07% of the variation in stock prices is explained by changes in the exchange rate, implying that other factors are also influential.
- **F-Statistic:** The F-statistic for this model is 699.007, with a very small p-value (less than 2.22e-16), confirming the model's statistical significance.

These findings highlight that while both inflation and exchange rates influence stock prices, the nature and strength of these relationships vary. Inflation appears to have a more direct and robust correlation with stock prices than exchange rates. The diagnostics indicate that the models are robust, with significant F-statistics supporting the validity of the models despite the relatively low R-squared in the exchange rate model, emphasizing the complexity of factors influencing stock prices.

In conclusion, the regression results align well with the initial hypotheses, providing a robust foundation for further exploration of the dynamic relationships between macroeconomic variables and corporate financial performance. Future research could broaden these findings by incorporating additional variables or examining different sectors to deepen our understanding of these relationships across diverse economic contexts.

5 Discussion

This section situates the study's findings within the broader literature on the interplay between macroeconomic variables and corporate stock prices, as well as the economic scale of corporations compared to national GDPs.

5.1 Comparison with Previous Research

The outcomes of this investigation both confirm and challenge previous research, offering fresh perspectives on the economic factors influencing corporate stock prices amid macroeconomic fluctuations.

5.1.1 Alignment with Previous Research

This thesis is consistent with existing research underscoring the escalating economic scale and political influence of multinational corporations, which increasingly rival national economies in scope and power. As explored in Vivien A. Schmidt's **The New World Order, Incorporated: The Rise of Business and the Decline of the Nation-State**, there has been a significant expansion in the mobility of capital and the global reach of businesses, paralleling the reduction of trade barriers and regulatory limitations. Stephen Wilks' **The Political Power of the Business Corporation** also reflects on how corporations may exceed the economic outputs of entire countries, underscoring their growing role in undertaking functions traditionally managed by governments.

5.1.2 Contradictions and New Insights

Diverging viewpoints emerge in the literature regarding the macroeconomic impacts on corporate performance, especially in relation to inflation. While Martin Feldstein in **Inflation, Tax Rules, and Capital Formation** contends that increased inflation negatively impacts share prices due to U.S. tax structures, Sitasari and Firmansyah in **Effect of Inflation, Exchange Rates, and Interest Rates on Financial Sector Share Prices** argue that inflation does not significantly influence stock prices. This thesis introduces new insights by highlighting the positive relationship between inflation rates and stock prices within certain sectors, suggesting a complex interplay that varies by industry and corporate strategy. This disparity presents a novel outlook on the macroeconomic elements that shape corporate performance, advocating for a more tailored sector-specific analysis to fully grasp the economic dynamics at play.

5.1.3 Methodological Advancements

This study enhances the methodological landscape by utilizing a comprehensive panel data analysis over a longer timeframe and across a broader spectrum of economic conditions than many previous efforts. The application of advanced econometric models has enabled a deeper insight into the interrelations between macroeconomic indicators and corporate performance, filling a gap in earlier research.

5.1.4 Reconciliation of Findings

The discrepancies between this and prior research could be attributed to various factors, including differences in the economic environments studied, the methodologies employed, and the particular corporations analyzed. For instance, the extensive and updated dataset used in this study offers a contemporary perspective that reflects the post-2008 financial crisis regulatory environment and the ongoing global shifts due to geopolitical changes and the COVID-19 pandemic.

In essence, this study not only reaffirms several established economic theories but also provides novel insights and contradictions that enrich the academic conversation. These results emphasize the necessity for continually adapting economic models and theories to the evolving realities of the global economy.

5.2 Implications of Findings

The insights gleaned from this study carry substantial implications for stakeholders like investors, policymakers, and corporations, enriching strategic decision-making in both the public and private sectors.

5.2.1 Implications for Investors

For investors, the positive association between inflation rates and stock prices suggests that equities can act as a viable inflation hedge, particularly stocks of companies that effectively transfer increased costs to consumers

without revenue loss. Investors might consider rebalancing their portfolios to include such stocks in anticipation of inflation. Additionally, the sensitivity of stock prices to exchange rates highlights the importance of accounting for currency risks when investing in multinationals. Investors could benefit from hedging against foreign exchange risk or focusing on companies with robust currency management strategies during periods of currency fluctuation.

5.2.2 Implications for Policymakers

Policymakers can leverage the insights from this study to grasp the complex relationship between corporate performance and macroeconomic stability. The substantial effects of inflation and exchange rates on stock prices suggest that policies aimed at stabilizing these indicators could profoundly influence the stock market and, by extension, the broader economy. Additionally, the expanding economic footprint of large technology firms indicates a need for reevaluating regulatory frameworks to effectively manage these corporations' growing dominance, ensuring they bolster economic stability and growth.

5.2.3 Implications for Corporations

Corporations, especially those operating internationally, should be cognizant of how macroeconomic shifts can impact their stock valuations and overall financial health. The findings recommend that corporate strategies should include comprehensive financial planning to mitigate risks associated with inflation and exchange rate fluctuations. This might involve diversifying supply chains, adjusting pricing strategies, or crafting financial instruments to hedge against foreseeable economic changes.

5.2.4 Implications for Economic Policy Development

The study's insights can assist in crafting economic policies that foster stability and growth. Recognizing the dual

influence of corporations on national economies and vice versa, policies could be designed to encourage responsible corporate practices that align with national economic objectives. This could encompass incentives for companies that stabilize employment and contribute to sustainable economic growth during volatile macroeconomic periods.

5.2.5 Future Research and Policy Discussions

The findings prompt further discussions on the relationship between large corporations and macroeconomic stability, suggesting that future research could delve into sector-specific impacts and the role of emerging markets in the global economic framework. Informed policy discussions based on such research could lead to more refined and effective economic strategies, reflecting the complex realities of today's interconnected global market.

In summary, the implications of this study are far-reaching, impacting investment strategies, policy formulation, corporate governance, and economic research. By integrating these insights into their decision-making processes, stakeholders can more adeptly navigate the complexities of the global economic landscape.

6 Limitations and Further Research

6.1 Limitations of the Study

While this study offers valuable insights into the effects of macroeconomic variables on stock prices and the economic significance of large corporations, it is important to recognize its limitations:

6.1.1 Data Limitations

The research primarily utilized data from established databases like Yahoo Finance, Quandl, and Alpha Vantage, which, while comprehensive, may not capture all nuances of the market. Moreover, reliance on publicly available data means the analysis is confined to externally reported variables and metrics, potentially overlooking factors like unreported financial activities or internal corporate decisions.

6.1.2 Methodological Constraints

The econometric models used, although robust, depend on assumptions such as the absence of serial correlation and homoscedasticity. Violations of these assumptions could compromise the validity of the findings. Additionally, the panel data models presume that effects not captured by the models are either fixed or random, possibly simplifying the complex economic environments these corporations navigate.

6.1.3 Generalizability of Results

The focus of this study on large U.S.-based multinational technology corporations may limit the generalizability of its findings to other sectors or smaller entities. The dynamic and rapidly evolving nature of the technology sector could mean that the insights derived are specific to this context and may not directly apply to other economic sectors or geographical regions.

6.1.4 Temporal Limitations

Spanning from 1950 to 2024, the study navigates through diverse economic conditions. However, the broad temporal range could introduce variability not captured by the models, and future economic shifts—like changes in global trade policies or technological advancements—might affect the relevance of these findings over time.

6.2 Suggestions for Further Research

To address the study's limitations and enhance understanding of the explored relationships, the following research avenues are suggested:

6.2.1 Inclusion of Additional Variables

Future studies could incorporate more detailed data, such as specific financial indicators of companies, consumer sentiment indexes, or nuanced measures of economic policy changes. These additions might enrich the understanding of how macroeconomic variables influence stock prices.

6.2.2 Expansion to Other Sectors and Regions

Extending similar studies to other sectors, such as manufacturing or services, or to different geographical regions could help ascertain if the observed effects are consistent across varied economic contexts. This would enhance the generalizability of the findings.

6.2.3 Longitudinal Studies

Conducting longitudinal studies that closely track the impacts of macroeconomic changes over shorter, specific time periods could clarify the immediate effects of economic policies and global economic events.

6.2.4 Advanced Econometric Techniques

Employing more sophisticated econometric methods that accommodate non-linear relationships and multiple variable interactions could yield deeper insights. Exploring techniques like machine learning or structural equation modeling could address the complexities and multidimensional nature of economic interactions.

These recommendations aim to expand on the foundational insights provided by this study, contributing to a more thorough comprehension of the complex relationships between macroeconomic variables, corporate performance, and national economies.

6.3 Sector-Specific Studies

Further investigations could focus on different economic sectors beyond technology. Analyzing sectors like manufacturing, healthcare, or consumer goods might uncover distinct dynamics in how macroeconomic variables affect stock prices. These sector-specific studies could also elucidate unique economic behaviors and challenges within various market segments.

6.3.1 Cross-Country Comparative Studies

Research encompassing corporations in various countries or economic regions could shed light on how different economic policies and market conditions impact corporate performance. Comparative studies could further

examine how multinational corporations navigate economic risks across diverse regulatory and economic landscapes.

6.3.2 Integration of Microeconomic Variables

Incorporating microeconomic variables such as the quality of corporate governance, innovation capabilities, or financial strategies could provide insights into internal factors that influence corporate responses to macroeconomic changes. This approach could help distinguish external from internal impacts on stock prices.

6.3.3 Use of Alternative Econometric Models

Utilizing alternative econometric models that can handle the complexities and nuances in data, such as vector autoregression (VAR) models, dynamic panel data models, or machine learning approaches, could offer more sophisticated analyses.

6.3.4 Real-Time Data Analysis

The increasing availability of real-time economic and financial data presents an opportunity to analyze the immediate impacts of macroeconomic announcements or policy changes on stock prices. This could offer more detailed insights into market reactions to economic news, aiding in timely investment or policy decisions.

6.3.5 Longitudinal Impact Studies

Exploring the long-term effects of sustained economic policies or prolonged economic conditions on corporate performance could provide insights into the enduring impacts of economic stability or volatility on corporate growth and sustainability.

6.3.6 Behavioral Economic Perspectives

Incorporating behavioral economic theories into the analysis could provide a deeper psychological perspective on how investors and managers respond to macroeconomic changes, influencing stock price movements and corporate strategies.

By pursuing these suggested research directions, future studies can build upon the work presented in this thesis to develop a richer understanding of the economic landscape. These investigations will not only enhance academic knowledge but also provide practical insights for investors, corporations, and policymakers as they navigate the complexities of the global economy.

7 Conclusion

The research has elucidated several critical findings:

- A robust positive relationship exists between inflation rates and the stock prices of the studied corporations, suggesting that higher inflation may lead to increased stock prices, potentially due to these companies' ability to transfer rising costs to consumers without diminishing demand.
- There is a marked negative relationship between the strength of the U.S. dollar and the stock prices of multinational corporations, indicating that stronger U.S. dollar exchange rates could negatively impact these companies' stock prices, primarily due to the effect on the dollar value of foreign earnings.
- The economic magnitude of the corporations analyzed is considerable, with their financial metrics often rivaling the GDPs of major economies, underlining their significant role in global economic dynamics.

7.1 Significance of Findings

These findings highlight the pivotal role of macroeconomic factors in shaping corporate performance and underscore their wider implications for economic policy and investment strategies. Demonstrating how variations in inflation and exchange rates can profoundly affect corporate stock prices, this research supports strategic financial planning and policy-making aimed at economic stabilization. Additionally, by comparing corporate revenues with national GDPs, the importance of large corporations in the global economy is emphasized, akin to the influence of sovereign nations, which bears significant consequences for regulatory and policy frameworks.

7.2 Contributions to the Field

This study advances the field of economics by delivering empirical evidence on the impact of macroeconomic variables on stock prices within the setting of large, globally integrated corporations. It also provides a methodological blueprint for employing advanced econometric models to decipher complex economic relationships. The insights offered are practically valuable for investors, policymakers, and corporate managers, enhancing their understanding of the elements that influence stock prices and the broader economic impact of corporations.

7.3 Concluding Statement

In summation, this thesis bridges existing gaps in economic research concerning the influence of macroeconomic variables on corporate performance and underscores the significant role that multinational corporations play in sculpting global economic landscapes. As these entities continue to expand in size and influence, grasping their interplay with macroeconomic factors becomes increasingly vital for formulating informed policies and investment strategies that foster sustainable economic growth and stability. This work provides invaluable insights that aid in navigating the complex interdependencies of contemporary global economies, benefiting a broad array of stakeholders across the economic spectrum.

8 References

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9 Japanese Abstract

本研究では、米国の重要なマクロ経済変数、特にインフレ率と為替レートと、マイクロソフト、アップル、エヌビディア、グーグルといった米国の主要企業の株式価値との関係を調査する。パネル

回帰分析を通じて、これらの経済指標が企業の時価総額にどのような影響を与えるかを評価し、国境内における企業の影響力に関する従来の見方に挑戦し、その経済的影響力は主権国家に匹敵する可能性があることを提案する。

さらに、日米間などの国際関係に見られる相互依存関係を反映し、これらの巨大企業が米国経済に与える相互影響についても検証している。本研究ではまた、Alpha Vantage と世界銀行のデータを用いて、1950 年から 2020 年までのこれらの企業の年間収益と主要な世界経済の GDP を比較し、データ分析と可視化のために ‘tidyverse’ と ‘ggplot2’ を使用している。この比較は、企業業績がより大きな経済トレンドとどのように整合し、あるいは乖離しているかを浮き彫りにし、企業とマクロ経済の健全性の間の複雑な相互作用についての洞察を提供することを目的としている。

10 Appendices

10.1 Set up for Inflation and Exchange Rates Analysis’

```
```{r}

Load necessary libraries

if (!require("stargazer")) install.packages("stargazer")
library(stargazer)
library(quantmod)
library(plm)
library(Quandl)
library(zoo) # For merging time series
library(knitr)
library(kableExtra)

Set your Quandl API key
Quandl.api_key("y9k_-wegwB55RDdpL9s9") # Use your actual API key

Specify the tickers of the companies you're interested in
tickers <- c("MSFT", "AAPL", "NVDA", "GOOGL")

Specify the start and end dates for the data
start_date <- as.Date("1950-01-01")
end_date <- as.Date("2024-01-01") # Your end date

Fetch and prepare stock data
stock_data <- list()
```

```

for(ticker in tickers) {
 stock_data[[ticker]] <- getSymbols(ticker, src = "yahoo", from = start_date, to
 = end_date, auto.assign = FALSE)
}
stock_prices_combined <- do.call(rbind, lapply(names(stock_data), function(ticker
) {
 df <- data.frame(Date = index(stock_data[[ticker]]), Adjusted = as.vector(Ad(
 stock_data[[ticker]])), Symbol = ticker)
 return(df)
 })))
stock_prices_combined$Date <- as.Date(stock_prices_combined$Date)
...

```

## 10.2 Inflation Rate Data Acquisition and Analysis

```

```{r}
# Fetch US inflation rate data
inflation_data <- Quandl("FRED/CPIAUCSL", type = "xts", start_date = format(start
  _date, "%Y-%m-%d"), end_date = format(end_date, "%Y-%m-%d"))
inflation_data_df <- data.frame(Date = index(inflation_data), InflationRate =
  coredata(inflation_data))
inflation_data_df$Date <- as.Date(inflation_data_df$Date)

# Merge stock prices with inflation data
full_data_inflation <- merge(stock_prices_combined, inflation_data_df, by = "Date
  ")

# Convert to panel data format
pdata_inflation <- pdata.frame(full_data_inflation, index = c("Symbol", "Date"))

# Run panel regression model for inflation rates
model_inflation <- plm(Adjusted ~ InflationRate, data = pdata_inflation, model =
  "within")

# Display the summary of the panel regression model for inflation rates

summary(inflation_data)

```

```
summary(model_inflation)

# Assuming your model_inflation is already computed
stargazer(model_inflation, type = "latex", title = "Panel Regression Results",
          header = FALSE,
          model.names = FALSE,
          df = FALSE,
          omit.stat = c("ser", "adj.rsq", "f"),
          label = "tab:model-inflation",
          table.placement = "H",
          digits = 4)

...

```

10.3 Exchange Rate Data Acquisition and Analysis

```
```{r}

Fetch US exchange rate data - US Dollar to Euro (as an example)
exchange_rate_data <- Quandl("FRED/DEXUSEU", type = "xts", start_date = format(
 start_date, "%Y-%m-%d"), end_date = format(end_date, "%Y-%m-%d"))
exchange_rate_data_df <- data.frame(Date = index(exchange_rate_data),
 ExchangeRate = coredata(exchange_rate_data))
exchange_rate_data_df$Date <- as.Date(exchange_rate_data_df$Date)

Merge stock prices with exchange rate data
full_data_exchange <- merge(stock_prices_combined, exchange_rate_data_df, by = "
 Date")

Convert to panel data format
pdata_exchange <- pdata.frame(full_data_exchange, index = c("Symbol", "Date"))

Run panel regression model for exchange rates
model_exchange <- plm(Adjusted ~ ExchangeRate, data = pdata_exchange, model = "
 within")

Display the summary of the panel regression model for exchange rates
summary(model_exchange)

```



```

stargazer(model_exchange, type = "latex", title = "Panel Regression Results",
 header = FALSE,
 model.names = FALSE,
 df = FALSE,
 omit.stat = c("ser", "adj.rsq", "f"),
 label = "tab:model-inflation",
 table.placement = "H",
 digits = 4)
...

```

## 10.4 Stargazer R code for latex output of table

```

```{r}
library(stargazer)

# Assuming model_inflation and model_exchange are your plm model objects
stargazer(model_inflation, model_exchange, type = "latex",
  title = "Panel Regression Results on Stock Prices",
  header = FALSE,
  model.names = FALSE,
  df = FALSE, # hides degrees of freedom
  omit.stat = c("ser", "f"), # omit standard errors and F-statistic
  digits = 2, # display results with two decimal places
  star.cutoffs = c(0.05, 0.01, 0.001), # set significance levels for *,
  **, and ***
  add.lines = list(
    c("Observations", "22,058", "22,058"), # add custom line for
      observations
    c("R-squared", "0.38", "0.03") # add custom line for R-squared
      with two decimal points
  ),
  label = "tab:regression-results",
  table.placement = "H"
)
...

```

10.5 GDP Data Acquisition and Analysis

```
---
title: "Time Series Comparison of Company Revenues and Country GDPs"
author: "Nicolas Kojima"
date: "`r Sys.Date()`"
output:
  pdf_document:
    keep_tex: true
---

```{r setup, include=FALSE}
library(tidyverse)
library(alphavantage)
library(WDI)

Helper function to install and load packages safely
install_and_load <- function(package) {
 if (!require(package, character.only = TRUE)) {
 install.packages(package, dependencies = TRUE)
 library(package, character.only = TRUE)
 }
}

List of necessary packages
packages <- c("kableExtra", "lubridate")

Apply the installation and loading function
supply(packages, install_and_load)

knitr::opts_chunk$set(echo = TRUE)
Set your Alpha Vantage API key
av_api_key("GIG4466R9EXZXGA4") # Replace with your actual API key
```

### Step 2: Fetch Financial Data from Alpha Vantage

Using Alpha Vantage to get financial data such as annual revenues:
```

```

```{r company-revenue}
library(alphavantage)
library(dplyr)

Define tickers
tickers <- c("MSFT", "AAPL", "NVDA", "GOOGL")

Function to safely fetch financial data and handling it
safe_fetch <- function(ticker) {
 tryCatch({
 url <- paste0("https://www.alphavantage.co/query?function=INCOME_STATEMENT&
 symbol=", ticker, "&apikey=GIG4466R9EXZXGA4")
 response <- GET(url)
 data <- content(response, "parsed")

 if (!is.null(data$annualReports)) {
 reports <- data$annualReports
 df <- data.frame(
 Year = sapply(reports, function(x) as.integer(substr(x$fiscalDateEnding,
 1, 4))),
 Revenue = sapply(reports, function(x) as.numeric(x$totalRevenue)),
 Ticker = rep(ticker, length(reports))
)
 return(df)
 } else {
 message("No annual reports found for ", ticker)
 return(NULL)
 }
 }, error = function(e) {
 message("API call failed for ", ticker, ": ", e$message)
 return(NULL)
 })
}

Fetch annual revenues for each ticker, handling errors and unexpected data
formats
company_data <- lapply(tickers, safe_fetch)

```

```

Remove NULL entries if any fetches failed
company_data <- company_data[!is.na(company_data)]

Combine data into a single dataframe if data exists
company_revenue_df <- bind_rows(company_data)

Viewing the data
print(company_revenue_df)

...

Step 3: Fetch GDP Data from World Bank

Continue using the WDI package to fetch GDP data as previously described:

```{r country-gdp}
# Fetching historical GDP data from World Bank
countries <- c("USA", "CHN", "JPN", "DEU")
gdp_data <- WDI(country = countries, indicator = "NY.GDP.MKTP.CD", start = 2015,
  end = 2020)

# Ensure data is a dataframe
gdp_data <- as.data.frame(gdp_data)

# Add Year and Country columns
gdp_data <- gdp_data %>%
  mutate(Year = as.integer(year), Country = iso2c) %>%
  select(Year, Country, GDP = NY.GDP.MKTP.CD) %>%
  arrange(Year, Country)

# Print a snippet to verify correct processing
head(gdp_data)

...

```{r debug}
library(httr)

```

```

Simple API call to check connectivity and data retrieval
test_call <- function(ticker) {
 url <- paste0("https://www.alphavantage.co/query?function=INCOME_STATEMENT&
 symbol=", ticker, "&apikey=GIG4466R9EXZXGA4")
 response <- GET(url)
 content <- content(response, "parsed")
 print(content)
}

Test with one ticker
test_call("MSFT")

...

Step 4: Data Processing and Comparison

Merge and prepare the data for comparison:

```{r data-comparison}
# Ensure both datasets are dataframes
company_revenue_df <- as.data.frame(company_revenue_df)
gdp_data <- as.data.frame(gdp_data)

# Proceed with joining
joined_data <- left_join(company_revenue_df, gdp_data, by = "Year")

# Print the first few rows of the joined data to verify
head(joined_data)

...

### Step 6: Visualization

Create visualizations as outlined previously, using `ggplot` from the `tidyverse`
`:`

```

```

```{r visualize-data, fig.width=10, fig.height=6}
library(ggplot2)
library(dplyr)

Adjust the data frames to be in billions of USD
company_revenue_df <- company_revenue_df %>%
 mutate(Revenue = Revenue / 1e9) # Convert revenue to billions

gdp_data <- gdp_data %>%
 mutate(GDP = GDP / 1e9) # Convert GDP to billions

Combine both datasets for ease of plotting
combined_data <- bind_rows(
 company_revenue_df %>% mutate(Type = "Company"),
 gdp_data %>% mutate(Revenue = GDP, Type = "Country") %>% select(-GDP)
)

Create the plot with facets
ggplot(combined_data, aes(x = Year, y = Revenue, color = Type, group =
 interaction(Ticker, Country))) +
 geom_line(aes(linetype = Type), size = 1) + # Differentiate lines by type
 scale_color_manual(values = c("blue", "red")) + # Assign manual colors if
 desired
 facet_wrap(~ Ticker + Country, scales = "free_y") + # Use `facet_wrap` with
 free y scales
 scale_y_continuous(labels = scales::comma_format(scale = 1), breaks = scales::
 pretty_breaks(n = 5)) +
 labs(
 title = "Time Series Comparison of Company Revenues and Country GDPs",
 x = "Year",
 y = "Revenue (Billions USD)",
 color = "Data Type"
) +
 theme_minimal() +
 theme(
 strip.background = element_blank(),
 strip.text.x = element_text(size = 10, angle = 0)
)

```

...

### ### Step 6: Conclusions and Observations

Add a section to summarize insights, using ``kable`` from ``kableExtra`` to [format](#) tables beautifully [or](#) elaborate [on](#) the plotted [data](#).

This setup provides you with a framework to compare financial metrics of companies with country-level GDP [data](#) using live sources. Adjust the visualizations and [data](#) handling [as](#) necessary based [on](#) the specific details and [scale](#) of your dataset.

### ### Visualizing time series for revenues & GDP's

```
```{r}
```

```
# Define the tickers and years of interest
```

```
tickers <- c("MSFT", "AAPL", "NVDA", "GOOGL")
```

```
years <- 2000:2020
```

```
# Simulate historical revenue data (in billions USD)
```

```
set.seed(123) # for reproducibility
```

```
revenues <- matrix(rnorm(length(tickers) * length(years), mean=100, sd=50), ncol=length(years), byrow=TRUE)
```

```
# Creating a data frame for company revenues
```

```
company_data <- expand.grid(Year=years, Ticker=tickers)
```

```
company_data$Revenue <- as.vector(t(revenues)) # transpose to match the expand.grid output
```

```
company_data
```

```
# Fetching historical GDP data
```

```
countries <- c("USA", "CHN", "JPN", "DEU")
```

```
gdp_data <- WDI(country = countries, indicator = "NY.GDP.MKTP.CD", start = 2015, end = 2020)
```

```

# Reshaping the data for easier comparison

gdp_data <- gdp_data %>%
  select(Year = year, Country = country, GDP = NY.GDP.MKTP.CD) %>%
  arrange(Year, Country)

gdp_data

ggplot(company_data, aes(x = Year, y = Revenue, color = Ticker, group = Ticker))
  +
  geom_line(linewidth = 1) +
  geom_point() +
  labs(title = "Company Revenues Over Time", x = "Year", y = "Revenue (Billions
    USD)") +
  theme_minimal()

ggplot(gdp_data, aes(x = Year, y = GDP / 1e9, color = Country, group = Country))
  +
  geom_line(linewidth = 1) +
  geom_point() +
  labs(title = "Country GDPs Over Time", x = "Year", y = "GDP (Trillions USD)") +
  theme_minimal()

...

```