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Governance and Economic Outcomes: A Data Analytics Approach

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ABSTRACT: Economic behavior is known to be tied to several political trends, with measures such as the rule of law and judicial independence serving as crucial indicators of economic growth. However, most analyses have focused predominantly on the aggregate factor of economic growth rather than exploring consumer expenditure as an indicator of economic health at the household level. Thus, a quantitative data analytics approach is proposed to address the aforementioned gap. First, I use data sourced from the World Bank (2025) to perform a cluster analysis using manifold learning to show the relationship between political factors such as rule of law, corruption, and stringency of policy, among other factors, with respect to consumer expenditure across several countries. The focus is on the possible grouping behavior based on the similarity measures among different countries. Following this, a regression analysis is performed to provide a prediction model for expenditures, and a sensitivity analysis is used to identify the most important political factors for consumer expenditure. Finally, several conclusions based on the collected data and analytics are drawn.

KEYWORDS: Economics, Political Economy, Cluster Analysis, Political Governance, Household Expenditure.

Introduction

Governance strongly affects the manner in which consumers behave, and as such, enacted policies directly affect an economy's capacity.[1] This relation is direct: As a government's ability to efficiently allocate resources increases, so too does its ability to respond to local needs, and vice versa: Ineffective allocation of resources diminishes both long-term and short-term economic growth.[2] As consumer confidence drops, spending drops, and leads to lower tax revenue, ultimately causing diminished economic growth. This misallocation of resources is further carried out to low- and middle-class families through less progressive taxes, diminished protections, and greater wealth inequality.[3] These aftereffects further lower consumer confidence, leading to lowered levels of consumer expenditure.

The relation between other political factors, like judicial independence and economic growth, has been thoroughly measured in a number of studies, which discover strong correlations between GDP growth and institutional quality.[4,5] Other researchers have further analyzed this trend in developing and developed nations, finding that institutional quality plays a larger and more significant role in developed economies, rather than developing economies.[6] However, research on variables outside of GDP growth has rarely been found in the open literature. Other outcomes, like consumer expenditure, remain largely uninvestigated, despite their potential to reveal information about individuals and their responses to economic stimuli. It should be noted that most existing studies focus on qualitative and/or theoretical perspectives to reveal the relationship. Likewise, econometric analyses tend to under-utilize quantitative data analytics methodologies, like clustering and regression analyses. One possible reason is that the large number of descriptive categorical variables and numerical variables coexist in such an analysis, which makes it relatively difficult to visualize the clustering and regression for people to understand relations.

In this paper, I use a technique called manifold learning to reduce the dimensionality of the investigated problem for easy clustering and regression in low dimensions (2D or 3D) to analyze how political factors influence consumer expenditure. Using a sample of 179 countries, I cluster countries into 5 distinct groups and analyze the factors that differentiate these clusters. Leveraging statistical analysis tools, this paper explores how political institutions relate to economic growth and their connection to consumer behavior. The results are directly visualized in a graphical format to facilitate interpretation. I hypothesize that consumer expenditure will be positively related to institutional quality by increasing consumer confidence.

The remainder of the paper is organized as follows: Section 2 covers the gap in research surrounding clustering/regression analysis of political factors and consumer expenditure. Section 3 presents the methodology of my analysis, and Section 4 presents the findings and graphical representations based on the collected data. Section 5 discusses the implications of this analysis, and Section 6 concludes and suggests future research directions.

Literature Review

Traditional economic theories of competition and neoclassical growth models imply that in the long term, open competition between countries caused by globalization and the gradual diminishment of trade barriers should lead to the convergence of wealth.[7] Under this theory, open trade standardizes prices across geographic barriers, allowing countries to gradually shift towards a globalized economy. However, this gradual

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mellowing of disparity is inconsistent with present-day conditions. Inefficient institutions render economic assumptions of efficiency faulty and contradictory to existing trends.[8] Given that institutions are inherently built upon the desire to shape human interaction, the relations between such political factors and economic factors build crucial frameworks for the effective development and analysis of consumer behavior. This observation also calls into question how political indicators engage with each other: Some actions, such as logrolling, that may be seen as a level of inefficiency, ultimately play a significant role in moderating exchange relationships between several interest groups. Understanding the mechanisms of economic growth thus relies heavily upon examining the interconnection between political and economic factors within the political economy.

The relation between political and economic variables, such as consumer behavior, has long been explored by economists, as institutional strength is often correlated with economic growth and vice versa. This study of the political economy dates back to the early 16th century, but only began to be closely examined by economists in the 20th century. This time period saw resurgent concerns surrounding global capitalism and several related declines in the classical political economy in favor of neoclassical analysis. This culminated in further analysis of trends in the role of the state in regulating behavior. As an example, analyses have concluded that the strength of political institutions has led to continued support for individual property rights, spurring economic development by enhancing consumer expenditure, a crucial component of gross domestic product.[9] Currently, countries already exhibit vastly different characteristics and polities in reaction to different situations: developing countries trend towards industrial investment while developed and post-industrial societies aim to promote service-driven growth.[10] Furthermore, this cross-country difference in receptiveness to political change and upheaval can largely be attributed to geopolitical differences across countries, including governance structure and proximity to other nations, a factor that must be accounted for when performing analysis. In order to ensure that sudden shifts in political indicators are accounted for, it's necessary to filter data by correlation and ensure that only the highest correlation relationships are preserved.

Gradually, literature has transitioned back to analyzing the effect of political institutions. Literature has consistently associated quality institutions with heightened adaptability to income shocks and heightened quality of economic outcomes.[11] Likewise, sustained economic development stems from inclusive and effective political institutions that effectively support the population.[12] GDP growth and other measures of economic health have been closely linked to the quality of institutions, including measures such as corruption, judicial independence, and rule of law in both democratic and authoritarian governments.[2–4] In this manner, literature has already comprehensively evaluated the effect of political governance on economic growth, and the results are the initial relation that one would expect: Higher quality political governance leads to positive trends in economic growth. However, these correlations have largely only analyzed a single country or single relational factor.

Current research continues to point towards the varying degrees of influence that political factors hold in varying types of governments. Institutions are necessary for continued growth, but the degree to which these institutions have an effect varies largely by the country's specific characteristics.[13] To such ends, understanding how governance structure and quality of political institutions affect consumer spending is crucial for stimulating the economy in a time of diminished expenditure.

Methods

In this manuscript, I used a combination of correlational, clustering, and regression analyses for the interpretation of cross-national data.

My data was sourced from World Bank Data360, a suitable database for gathering cross-country metrics due to its open-source nature and extensive collection of variables, allowing me to compile various political and economic factors for analysis.[14] Data360 offers various sorting features that help download and aggregate data, as well as being reliable due to the various international guidelines for any publications of datasets and indicators.

In this section, I will outline the process of my data collection, beginning with the reasoning for each of the decisions made.

Correlational Filtering, Analysis, and Selection:

To determine and evaluate the predictivity of each political indicator as well as the strength of each economic indicator, I computed the coefficient of determination (R^2) between each political indicator and economic indicator, and compiled a dataset containing each coefficient of determination. Data points were taken at different time slots for each indicator, with each political indicator having its correlation analyzed at 0 years lagged, 1 year lagged, and 2 years lagged data to allow for economic adjustment to any political changes that were to occur.

To account for potential political disturbances that may have created political instability and thus led to statistical discrepancies, I disregard any points that were not highly correlated (R^2 above 0.5) with my economic factors. The most highly correlated factors are shown in Figure 1, with the highest correlated countries being predominantly from Asia and Africa.

COUNTRY	POLITICAL INDICATOR	TYPE	R2 FACTOR
Lao PDR	Public Trust in Politicians	Current	0.999288049
Sri Lanka	Bertelsmann Governance Index	Lagged	0.9655095064
Lao PDR	Judicial Independence	Current	0.9523322779
Angola	Judicial Independence	Current	0.9386184323
San Marino	Control of Corruption: Estimate	Lagged	0.9303889555
Angola	Government Spending Efficiency	Lagged	0.9111770558
Ethiopia	Bertelsmann Governance Index	Current	0.9012411747
Syrian Arab Republic	Public Trust in Politicians	Lagged	0.8905983374
San Marino	Estimated Govt. Effectiveness	Lagged	0.8888569023
Saudi Arabia	Bertelsmann Governance Index	Lagged	0.8499171483

Figure 1: Top 10 Correlation Factors between Political Indicators and Household Spending. Correlations between each of the top five political indicators and household spending, with data classified under four columns: Country, political indicator, type, and coefficient of determination. Lao PDR and Angola are the two countries with the highest prevalence of relations, and the Bertelsmann Governance Index was the indicator with the highest prevalence.

Then, in order to allow for easier clustering and regression analysis, I needed to choose a single economic indicator between the three that I had. To decide on the most statistically robust indicator that would be most likely to yield results, I created a correlational system/network analysis between each political factor and economic factor. Using the compiled list of high-correlation R^2 factors, I draw this network using the frequency of correlations between each political and economic indicator, with political indicators represented as blue circles and economic indicators represented as red circles. Greater width and opacity of the connection signify higher frequencies, and lower width and opacity represent lower frequencies. Thus, the economic indicator with more and darker lines attached to it would show the greatest surface-level correlations and be more likely to yield results.

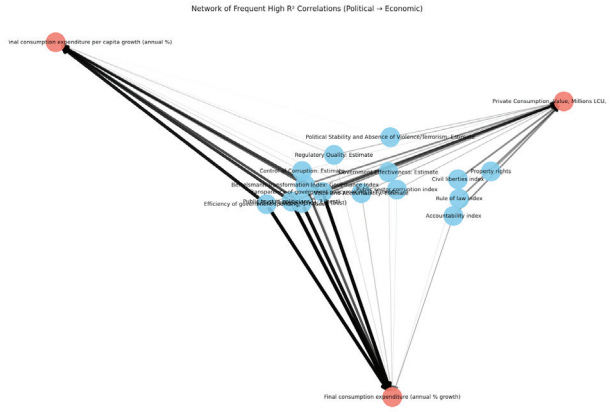

Figure 2: Correlational System between Political and Economic Factors. Correlation network between each political factor and economic factor, with high-opacity lines representing more high-correlation values. Private Consumption value was the least correlated economic factor, with Final Consumption Expenditure Growth being roughly equally correlated with Household and Non-Profit Institutions Serving Households Consumption Growth Per Capita.

From Figure 2, I find that the two most correlated factors are Household Expenditure Per Capita Growth and Final Consumption Expenditure Growth, with both indicators having similar frequencies of high-correlation relationships. I chose Household and Non-Profit Serving Institutions Expenditure Per Capita Growth, simplified to Household Expenditure Per Capita, as my factor to analyze. This choice was made due to the relative broadness of consideration of Final consumption expenditure, which accounts for not only household and private expenditure but also government spending, an outside factor that was unrepresentative of consumer behavior at the individual level.

My final correlational analysis was intended to find any significant statistical phenomena that existed within the list of indicators that I analyzed. This was a secondary analysis after isolating correlation factors for the final consumption expenditure, with relative frequencies represented as the length of the bars in a bar graph. Interestingly, the data has a significant elbow point after the top 5 political indicators. Noting this relation, I decided to select only the top 5 indicators for further cluster analysis, constructed using CAMEL dimensional reduction and K-Means clustering.

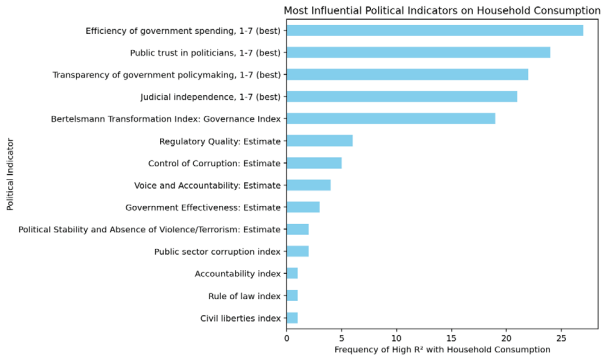

Figure 3: Frequency of High-Correlation Factors. A bar chart revealing the frequency of high-correlation factors of each political factor. An elbow point can be found in the top 5 indicators, representing a significance point at 5 terms. Beyond 5 terms, statistical significance plateaus or drops.

Cluster Analysis:

The clustering analysis using CAMEL reveals the topological similarities in the input feature space. From Figure 4, it is shown that five clusters can be observed, which show five major groups of the input features, such as the used political indicators and household consumption. This cluster analysis shows potential similar behavior and trends in different countries. For example, Chad and Angola (purple color dots) are very close in the embedding space, which indicates these two countries are similar. While Chad and Kuwait are far away from each other, this indicates they are distinctly different. This cluster analysis provides a way to easily visualize different countries in a 2D plot and facilitates the downstream analysis and discussion for each individual group. For example, the proposed study also investigates the democratic and developmental characteristics of identified clusters from CAMEL analysis.

K-Means is used to find the distinct clusters in the data without supervision, which is widely used in the machine learning community. In the current analysis, K-Means is to find

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countries with similar political indicators and group them into similar clusters for downstream analysis. It has been reported that economic development can be impacted for the countries' political indicators, and countries with similar political characteristics will show similar trends for economic development patterns.[15] K-Means intends to find politically similar groups with the help of dimension reduction techniques.

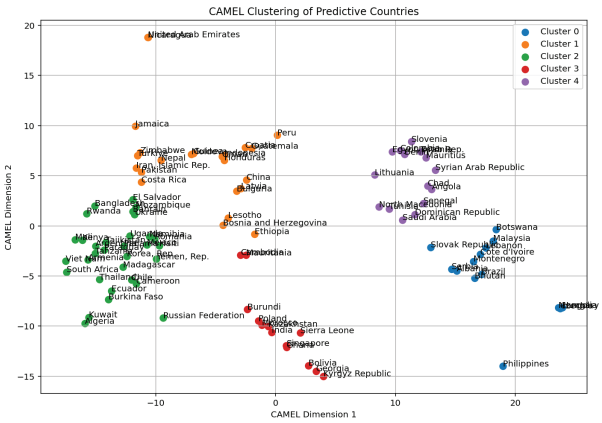

Figure 4: CAMEL Clustering of Country Data. A color-coded map representing country clusters after selecting 5 groups as the input parameter. Evaluating each cluster's GDP per capita reveals inter-cluster differences between democratic development and average country wealth.

There were several reasons for choosing both CAMEL's dimensional reduction and K-Means clustering. Principally, dimensional reduction programs such as t-SNE and UMAP, which are the two most commonly used dimensional reduction programs, exhibit fragmentation behavior at higher dimensions. UMAP, in particular, experiences difficulty in data analysis when several data points are missing. CAMEL is also more computationally efficient than other standard dimensional reduction programs, making it more suitable for my particular data analysis.[16] Furthermore, K-Means clustering was chosen due to the knowledge obtained through my correlational analysis as well as its suitability for my situation. K-Means clustering, similarly to CAMEL, shows clear benefits in regard to computational efficiency and ability to be used across large datasets, which serves particularly well in cross-country analyses of several indicators. Its scalability and comparative simplicity also provide benefits in reducing the time needed to learn the programming for my data analysis. K-Means has one primary limitation, that being the need to specify the number of clusters beforehand: 5 clusters were selected due to the elbow point observed in Figure 3. Since my data indicated that in-cluster variance plateaued at more than 5 clusters, I chose 5 as my predetermined number of clusters.

Using the above methods, I construct a 14-dimensional feature space in Figure 4 based on the five most correlated political indicators and household consumption, evaluated at three time lags (current year, 1-year lag, and 2-year lag). Evaluating in such a manner ensures consideration of the delayed effects of political changes. I further normalize this data using standard scaling and reduce it into a two-dimensional space using CAMEL, a nonlinear manifold learning algorithm. Then, I apply K-Means clustering to group countries into five clusters that indicate similarity between countries. I discuss the implications of such clusters in the final methodology subsection.

Regression Analysis

However, cluster analyses serve primarily as a foundation for analysis (oftentimes case studies) on the underlying structural or institutional factors behind the shared behavior of countries. In order to definitively establish a political factor that most strongly influences economic behavior, analysis must continue beyond a simple establishment that one country's behavior is related to another. To such ends, a regression analysis was necessary to properly examine the relation between political factors and expenditure.

Subsequently, I filtered the dataset I used for my cluster analysis. After extracting household final consumption growth for each of the 97 countries as well as the five aforementioned political indicators, I generated a set of lagged data for the past two years.

I further cleaned my data using a Variance Inflation Factor to remove any features exhibiting low variance or redundant features, which could create irregularities for future simple linear regression. Using this finalized dataset, I performed an Ordinary Least Squares regression to determine the explanatory power of the R^2 factor, selecting the five most correlated countries. After the fifth country, correlation values across the five political indicators decreased significantly, so regression analysis was limited to solely the top 5 most strongly correlated countries across the five 'general' political indicators.

After selecting the five countries with the highest correlation factors, I conduct a two-part regression: First, a simple linear regression was performed across the five countries, followed by a Lasso regression to reduce collinearity and for sparse feature selection, selecting certain features as highly related. I further construct visualizations for my findings, including scatter plots of predicted vs actual results and bar graphs representing the significance of lasso-selected features.

I made several key assumptions in the analysis of statistical factors. I assume that all countries will follow the statistically identified features list for the top 5 political indicators, as these indicators represent a generalized set of factors behind household consumption change. While each country may have its own political factors and situation, it's difficult to account for such factors comprehensively when analyzing large datasets. Thus, selective regression may exhibit slight variances from the actual correlation between countries and may select for countries that only follow trends regarding the five most correlated indicators, skewing the data.

■ Results and Discussion

I will interpret and explain my results beginning with my correlation analysis, then my cluster analysis, and then my regression analysis.

My correlation analysis revealed several significant results. Notably, analysis between political indicators and economic indicators revealed a strong correlation between political indicators and both changes to final consumption expenditure

as well as changes in household final consumption per capita. This finding is not unprecedented, as final consumption expenditure is partially comprised of final household spending as well as final government spending. While I elected to choose final household consumption due to its greater ability to represent consumers at the local level, analyzing trends along final consumption expenditure could also be a plausible alternative to analyzing GDP, due to its omission of factors such as net exports and capital investment. Furthermore, my frequency analysis revealed 5 political factors most commonly associated with changes in household spending, those being government spending efficiency, political trust, government transparency, judicial independence, and overall governance quality. It's interesting to note that the top 4 indicators most associated with Household Consumption are all derived from the World Economic Forum's Global Competitiveness Report, potentially indicating a consistent trend between such factors and economic success.

My cluster analysis revealed some interesting trends between each of the groups of countries. By further aggregating data on both GDP level, GDP per capita, and democratic development, I perform a sub-analysis of each group to identify trends that characterize and differentiate each cluster. Terming each cluster as clusters 0-4, the trends are as follows: Cluster 0 countries tend to be established democracies in the early stages of development, exhibiting relatively high democracy indexes and low GDP averages. Cluster 1 countries are relatively authoritarian and developed countries, having the highest GDP averages of all the clusters. Cluster 2 countries are likewise relatively authoritarian and somewhat developed at a median-level income. Cluster 3 countries are relatively authoritarian with developing economies, showing relatively low GDP values relative to the world average. Finally, Cluster 4 countries trend towards relatively democratic political systems and somewhat developed economies, with middle-to-low level incomes relative to the rest of the world.

From the regression analysis, I find that the Bertelsmann Governance Index is consistently shown to be strongly correlated with household consumption across all five of the most strongly correlated countries. It's worth noting that both individual country regression and analysis of correlation strength reveal this indicator to have strong predictive power in high correlation countries. Predictivity of such regression models drops significantly past the fifth country, but the five countries with a high frequency of correlation consistently demonstrate a close and positive relation between quality of governance and economic stability.

Across the five most correlated countries found by these regressions, I find that predicted household expenditure with a lag of one year based on correlation coefficients closely to true values of household expenditure for the first four countries. However, it should be noted that there remain strong deviations from predicted values and actual values, as correlation coefficients often decreased significantly as I moved down the list of countries. It should also be noted that LASSO failed to identify any features for Niger due to the low correlation value.

There are several limitations to these findings. Due to the usage of data from different datasets, there were often large discrepancies in available information in several countries, ranging from gaps in the timeframe to missing indicators. Lack of such information may have skewed correlation results and led to changes in findings. Similarly, my analysis of how countries cluster only reveals some shared traits within groups of countries that exhibit similar behavior, and doesn't account for how these countries may respond to changes in political factors. In this manner, my clustering analysis only reveals shared trends between countries rather than any definitive answer for how each cluster would behave in response to political change. While I did perform regression analyses, my findings showed high variance, and predictions tended to be relatively unreliable outside of the top four most correlated countries. The results of this study may show discrepancies due to missing data points and limited sample size, due to data cleaning, as well as due to oversights surrounding political events and climates that may shift variables unrepresented within the limited set of indicators.

Conclusion

This paper aimed to examine two aspects: first see if countries could be grouped into clusters for easier data analysis, and to see what trends were most predictive of economic growth.

In order to answer these questions, the proposed study tackles this from a data analytics standpoint, using a correlational model, clustering model, and regression model to determine basic relations between each factor and economic outcomes. In the clustering model, I grouped countries into 5 distinct clusters and conducted an analysis that revealed a trend of GDP level and democratic development on the strength of the correlation between political factors and economic trends.

Political transitions and changes in both government and regimes grow increasingly important as global tensions rise. Previous studies have indicated that political institutions and their encouragement of civil rights have led to strong and continued growth in the economy, indicating strong political influences on economic outcomes. This study conducted a cross-country analysis of the influence of governance on household expenditure, finding that efficiency of government spending, public trust in politicians, transparency of government policymaking, judicial independence, and quality of governance are strongly correlated to household consumption. I also developed a dimensional reduction clustering model that revealed how countries cluster into 5 groups sharing trends in democratic development and GDP.

This has important implications for policymaking, particularly in developing countries. Democratically-oriented countries, for instance, should explore the expansion of civil liberties and work to enhance the transparency/legitimacy of their government to sustainably stimulate household spending. Likewise, the clustering of various countries may indicate the need for reconsideration of political factors when countries reach various stages of development.

Future research could further expand on the significance of the clustering analysis by investigating each cluster's gen-

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eral correlation to household spending. Similarly, a reanalysis of trends with a more complete dataset with more indicators could also contribute to ensuring statistical robustness and to managing factors outside of the political indicators used in this research. Conducting research in such areas may reveal more detailed trends surrounding how political factors influence household spending and how receptive household spending in varying countries is to changes in the political state.

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Appendixes

Appendix 1 - Data Cleaning and Collection:

The first step in my research was compiling a set of data that would demonstrate the relation between political factors like governance and corruption and consumer spending. To this end, 14 political variables were selected from the World Bank Database for analysis based on the number of countries and the time period of data collection. Indicators were chosen that had 120 or more countries listed, with a minimum of 20 years of data. This set of data was intended to store the various values of each indicator, which ranked each condition of political liberties and other political factors on an ordinal scale.

Due to inherent discrepancies in the manner in which data was organized between different databases, each separate indicator had separate column titles for observed values, full country name, political indicator name, and year of observation. To improve clarity and compatibility for code, I created a script to rename and convert columns to a standardized name, which allowed compilation of several indicators. Upon aggregating this data, I obtained a complete set of data containing 18 indicators for 179 countries spanning from 1961 to 2024.

While the complete dataset contained all the indicators necessary for analysis, problems arose concerning the reliability of such data: Since each indicator was collected across different time spans and for different country groups, some countries would be missing indicators for the time periods in which I was analyzing. While missing data points could be extrapolated to an extent using existing indicators, too much estimation would lead to statistical inconsistency. Thus, I decided to remove countries that lacked more than six indicators, as well as any countries that lacked more than six years of valid data to ensure statistical robustness. Data was then separated back into two categories, political and economic indicators, for use in correlational analysis, allowing for a structured comparison between political governance metrics and economic performance indicators in a cross-country analysis. After completing data cleaning, my dataset consisted of a total of 97 countries possessing a majority of their indicators.

Appendix 2 - Countries Used:

List of 97 countries used in analysis: Albania, Bhutan, Botswana, Brazil, Cote d'Ivoire, Czechia, Hungary, Lebanon, Malaysia, Mongolia, Montenegro, Philippines, Serbia, Slovak Republic, Bosnia and Herzegovina, Bulgaria, China, Costa Rica, Croatia, Ethiopia, Guatemala, Guinea, Honduras, Indonesia, Iran, Islamic Rep., Jamaica, Latvia, Lesotho, Moldova, Nepal, Nicaragua, Oman, Pakistan, Peru, Turkiye, United Arab Emirates, Zimbabwe, Algeria, Argentina, Armenia, Bahrain, Bangladesh, Burkina Faso, Cameroon, Chile, Ecuador, El Salvador, Haiti, Kenya, Korea, Rep., Kuwait, Madagascar, Mali, Mexico, Mozambique, Namibia, Panama, Paraguay, Romania, Russian Federation, Rwanda, South Africa, Tajikistan, Tanzania, Thailand, Uganda, Ukraine, Viet Nam, Yemen, Rep., Bolivia, Burundi, Cambodia, Georgia, Ghana, India, Kazakhstan, Kyrgyz Republic, Mauritania, Morocco, Poland, Sierra Leone, Singapore, Angola, Benin, Chad, Colombia, Domini-

can Republic, Egypt, Arab Rep., Estonia, Lithuania, Mauritius, North Macedonia, Saudi Arabia, Senegal, Slovenia, Syrian Arab Republic, Tunisia

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Tony Liu is a junior at Hamilton High School with a passion for economics and political science. He hopes to dual/joint major in Economics/Political Science, and is passionate about promoting financial and legal education for students beginning from a young age.

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