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Certainties and Sensitivity Analysis of the Global Economy: A GDP by End-Use Approach

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ABSTRACT

This research first analyses the evolution of four GDP by end-use variables (Household Consumption, Government Spending, Exports, and Imports) for the top 40 economies in the world, covering up to 90% of the global economy. The first part of the research project is determined by a longitudinal analysis of 40+ years, resulting in a linear regression to the expected GDP value of each nation for 2030. Secondly, both a Monte Carlo and a sensitivity simulation analysis are performed. The analysis reveals that the most sensitive variables that contribute to the dispersion of the GDP by end-use future results are imports, followed by exports. Also, Household Consumption appears with a small presence, while the Government Spending factor shows no sensitivity in the model. This research demonstrates the crucial importance of adjusting the balance of trade.

INTRODUCTION

Looking at a country's GDP by what it's used for—like consumption, investment, government spending, and exports—gives us an idea of where national income goes. But this single number doesn't tell the whole story. To really understand what's happening, we need to look at how each part changes over time, as well as the factors that affect them.

For example, if GDP goes up mostly because of government spending, it might not mean the growth will last. On the other hand, if private investment is the main driver, it could point to long-term growth. Also, a lot of household consumption could suggest people are doing well—or that they're taking on too much debt. The only way for those in charge to judge the quality and sustainability of growth is by watching patterns, how quickly things change, and outside factors such as inflation, interest rates, or global trade.

Plus, what makes up GDP affects what happens later on. Ongoing trade deficits might mean a country is losing its competitive edge, while less investment could hurt innovation and productivity. Looking at things such as how different sectors contribute, how much a country relies on imports, or how income inequality plays a part makes the analysis more complete.

In short, knowing how and why GDP parts change helps us better understand the overall economy, spot problems, and come up with good policies. Without looking at these changes, GDP numbers might be confusing or not give the full picture.

LITERATURE REVIEW

The Importance of Each Variable of GDP by End Use

Gross Domestic Product (GDP) serves as a key metric for evaluating a nation's economic standing. It is broadly used to assess economic well-being, guide policy development, and consider social welfare matters. Knowing the parts of GDP by end use is important for academic study and practical governance and planning. This review of the literature summarizes current data to clarify the roles of the main GDP parts: consumption, investment, government spending, and net exports (exports-imports).

Consumption

Consumption can sometimes form a large part of GDP in economies. For example, in the US, it makes up almost 70% of total GDP, and determining how much people consume directly shows their confidence and activity in the economy. Studies show that when GDP rises 10 percentage points, premature deaths decrease by 1 percentage point because better GDP growth can mean better healthcare and living standards, which affects what people buy and their quality of life (Alexander & Perkowski, 2023). There are also links between public health spending and how people consume things, which shows how health spending and consumption relate (Woodward & Wang, 2011; Brewer *et al.*, 2022).

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Investment

The investment part of GDP includes company investments in equipment, buildings, and ideas, plus home building. Investment helps the economy grow by making work more productive and advancing technology. Research has found a close link between defense spending and GDP, suggesting these investments can boost the economy (Guo, P &M,A 2017). Also, government finance policies matter. For example, more public spending can help the economy, as seen in places like Kosovo (Miftari *et al.*, 2021).

Government Spending

Government spending covers all public spending on goods and services and greatly affects the economy. Studies say public spending is needed for economic growth because government investments boost demand, especially during slow times (Miftari *et al.*, 2021). Also, health care spending shows that government health investments can increase GDP and help people be healthier, which can improve consumption and other things Woodward &; Wang, 2011; Cameron *et al.*, 2013).

Net Exports

Net exports, figured as exports less imports, are key to a country's economic state. A trade surplus helps GDP, but a deficit hurts it. Research shows that environmental rules can change energy prices for end users, which matters for how well exports compete (Liddle, 2020). Understanding how the world market and local economies connect helps to measure the net export part of GDP.

Relationships Between GDP Parts

The ways these parts relate show how important they are. For example, consumption and government spending often rise together. More government money for public projects can increase jobs and confidence, which boosts consumption (Alexander &Perkowski, 2023; Woodward & Wang, 2011). When these things depend on each other, growth in one part can lead to growth in others.

Also, it is important to see how domestic things and outside things, like world prices and economic health, affect GDP by end use. In today's connected world economy, net exports hinge not only on what a country can make but also on changes in world demand and trade rules, which can shift investment and consumption (Guo & M.A., 2017; Liddle, 2020).

What This Means for Policy

Knowing the parts of GDP and how they relate gives useful facts for those who make policy. Good governance means knowing how consumption helps the economy, how investment raises productivity, and how government spending can build economic toughness, especially in crises. Those in charge should think about these connections when they plan finance and money policies to keep the economy steady or help it grow. Also, it is key to think about how each thing is sustainable and affects the long term because choices now can greatly change the economy later. This covers the environment and how resources are used, which then affects how GDP works (Petrova *et al.*, 2023; Palmer, 2017).

GDP parts, like consumption, investment, government spending, and net exports, work together in ways that are not simple. Each one adds in its way to the whole economic picture. Knowing these parts and how they link is needed for those in policy, experts, and people who want to see the economy grow in a lasting way. Future research should keep looking at these parts, mainly as new economic problems and world shifts come up.

The Link Between Imports and Exports and Economic Growth

The relationship between imports and exports has received considerable attention in economics, especially regarding their combined impact on GDP growth. Many studies provide data showing that increases in either imports or exports can boost economic growth, showing how important trade is for broader economic progress. This review looks at findings from different studies on this topic, focusing on how import growth can lead to greater economic expansion.

Import Growth and Economic Growth

Evidence suggests that imports can greatly help a country's economic growth. For example, Kırıkkaleli *et al.* (2021) discovered that a 1% rise in imports correlates with a 0.17% increase in GDP growth, assuming other variables are constant. This suggests that imports increase the goods and services available, which can stimulate the economy (Kırıkkaleli *et al.*, 2021). This data a key way in which economies can grow: as economies become more open and increase imports, they often bring in capital goods needed for production, which improves productivity.

In Palestine, Omarya (2023) supported this by showing that imports have a positive impact on GDP, which agrees with other studies that say imports aid economic growth (Omarya, 2023). This could be because of increased consumer choice, better raw material access, and the use of advanced technology, which together improve production capabilities.

Exports and Economic Growth

Exports also contribute significantly to economic growth. Kajtazi & Fetai (2022) reported that a 1% increase in exports leads to a 0.12% increase in GDP growth (Kajtazi & Fetai, 2022). Many studies support this idea, connecting export performance to industrial expansion and modernization, especially in developing economies. Triyawan *et al.* (2023) noted that expanding exports is important for countries that want to use international markets to grow (Triyawan *et al.*, 2023).

Ji *et al.* (2022) found a two-way causal link between imports and GDP, suggesting that not only do imports increase GDP but GDP growth also encourages more

imports, creating a beneficial cycle (Ji *et al.*, 2022). This is supported by Spahiu & Spahiu (2022), who identified exports as key factors affecting GDP growth in Kosovo (Spahiu & Spahiu, 2022).

Interconnectedness of Imports and Exports

Imports and exports are related in a two-way manner. Awokuse (2008) said that past studies have mostly focused on exports as the source of growth, while not fully considering the role of imports (Awokuse, 2008). Awokuse's work showed that import growth can also stimulate exports by creating an environment that increases productivity and competitive advantage.

A detailed analysis by Mahadevan & Suardi (2010) showed that both import and export growth have an important impact on GDP, supporting the idea that the trade-growth relationship is complex and linked (Mahadevan & Suardi, 2010). They also found that trade openness is a key factor in economic resilience, helping economies withstand external shocks while continuing to grow.

Economic Policy Implications

Understanding how imports and exports work together is important for policymakers. As shown in research by Tumaku (2018), focusing on import and export activities can improve GDP for countries working toward economic development (Tumaku, 2018). Policymakers should develop structures that support both import and export activities, increasing trade openness, which is known to promote sustainable economic growth. The insights from this literature emphasize that trade policies must combine import decisions with export goals to encourage full economic development.

Literature Review Conclusion

The literature strongly suggests that there is a strong connection between imports and exports and their shared contribution to economic growth. Import growth increases GDP by improving access to resources and advancing production capabilities, while exports further boost economic activity through international markets. This reciprocal relationship shows how crucial trade is for economic sustainability and growth, suggesting that policymakers should consider the interconnected nature of imports and exports when forming economic strategies.

MATERIALS AND METHODS

The Research Context

A total of forty nations dictate the global economy. The first 40 nations in GDP share account for 90% of the total GDP in the world in 2024. This research has chosen these Top 40 nations. Nigeria appears in the Top 40 nations in GDP World Share, but it has been excluded from the list due to the lack of data referring to its GDP composition by end-use. Nigeria has been excluded, but Pakistan and Hong Kong (nations #41 and #42 have been added instead of Nigeria.

The total Top 41 nations represent today, at the end of 2024, a world GDP Share of 90.3% according to The WorldFactbook 2023 (archive).

As you can see in Table 1, all GDP by end-use magnitude values sum to 100%. Some of them present a small deviation of 1% or 1.5% due to inaccuracies in the data provided by the source CIA World Factbook 2023 archive. The source estimates values, so it is easy to understand that not all values always sum to a perfect 100%. Also, information about the GDP growth of each nation has been supplied to make the table even more informative.

The table shows the importance of each magnitude (C, GS, I, Exp, Imp) in each economy. In some countries, for example, the US, Hong Kong, or the Philippines, the variable Household Consumption (C) is very important, presenting a weight of around 70% in the national economy. On the other side, other countries present high dependency on their Trade Balance (Exports-Imports), like for example Ireland or Singapore show values higher than 100% in their Balance of Trade (BOT).

It is presented in Table 1, the GDP by end-use of the Top 41 nations by GDP in the world in 2023. (Nigeria excluded and Pakistan and Hong Kong added).

Expected Author's Forecast of Each Country's Top 40 Nations by 2028

Data on the five (5) magnitudes of the GDP by end-use have been collected. Data related to Household consumption (C), exports (EXP), imports (IMP), and government spending (GS) have been collected according to (World Bank Data, retrieved in 2024), in the Global Economy webpage. Also, the magnitude of Investment (I) has been collected from the IMF data, also retrieved in 2024.

The presented abbreviations appear here:

C = Household Consumption GS: Government Spending

I: Investment

Exp: Exports

Imp: Imports

Out of the total 5 magnitudes that make up the GDG by end-use, the main equation universally considered is:

GDP by end-use = Household Consumption (C) + Government Spending (GS) + Investment (I) + Exports (Exp) – Imports (Imp), so simplified it is as:

GDP by end-use: C + GS + I + (Exp-Imp)

Four of the five GDP magnitudes have been analyzed in a longitudinal sequence using the last 50-60 years of historical data. Data about the evolution of the magnitudes is collected from the 1960s; in most cases, some others start in the 1970s or 80s. See the next table, which clarifies the data history.

Once the historical data of each GDP magnitude and its evolution (1960/1970-2023) have been collected, a forecast for the year 2028/30 has been made. A mathematical linear regression has been applied to four (4) out of the five (5) GDP magnitudes. The chosen magnitudes for forecasting are: Household Consumption (C), Government Spending (GS), Exports (EXP), and Imports (IMP).

Table 1: Number of years covered in the research using a Longitudinal Analysis.

RANK	COUNTRY	YEARS
1	United States	1980-2023
2	China	196-2023
3	Japan	1970-2023
4	Germany	1970-2023
5	India	1960-2023
6	United Kingdom	1960-2023
7	France	1960-2023
8	Russia	1988-2023
9	Canada	1961-2023
10	Italy	197-2023
11	Brazil	1960-2023
12	Australia	1960-2023
13	South Korea	1960-2023
14	Mexico	1960-2023
15	Spain	1970-2023
16	Indonesia	1960-2023
17	Saudi Arabia	1968-2023
18	Netherlands	1969-2023
19	Turkey	1960-2023
20	Switzerland	1970-2023
21	Poland	1985-2023
22	Argentina	1960-2023
23	Sweden	1960-2023
24	Norway	1970-2023
25	Belgium	1970-2023
26	Ireland	1970-2023
27	Israel	1970-2023
28	United Arab Emirates	2001-2023
29	Thailand	1960-2023
31	Egypt	1960-2023
32	Austria	1970-2023
33	Singapore	1960-2023
34	Bangladesh	1960-2023
35	Vietnam	1980-2023
36	Malaysia	1960-2023
37	South Africa	1960-2023
38	Philippines	1980-2023
39	Denmark	1966-2023
40	Iran	1960-2023
41	Pakistan	1960-2023
42	Hong Kong	1960-2023

The variable Investment (I) has already been forecasted to 2028 by the International Monetary Fund (IMF) in its forecast to 2028, so the already-made variable is used in the study with no volatility assumptions or changes.

Each variable or magnitude predicted for each country appears in longitudinal sequences from the 1960s to 2023.

The total variables are 5 (the 5 magnitudes of GDP by end-use), and the Top 41 nations (Top 42 except Nigeria + Hong Kong and Pakistan) lead the study to a sample of data N = 14.184

Consequently, the actual panorama in charts at the end of 2024 is like this:

Table 2: GDP by the end of 2023 of the Top 40 economies. Source's CIA World Factbook 2024, and own elaboration.

RANK	COUNTRY	SHARE GDP	C	GS	I	EXP	IMP	TOTAL	YEAR	GDP Growth
1	United States	25.32%	68.00%	13.90%	21.90%	11.60%	15.40%	100.00%	2022	2.06%
2	China	17.86%	37.40%	16.10%	43.10%	19.70%	17.60%	98.70%	2022	2.99%
3	Japan	4.21%	55.60%	21.60%	26.60%	21.50%	25.30%	100.00%	2022	1.03%
4	Germany	4.05%	50.70%	21.60%	23.50%	47.10%	43.00%	99.90%	2023	1.79%
5	India	3.37%	60.30%	10.50%	33.70%	21.90%	24.00%	102.40%	2023	7.00%
6	United Kingdom	3.05%	61.80%	20.70%	17.80%	32.20%	33.40%	99.10%	2023	4.10%
7	France	2.77%	53.70%	23.20%	25.20%	32.70%	34.90%	99.90%	2023	2.56%
8	Russia	2.23%	49.80%	18.50%	25.70%	21.30%	18.70%	96.60%	2023	-2.07%
9	Canada	2.13%	55.20%	21.20%	23.90%	33.50%	33.90%	99.90%	2023	3.40%
10	Italy	2.00%	59.60%	18.10%	20.90%	35.10%	33.70%	100.00%	2023	3.67%
11	Brazil	1.91%	63.30%	18.20%	16.00%	18.10%	15.70%	99.90%	2023	2.90%
12	Australia	1.67%	49.60%	21.30%	22.90%	26.70%	21.40%	99.10%	2023	3.62%
13	South Korea	1.66%	48.90%	18.90%	32.20%	44.00%	43.90%	100.10%	2023	2.56%
14	Mexico	1.41%	70.40%	11.00%	22.00%	36.20%	37.90%	101.70%	2023	3.06%
15	Spain	1.39%	55.60%	19.90%	19.40%	39.00%	34.80%	99.10%	2023	5.45%
16	Indonesia	1.31%	54.40%	7.40%	30.50%	21.70%	19.61%	94.39%	2023	5.31%
17	Saudi Arabia	1.10%	40.00%	23.30%	29.30%	34.70%	27.40%	99.90%	2023	8.74%
18	Netherlands	0.99%	43.50%	25.30%	20.10%	85.00%	73.90%	100.00%	2023	4.48%
19	Turkey	0.90%	59.40%	13.60%	29.40%	32.30%	34.70%	100.00%	2023	5.57%
20	Switzerland	0.80%	51.60%	11.40%	24.50%	75.30%	62.90%	99.90%	2023	2.06%
21	Poland	0.68%	57.20%	18.60%	18.10%	57.80%	51.70%	100.00%	2023	4.87%
22	Argentina	0.63%	67.20%	15.80%	19.50%	12.90%	14.10%	101.30%	2023	5.24%
23	Sweden	0.58%	43.20%	25.70%	26.80%	54.00%	49.60%	100.10%	2023	2.64%
24	Norway	0.58%	37.50%	21.90%	25.30%	47.20%	32.50%	99.40%	2023	3.28%
25	Belgium	0.58%	51.40%	24.20%	25.30%	86.70%	87.60%	100.00%	2023	3.25%
26	Ireland	0.53%	27.00%	12.30%	26.60%	134.10%	100.60%	99.40%	2023	11.97%
27	Israel	0.52%	48.20%	22.40%	25.70%	30.90%	27.10%	100.10%	2023	6.46%
28	United Arab Emirates	0.50%	40.20%	14.50%	22.80%	95.90%	70.60%	102.80%	2023	7.41%
29	Thailand	0.49%	57.70%	16.60%	22.60%	65.40%	63.70%	98.60%	2023	2.59%
30	Nigeria	0.47%						0.00%	2017	3.25%
31	Egypt	0.47%	82.60%	6.80%	12.90%	19.10%	21.30%	100.10%	2023	6.59%
32	Austria	0.47%	51.80%	20.30%	25.30%	59.50%	56.60%	100.30%	2023	5.00%
33	Singapore	0.46%	31.30%	10.20%	21.00%	174.30%	136.90%	99.90%	2023	3.65%
34	Bangladesh	0.46%	68.60%	5.70%	31.00%	13.20%	17.80%	100.70%	2023	7.10%
35	Vietnam	0.41%	54.80%	8.90%	32.60%	93.80%	90.00%	100.10%	2023	8.02%
36	Malaysia	0.40%	60.40%	12.00%	22.50%	68.40%	63.40%	99.90%	2023	8.69%
37	South Africa	0.40%	64.70%	19.70%	16.20%	33.00%	32.70%	100.90%	2023	2.04%
38	Philippines	0.40%	76.50%	14.20%	23.30%	26.70%	40.70%	100.00%	2023	7.57%
39	Denmark	0.39%	45.80%	22.60%	22.00%	69.00%	59.40%	100.00%	2023	3.82%
40	Iran	0.39%	47.20%	13.20%	36.40%	28.60%	26.90%	98.50%	2023	2.75%
41	Pakistan	0.37%	83.40%	10.20%	13.70%	10.40%	17.70%	100.00%	2023	6.19%
42	Hong Kong	0.36%	70.30%	13.20%	15.70%	176.20%	175.40%	100.00%	2023	-3.48%

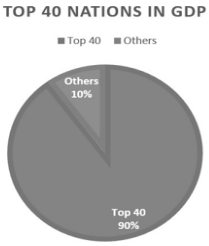


Figure 1: Market Share in the Global Economy of the Top 40 Nations in 2024. Source Own elaboration

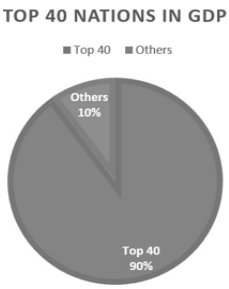


Figure 2: Market Share in the Global Economy of the Top 10 Nations in 2024. Source: own elaboration

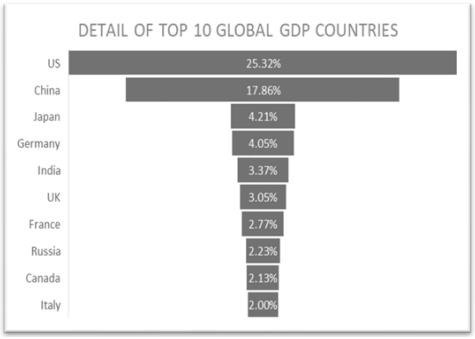


Figure 3: Global Market Share Detailed in the Global Economy of the Top 10 Nations in 2024.
Source IMF 2025

GDP Forecast Analysis

From now on, you can read in Table 3 the obtained values after the author's prediction of GDP by end-use magnitudes in each country. The forecast makes the magnitudes change in certain degrees, and consequently, the total GDP obtained is sometimes more or less than

Table 3: GDP Prediction by end-use year 2030 of the Top 40 Economies. Source: own elaboration.

RANK	COUNTRY	SHARE GDP	C	GS	I	EXP	IMP	TOTAL	YEAR
1	United States	25.32%	67.84%	13.92%	22.37%	12.99%	15.18%	101.94%	2030
2	China	17.86%	37.39%	16.80%	41.78%	19.30%	17.57%	97.70%	2030
3	Japan	4.21%	56.18%	21.91%	26.28%	22.07%	26.74%	99.70%	2030
4	Germany	4.05%	50.15%	20.60%	21.17%	50.77%	48.02%	94.67%	2030
5	India	3.37%	60.22%	10.48%	32.75%	22.40%	23.40%	102.45%	2030
6	United Kingdom	3.05%	61.82%	19.59%	17.31%	32.19%	34.44%	96.47%	2030
7	France	2.77%	53.77%	23.08%	21.56%	34.48%	38.17%	94.72%	2030
8	Russia	2.23%	51.52%	18.14%	26.77%	27.08%	17.71%	105.80%	2030
9	Canada	2.13%	55.89%	21.10%	23.41%	33.30%	34.00%	99.70%	2030
10	Italy	2.00%	59.50%	18.17%	21.61%	37.11%	36.48%	99.91%	2030
11	Brazil	1.91%	62.82%	17.99%	15.62%	16.03%	16.19%	96.27%	2030
12	Australia	1.67%	49.63%	21.15%	24.16%	27.68%	21.01%	101.61%	2030
13	South Korea	1.66%	48.93%	19.47%	30.45%	45.67%	43.67%	100.85%	2030
14	Mexico	1.41%	71.98%	10.79%	24.57%	43.61%	41.21%	109.74%	2030
15	Spain	1.39%	54.65%	19.76%	20.63%	39.44%	40.81%	93.67%	2030
16	Indonesia	1.31%	54.38%	6.16%	30.89%	22.09%	19.32%	94.20%	2030
17	Saudi Arabia	1.10%	38.30%	23.09%	31.36%	35.59%	28.94%	99.40%	2030
18	Netherlands	0.99%	43.99%	25.34%	19.50%	92.65%	81.97%	99.51%	2030
19	Turkey	0.90%	58.83%	13.64%	26.41%	36.58%	38.19%	97.27%	2030
20	Switzerland	0.80%	52.00%	11.44%	25.04%	80.81%	62.88%	106.41%	2030
21	Poland	0.68%	53.31%	18.36%	19.61%	70.73%	62.86%	99.15%	2030

22	Argentina	0.63%	67.01%	15.78%	23.46%	13.25%	14.28%	105.22%	2030
23	Sweden	0.58%	42.25%	25.87%	27.33%	56.73%	51.05%	101.13%	2030
24	Norway	0.58%	38.00%	21.46%	27.33%	40.41%	37.71%	89.49%	2030
25	Belgium	0.58%	51.69%	24.49%	24.14%	94.53%	96.11%	98.74%	2030
26	Ireland	0.53%	20.85%	11.04%	18.90%	131.69%	105.44%	77.04%	2030
27	Israel	0.52%	48.09%	22.27%	23.25%	32.14%	35.31%	90.44%	2030
28	United Arab Emirates	0.50%			29.82%			29.82%	2030
29	Thailand	0.49%	58.90%	16.28%	20.81%	66.77%	62.42%	100.34%	2030
31	Egypt	0.47%	82.57%	6.29%	12.58%	19.46%	25.61%	95.29%	2030
32	Austria	0.47%	51.80%	20.42%	24.16%	66.06%	61.61%	100.83%	2030
33	Singapore	0.46%	27.98%	10.12%	26.12%	185.92%	154.85%	95.29%	2030
34	Bangladesh	0.46%	71.87%	6.21%	32.84%	13.18%	18.42%	105.68%	2030
35	Vietnam	0.41%	54.08%	8.81%	32.71%	107.38%	98.10%	104.88%	2030
36	Malaysia	0.40%	60.51%	12.03%	23.46%	65.01%	62.15%	98.86%	2030
37	South Africa	0.40%	64.82%	20.20%	16.27%	32.96%	32.70%	101.55%	2030
38	Philippines	0.40%	79.01%	14.02%	27.89%	26.11%	39.91%	107.12%	2030
39	Denmark	0.39%	46.18%	22.86%	21.75%	75.24%	63.39%	102.64%	2030
40	Iran	0.39%	48.21%	13.18%	37.08%	23.23%	21.35%	100.35%	2030
41	Pakistan	0.37%	83.73%	11.01%	16.15%	10.39%	18.05%	103.23%	2030
42	Hong Kong	0.36%	68.00%	13.06%	21.59%	172.85%	173.78%	101.72%	2030

100%. For example, the GDP presented in Table 3 that relates to the US states that according to this data, 100% of US GDP will become 102.69% by 2030, meaning this is an increase of 2.69% while other countries are expected to decrease, see the example of Italy which goes from 100% in year 2023 to 97.33% by year 2030 meaning this a decrease of -2.67% (periods 2024, 2025,2026,2027, 2028,2029,2030).

Aggregated Data

• Household consumption as a percent of GDP, 2023 (C): The average obtained for 2023 based on 146 countries was 62.92 percent. The highest value was in Somalia: 123.53 percent, and the lowest in Ireland: 26.77 percent. The indicator is available from 1960 to 2023. Below is a chart for all countries where data are available. Source: The World Bank. Retrieved from The Global Economy (2024)

• Government Spending (GS). Government spending as a percent of GDP, 2023: The average for 2023, based on 130 countries, was 16.14 percent. The highest value was in Ukraine: 41.68 percent, and the lowest in Chad: 4.21 percent. The indicator is available from 1960 to 2023. Below is a chart for all countries where data are available. Source: The World Bank. Retrieved from The Global Economy (2024).

• Investment (I). Investment forecast, 2024: The average for 2024 based on 164 coun-tries was 23.42 percent. The highest value was in Suriname: 48.84 percent, and the lowest in Djibouti: -25.32 percent. The indicator is available from 1980 to 2028. Below is a chart for all countries where data are available. Source: International Monetary Fund. Retrieved from The Global Economy (2024).

• Exports (Exp). Exports of goods and services as a percent of GDP, 2023: The average for 2023, based on 138 countries, was 45.76 percent. The highest value was in Luxem-bourg: 212.53 percent, and the lowest in Sudan: 1.16 percent. The indicator is available from 1960 to 2023. Below is a chart for all countries where data are available. Source: The World Bank. Retrieved from The Global Economy (2024).

• Imports (Imp). Imports of goods and services as percent of GDP, 2023: The average for 2023 based on 138 countries was 49.03 percent. The highest value was in Luxem-bourg: 181.69 percent, and the lowest in Sudan: 1.04 percent. The indicator is available from 1960 to 2023. Below is a chart for all countries where data are available. Source: The World Bank. Retrieved from The Global Economy (2024).

Explanation of the Research Model and Method.

Firstly, data from the last 40/45 periods (years) have been collected, referring to each variable.

Also, a forecast to 2030 using linear regression techniques has been applied. See example of the US values obtained for C, GS, EXP, and IMP.

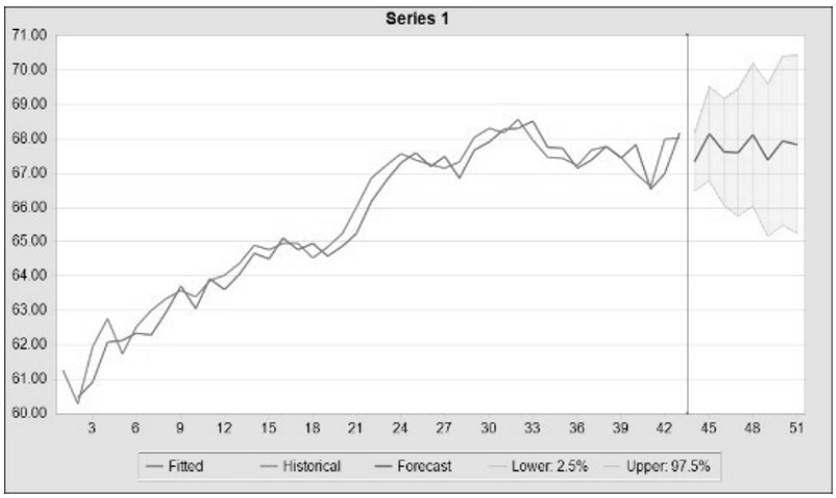


Figure 4: Details of US Household Consumption Evolution during 1983-2023 and linear regression for 2030. Source own elaboration

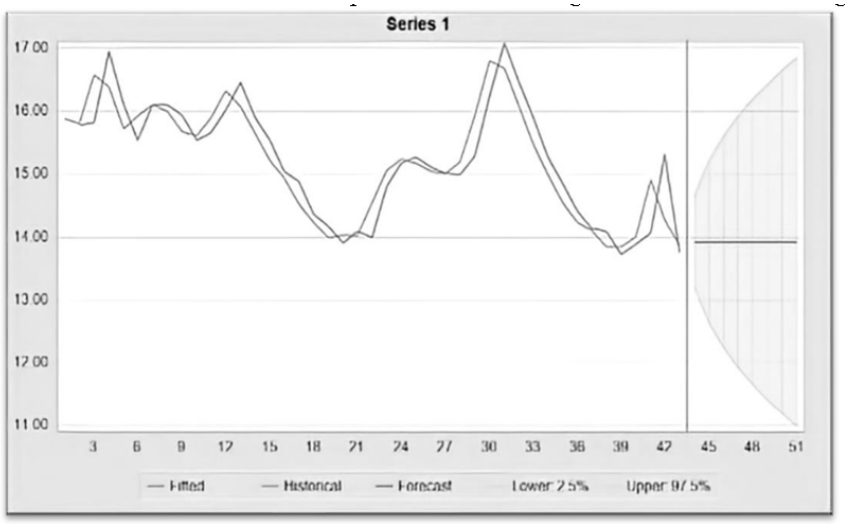


Figure 5: Details of US Government Spending Evolution during 1983-2023 and linear regression for 2030. Source own elaboration

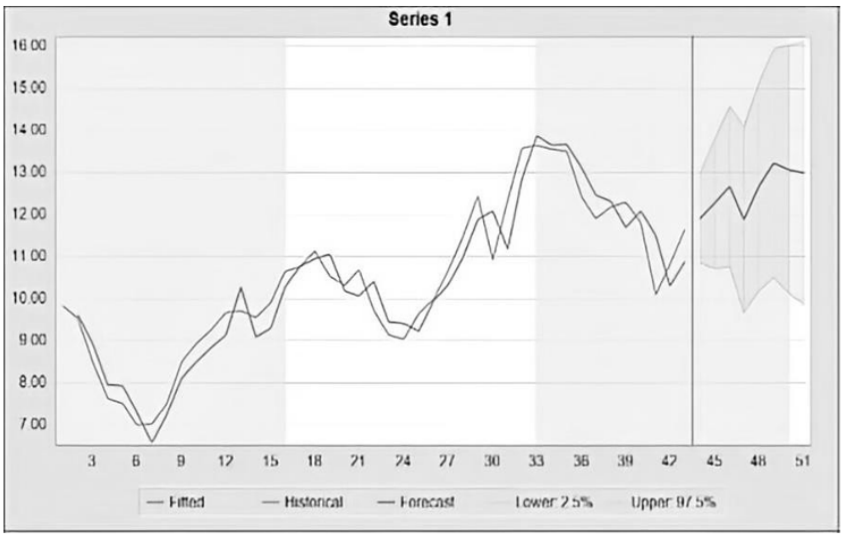


Figure 6: Details of US Exports Evolution during 1983-2023 and linear regression for 2030. Source own elaboration

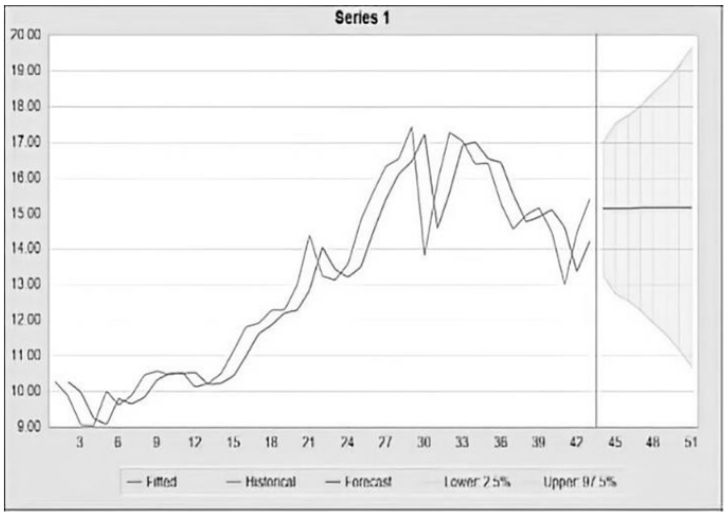


Figure 7: Details of US Imports Evolution during 1983-2023 and linear regression for 2030. Source own elaboration

Secondly, Uncertainty analysis about the evolution of the US GDP by end-use magnitudes.

A Monte Carlo simulation has been made considering all Top 40 countries and their forecasted values by the year 2030, see Table 4 as an example applied to the US imports.

The expected value of a function is the main basis of the Monte Carlo simulation system $f(x_1, x_2, x_3, x_4)$. Where:

- x_1, x_2, x_3, x_4 are random variables, possibly with given probability distribu-tions.
- $f(x_1, x_2, x_3, x_4)$ be a function of interest (e.g., profit, temperature, risk score, etc.)
- N be the number of simulations (samples).

Monte Carlo Estimate Formula used:

$$\hat{E}[f(x_1, x_2, x_3, x_4)] = \left(\frac{1}{N}\right) \sum_{i=1}^{n} f(x_1^{(i)}, x_2^{(i)}, x_3^{(i)}, x_4^{(i)})$$

Where:

- $x_j^{(i)}$ is the i-th sampled value of variable x_j, for j = 1,2,3,4
- All $x_j^{(i)}$ are sampled independently from their respective distributions.

"I-th" is a mathematical notation indicating the i-th element of a sequence or set, where 'i' is an index.

The value of each GDP by end-use magnitude for each country has been considered. The model has been done by applying assumptions to the 4 variables of the GDP by end-use. The variables/magnitudes are: 1) Household consumption (HC), 2) Government Spending (GS), Exports (Exp), and Imports (Imp). The last magnitude, Investment (I), has not been considered using it in the equation of total GDP expected for 2030, but not included in the Monte Carlo simulations. The values of the Investment are those provided by the IMF in its forecast for 2028.

The total of four GDP magnitude variables in each country has been considered using a triangular statistical assumption of values related to the lower, upper, and forecasted levels. All these assumptions end up in an uncertainty and risk analysis of the final GDP in 2030 expressed as a percentage. Consequently, the model applies randomly a total of 20.000 iterations (simulations) to each GDP magnitude in each country under a 99% confidence. The model consequently has 4 magnitudes x 40 countries x 20.000 iterations = 3.2 million iterations, affecting the final output (GDP expected in 2030).

Forecast Results

As we can see in the former table, the US has increased its imports from levels of 11-12% in the 1980s and 1990s to levels of 14-16% showing excessive dependency on the rest of the countries, including China.

Table 4: Forecast linear regression for 2030 on the evolution of US imports.

Period	Lower: 2.5%	Forecast	Upper: 97.5%
44	13.30	15.15	17.00
45	12.75	15.15	17.56
46	12.57	15.16	17.75
47	12.29	15.16	18.03
48	11.92	15.17	18.42
49	11.61	15.17	18.74
50	11.19	15.18	19.17
51-2030	10.68	15.18	19.69

RESULTS AND DISCUSSION

Results Derived from the Monte Carlo Analysis of Statistical Certainties.

In research, making accurate predictions and good decisions is very important across many fields. The Monte Carlo simulation is a key tool in this area, using random sampling to look at complex problems that normal methods struggle with. By running many scenarios with different input variables, researchers can get a sense of possible outcomes and measure the uncertainty that comes with them. This method helps in understanding risks and opportunities better, improving the quality of insights from data analysis. Additionally, the Monte Carlo method is useful in many areas, including finance, engineering, healthcare, and environmental studies. As researchers deal with complex data and systems, the Monte Carlo simulation not only supports traditional methods but also raises the level of research with its strong analytical features.

Each country has been tested for the probabilities of maintaining the expected level of GDP expressed in Table 3, while likely volatilities apply to the variables C, GS, EXP, and IMP.

The assumption of fluctuations in each variable comes from the linear regression already executed using the forecast result, lower bound, and upper bound as the terms expected, minimum, and maximum value in a triangular distribution applied.

Now the chart of the results of the first 3 nations in the Top 40 is presented here. Note that the analysis covers the top 40 nations in GDP in the world, but only 3 charts are used for illustration purposes in this paper; the charts here relate to the US. China and Japan. See the results of the simulations here:

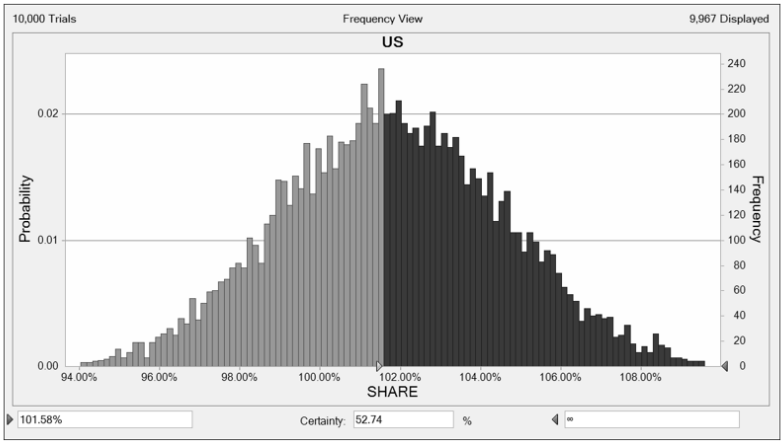


Figure 8: Statistical probabilities of the US achieving 100% of its GDP by 2030.



Figure 9: Statistical probabilities of China achieving 100% of its GDP by 2030

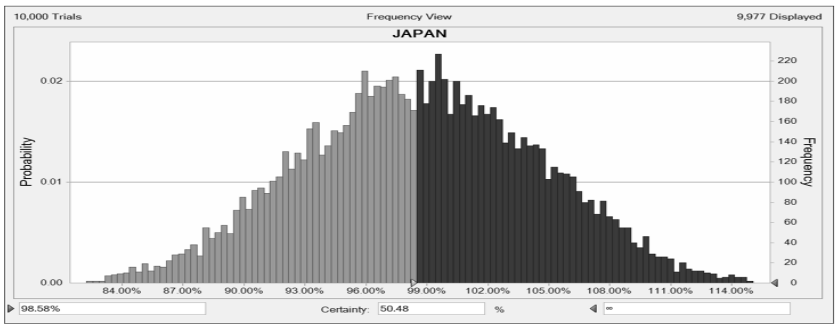


Figure 10: Statistical probabilities of Japan achieving 100% of its GDP by 2030

Results Derived From the Sensitivity Analysis

This research also executes a Sensitivity Analysis on the 4 variables analyzed for each country. As an example, the GDP of the US presents a very high sensitivity to changes in imports, expressed with a sensitivity value of -45%. Even if imports do not account for a significant weight as Household consumption does, they contribute to reducing the balance of trade in a way that really impacts the country's GDP fluctuations. Also, increasing exports will be important for the US. Exports present a sensitivity of +21.3%. Government spending will contribute to the variability of the results of GDP by 18% while Household Consumption will impact with a 14.4% only. See Figure 11. Consequently, the US Administration will have to pay special attention to restoring the trade deficit with all the countries and also improving consumption and government spending.

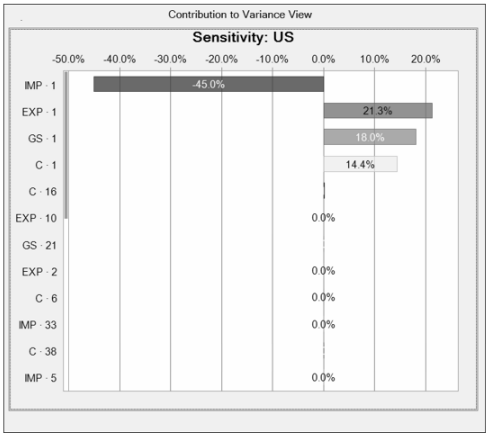


Figure 11: Sensitivity analysis applied to the variables of the US GDP. Source own elaboration

Other examples of the same analysis applied to China and Japan are as follows:

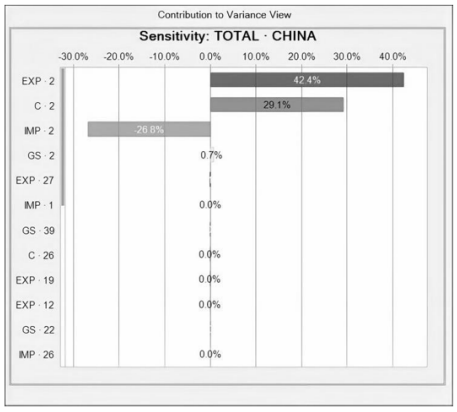


Figure 12: Sensitivity analysis applied to the variables of China's GDP. Source own elaboration

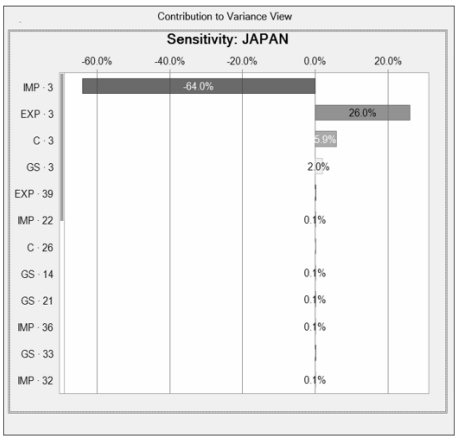


Figure 13: Sensitivity analysis applied to the variables of Japan's GDP. Source own elaboration

As stated in the chart in Figure 12, China needs to pay attention mainly to its exports (showing a +42% contribution to the variability of the results of its GDP). On the other side, Japan will have to maintain its economic vigilance while importing due to the fact that its economy presents sensitivity in its imports, up to a -64% impact.

The same kind of analysis has been applied to the Top 40 economies in the world, leading to aggregated results of GDP uncertainty and variable-sensitivity analysis.

Aggregated Results

As we can see, and following exclusively a forecast based on mathematical criteria, some countries will increase their GDP in a range of 5 years from now on, and some others will decrease their GDP in the same range

• List of countries with high probabilities of achieving their forecast (>70% statistical certainties): Russia, Mexico, Switzerland, Argentina, Bangladesh, and the Philippines

• List of countries with a high level of uncertainty. (values in the range between 40-69%) USA, China, Japan, India, Canada, Australia, South Korea, Saudi Arabia, Netherlands, Poland, Sweden, Belgium, Thailand, Austria, Singapore, Vietnam, Malaysia, South Af-rica, Denmark, Iran, Pakistan, Hong Kong.

• List of countries with low probabilities of achieving their expected results (<40% sta-tistical certainties): Germany, the United Kingdom, France, Italy, Brazil, Spain, Indo-nesia, Turkey, Norway, Ireland, Israel, and Egypt.

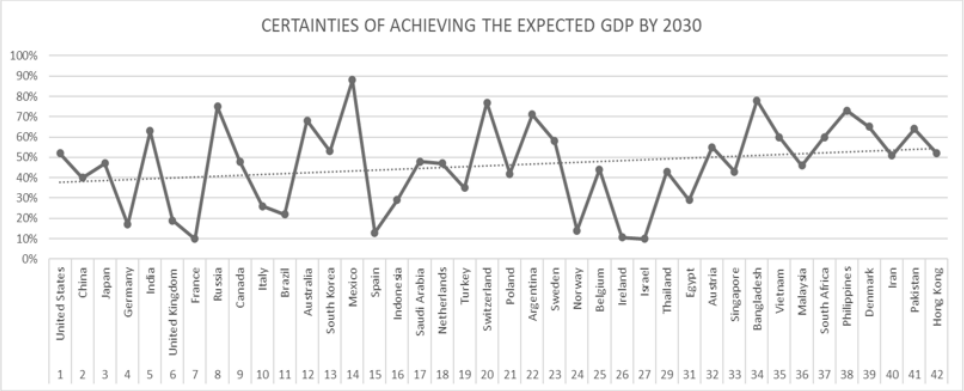


Figure 14: Certainties for all countries analysed

Global Economy Sensitivity Analysis

The most important analysed variables of the GDP Global evolution are imports and exports, which appear to be the most sensitive factors in the GDP composition. Exports appear in 23 out of 40 nations (57.5%) of the

Table 5: Results for Sensitivity Analysis obtained for each GDP by end-use of the top 20 Global economies

RANK	COUNTRY	C	GS	EXP	IMP	Total	BLOC	BLOC CODE
1	United States	39.60%	19.80%	9.60%	30.20%	99.20%	USCAM	1
2	China	73.00%	0.60%	13.80%	11.70%	99.10%	RCEP	2
3	Japan	6.00%	1.50%	27.00%	64.80%	99.30%	RCEP	2
4	Germany	11.11%	8.40%	30.30%	49.50%	99.31%	EU	3
5	India	21.90%	4.60%	22.50%	50.20%	99.20%	Others	4
6	United Kingdom	15.80%	11.10%	25.50%	46.70%	99.10%	Others	4
7	France	3.60%	12.10%	36.30%	47.10%	99.10%	EU	3
8	Russia	22.90%	1.70%	54.80%	19.70%	99.10%	Others	4
9	Canada	15.10%	9.00%	45.30%	29.80%	99.20%	USCAM	1
10	Italy	4.10%	3.40%	16.20%	75.50%	99.20%	EU	3
11	Brazil	42.90%	18.90%	16.60%	12.50%	90.90%	Mercosur	5
12	Australia	32.40%	16.10%	22.20%	28.60%	99.30%	RCEP	2
13	South Korea	19.40%	2.00%	20.69%	56.90%	98.99%	RCEP	2
14	Mexico	15.30%	1.70%	39.20%	43.10%	99.30%	USCAM	1
15	Spain	2.10%	6.00%	45.70%	45.50%	99.30%	EU	3
16	Indonesia	24.10%	2.20%	56.60%	16.30%	99.20%	RCEP	2
17	Saudi Arabia	16.30%	6.90%	56.50%	19.50%	99.20%	Others	4

18	Netherlands	3.40%	2.40%	55.60%	37.70%	99.10%	EU	3
19	Turkey	32.40%	9.60%	21.10%	36.10%	99.20%	Others	4
20	Switzerland	6.90%	0.80%	44.30%	47.10%	99.10%	Others	4

Note that values in cells in bold and italics represent the most relevant factors of sensitivity

time, and imports appear in 24 out of 40 nations (60%) of the time. The variable Household Consumption will be crucial only in 8 countries (20%).

As we can see, the variable "Investment" has not been an object of analysis, and the variable Government Spending does not contribute at all to the variability of the results obtained.

Table 6: Results for Sensitivity Analysis obtained for each GDP by end-use economies in positions 21-40 in the Global arena

RANK	COUNTRY	C	GS	EXP	IMP	Total	BLOC	BLOC CODE
21	Poland	9.20%	1.20%	24.60%	64.10%	99.10%	EU	3
22	Argentina	47.10%	20.40%	22.60%	9.10%	99.20%	Mercosur	5
23	Sweden	19.90%	15.90%	36.50%	27.00%	99.30%	EU	3
24	Norway	10.40%	5.90%	64.80%	14.50%	95.60%	Others	4
25	Belgium	1.80%	1.30%	64.70%	31.40%	99.20%	EU	3
26	Ireland	2.00%	1.24%	9.60%	86.40%	99.24%	EU	3
27	Israel	20.90%	19.30%	31.10%	27.90%	99.20%	Others	4
28	United Arab Em	12.90%	9.50%	14.70%	62.00%	99.10%	Others	4
29	Thailand	8.10%	1.30%	46.30%	43.50%	99.20%	RCEP	2
31	Egypt	5.10%	4.20%	20.30%	69.70%	99.30%	Others	4
32	Austria	31.90%	16.00%	22.80%	28.40%	99.10%	EU	3
33	Singapore	2.10%	0.40%	44.70%	52.20%	99.40%	RCEP	2
34	Bangladesh	14.20%	19.00%	38.90%	27.00%	99.10%	Others	4
35	Vietnam	3.90%	0.90%	53.00%	41.40%	99.20%	RCEP	2
36	Malaysia	3.90%	1.60%	51.10%	42.60%	99.20%	RCEP	2
37	South Africa	15.70%	3.70%	48.40%	31.40%	99.20%	Others	4
38	Philippines	14.90%	2.90%	30.40%	51.00%	99.20%	RCEP	2
39	Denmark	4.00%	6.30%	39.10%	49.80%	99.20%	EU	3
40	Iran	9.90%	4.00%	43.30%	41.90%	99.10%	Others	4
41	Pakistan	17.60%	8.00%	35.20%	38.40%	99.20%	Others	4

Note that values in cells in bold and italics represent the most relevant factors of sensitivity

Limitations

The study relies purely on quantitative secondary data, omitting qualitative geopolitical shifts and the economic fallout of Trump-era trade policies. Additionally, baseline forecasts from supranational institutions may shift over the next two to three years.

CONCLUSION

Major EU economies and the UK show low probabilities (under 40%) of meeting their 2030 GDP forecasts, with most top 40 nations falling into moderate uncertainty (40–70%). In contrast, countries like Mexico, Argentina, Switzerland, and Russia hold stronger odds (over 70%). Within BRICS, India, Russia, and South Africa show favorable outlooks, while Brazil lags and China faces high volatility.

International trade heavily drives these projections: imports rank as the most sensitive GDP variable in 57.5% of nations (including Japan, Germany, and the UK), followed by exports (40%). Conversely, government spending shows minimal impact. Key exceptions include the US and China, where domestic household consumption is the primary sensitivity factor (36.9% and 73%, respectively), making China better insulated against trade war shocks. Consequently, high import sensitivities across European and RCEP nations may fuel renewed protectionist tariff policies.

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