The Seybold Report

ISSN 1533-9211

DOI: 10.5281/zenodo.8370154

TOTAL FACTOR PRODUCTIVITY, TRADE OPENNESS, AND ECONOMIC GROWTH: EVIDENCE FROM G20 COUNTRIES

RAJESH KUMAR

Assistant Professor and Research Scholar, New Delhi Institute of Management & National Institute of Technology, Agartala, India. Email: rajeshseco@gmail.com

Dr. DEBASIS NEOGI

Professor, Department of Management, Humanities & Social Sciences, National Institute of Technology, Agartala, India. Email: dneogi@nita.ac.in

Abstract

The intricate relationship between trade openness and economic growth has spurred extensive inquiry, yet definitively establishing whether trade openness indeed fuels higher economic growth remains elusive. This challenge stems from diverse methodologies and measures used in previous research. Analytical techniques and proxies for trade openness, alongside inconsistent findings, hinder conclusive outcomes. Comprehending the precise mechanisms linking trade openness and economic growth is complex, demanding meticulous empirical scrutiny. Utilizing panel data from 1990 to 2019, this study employs an Ordinary Least Squares (OLS) regression model to explore the interplay among trade liberalization, government size, capital, reserves, and GDP per capita in G20 nations. The dependent variable is GDP per capita growth, while the independent variables include trade openness, government size, capital, total reserves, and total factor productivity (TFP). This research hypothesizes a substantial link between these factors and economic growth, aiming to bridge existing gaps and offer a foundation for well-grounded economic strategies. By delving into this multifaceted relationship within a specific time frame and employing robust econometric techniques, this study contributes to a nuanced understanding of trade's ramifications for development. Its findings hold potential to guide evidence-based policymaking, informing decisions that steer global economic progress.

Keywords: TFP, Trade Openness, Economics growth, Panel Data, OLS

INTRODUCTION

There has been a lot of discussion and study about the correlation between freer trade and higher GDP. However, arriving at a clear conclusion regarding whether trade openness indeed promotes higher economic growth has proven challenging for researchers. This difficulty arises from various factors that warrant careful consideration.

The methodologies used to estimate the models linking these variables, as well as the measures of trade openness used in prior research, provide a significant obstacle to drawing a firm conclusion on the relationship between trade openness and economic development (Huchet-Bourdon et al., 2011). Researchers have used a variety of analytical methods and looked at both objective and subjective measures of openness to show a strong correlation between trade openness and economic development. However, the selection of suitable econometric instruments and proxies for trade openness has become more difficult as a result of these developments in the literature. Inconsistent findings about the effects of liberalisation on economic development may have resulted from the use of several liberalisation indices and

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

related misspecification difficulties. (Greenaway et al., 2002). Another challenge lies in understanding the precise mechanisms through which trade openness affects economic growth. Scholars have highlighted the need for future studies to delve into the underlying processes of the trade openness-growth link (Hallak and Levinsohn, 2004). Wald and Wood (2004) make similar points about the gaps in our understanding of how trade policy affects economic development. There is still no definitive theoretical framework that explains why trade leads to economic development (Ulasan, 2012). This means that examining the connection between trade and economic development requires careful empirical examination.

In addition, data quality poses significant challenges, particularly in low-income developing nations. Sample variability and non-linear relationships between trade and growth account for the differences seen among studies. Furthermore, the inclusion of nations with notable economic differences and the limitations in data quality can hinder generalizability. It becomes essential for researchers to exercise caution in ensuring data reliability and sample homogeneity in terms of economic characteristics.

Scientific work suggests that trade liberalisation is crucial to a country's economic development. It's very relevant to policy debates in both the academy and the government. The vast majority of studies found that openness promoted economic expansion.Scholars argue that open economies are better equipped to adopt cutting-edge technologies from around the world, enhancing resource allocation, facilitating information diffusion and technological innovation, and promoting competition in domestic and international markets (Romer, 1993; Grossman and Helpman, 1991; Barro and Sala-i-Martin, 1995; Chang, Kaltani, and Loayza, 2005).

However, alternative models propose that trade openness can either expedite or hinder international economic growth, particularly when trading partners exhibit significant differences in factor endowments (Rivera-Batiz and Romer, 1991)

Knowledge spillovers and human capital accumulation are two factors that have been overlooked by neoclassical growth models, which have been criticised by endogenous growth theories. In a number of studies, including those by Frankel and Romer (1999), Balassa (1978), Harrison (1996, and Wacziarg et al. (1999), researchers found that freer trade led to higher GDP. While proponents of trade liberalisation argue that it would lead to a flourishing economy, others point out that it might actually slow growth (Baliamoune-Lutz and Ndikumana, 2007; Levine and Renelt, 1992; Rodriguez and Rodrik, 2000). Given the lack of agreement, further study is needed to evaluate the overall effect of trade openness on economic development, taking into account the limitations of earlier research (Rodriguez and Rodrik, 2000; Foster, 2008; Eri and Ulaan, 2013).

This study's overarching objective is to learn how the G20 nations' trade liberalisation, government size, capital, total reserves, and GDP per capita are all connected. The objective is to determine the extent to which these factors impact economic growth and provide valuable insights for policymakers in formulating effective economic policies. The research hypothesis posits a significant relationship between trade openness, government size, capital, total reserves, and total factor productivity (TFP) on GDP per capita in the G20 countries.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

To achieve these research objectives, the study will employ a combination of theoretical analysis and empirical methods, considering the challenges and limitations outlined in the literature. This study aims to add to the current body of information and provide useful insights for policymakers by analysing the trade openness-economic growth link within the context of the G20 countries.

REVIEW OF THE LITERATURE

Trade liberalisation and economic expansion have been shown to be studied in recent decades using a variety of econometric approaches, both objective and arbitrary. According to the growing agreement, there is a substantial link between trade openness and economic development in the literature. Significant policy changes in regard to international commerce have resulted from the impressive economic performances of nations like Singapore, Taiwan, Hong Kong, South Korea, and India as well as the outstanding growth experiences of China and India (together known as the Asian Tigers). According to Panagariya (2004), the past 50 years of experience offer compelling evidence in favour of free trade. To make definite conclusions on the relationship between trade openness and economic development, however, several factors must be considered. However, it is essential to keep in mind that the presence of these issues does not imply that the connection between trade openness and economic development is tenuous. Fiestas (2005) is accurate in arguing that there is no evidence to support the notion that trade liberalisation is damaging to economic development, despite several problems with the study's methodology. The academic community and the political class both recognise and acknowledge the merits of outwardly focused initiatives.

Researchers have found it difficult to make a clear conclusion about whether trade openness really promotes higher economic growth for a number of reasons. First, there are unanswered problems about the metrics of trade openness and the methodologies used to estimate the models that link trade openness to growth (Huchet-Bourdon et al., 2011). "Over time, scholars have employed different analytical methods and examined different objective and subjective indicators of openness in an attempt to show a clear relationship between trade openness and economic development. These advancements in the literature have made it more difficult to choose appropriate econometric instruments and proxies for trade openness in the study. Greenaway et al. (2002) suggest that the adoption of several liberalisation indices, along with the misspecification difficulties that come with them, may be to blame for the inconsistent findings about liberalization's effects on GDP growth.

Second, the precise way in which trade openness affects economic growth is yet unclear. Future study must concentrate on finding the processes behind the trade openness-growth link, as correctly noted by Hallak and Levinsohn (2004). Wald and Wood have also criticised the public's lack of understanding between trade policy and economic expansion (2004). Ulasan (2012) demonstrates that the link between trade and growth is not well explained by current theoretical frameworks. Consequently, in order to study the trade-growth link, scholars must rely on empirical analysis.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

Third, there are issues with data quality, particularly in low-income developing nations. The observed discrepancies amongst studies can be partially explained by sample heterogeneity and non-linear correlations between trade and growth. Generalizability may be hampered by the inclusion of nations with notable differences in economic factors and by the low quality of the data. In order to ensure data reliability and sample homogeneity in terms of economic characteristics, researchers must take extra care.

It has been theorised that freer trade flows are crucial to a country's economic development. For many reasons, free trade is a hot subject in both academic circles and policy circles. To begin, the World Bank and the International Monetary Fund prioritise trade openness in the structural adjustment initiatives they assist in a variety of developing nations. The majority of studies, however, support the idea that openness has a beneficial effect on development, at least in terms of the theoretical link between openness and growth. Romer (1993), Grossman and Helpman (1991), and Barro and Sala-i-Martin (1995) are just a few of the academics who have claimed that open economies are better able to catch up to the most cutting-edge technology in the rest of the world. Openness, as stated by Chang, Kaltani, and Loayza (2005), promotes efficient allocation of resources through comparative advantage, allows for the spread of knowledge and technical innovation, and increases competitiveness in both local and foreign markets.

Solow's (1957) development model of technological progress as being wholly external (1996) has been attacked by endogenous growth theories such as those offered by Coe and Helpman (1995), Grossman and Helpman (1991a), and Sala-i-Martin (1991). Within the context of a long-term development process, the endogenous growth models use knowledge spillovers and HCA to explain the positive relationship between the adoption of trade openness strategies and economic growth. Multiple researchers have shown a positive correlation between trade openness and GDP growth (1999), including Frankel and Romer (2001), Balassa (1978), Harrison (1996), and Wacziarg (1999). Romer (1990) conducted a cross-sectional study of 90 countries and came to the same conclusion: trade openness drives innovation, productivity, and development.

On the other hand, other studies claim that trade liberalisation is bad for economic growth. Some research has shown that increasing trade openness has a detrimental influence on the economic development of adjacent nations; for example, Baliamoune-Lutz and Ndikumana's (2007) analysis of the relationship between trade openness and economic growth in African countries. It is difficult to identify a substantial positive correlation between trade openness and development, as pointed out by Levine and Renelt (1992) and Rodriguez and Rodrik (2000). Since academics can't seem to agree on anything, we need more data to know how trade liberalisation affects GDP growth in the long run. According to Rodriguez and Rodrik (2000), most research in this area suffer from at least two primary weaknesses. To begin, there are problems with the trade-openness indices now in use. Second, skewed numbers might be attributed to unreliable techniques of estimation. Yanikkaya (2003) found conflicting results, including both positive and negative outcomes, or no correlation at all. Quantile regression was employed by Foster (2008) to look at how trade liberalisation affected GDP growth. He

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

reasoned that although trade openness is good for economic development in the long run, it has a negative effect in the near run. Eri and Ulaan (2013) conducted a cross-sectional investigation of the trade-growth link from 1960 to 2000 and found no evidence for a correlation between trade openness and long-term economic development.

The theory of comparative advantage

In order to explain international commerce, comparative pricing and costs have typically received the most attention in international trade theory. However, it is unclear that price factors can account for the swift growth of trade. Although this is not to say that levels or changes in prices may not do so, it simply indicates that in the periods studied, other influences have been much more significant. There is now a sizable collection of empirical findings that levels or changes in prices have attributed for very little in most quantitative explanations of trade. There are more flaws in the conventional theory of comparative advantage! Along with being irrelevant from an empirical standpoint, it is also restrictive in its presumptions of perfect competition, full employment, and constant returns to scale; additionally, because it makes the assumption that all goods are the same, it is unable to explain the phenomenon of based on inter trade. (Grubel and Lloyd, 1971, 1975)

Time Series Analysis Review

Since the 1990s, researchers and policymakers have paid a lot of attention to the correlation between financial development and economic growth. Many researchers, some more successful than others, have attempted to assess the long-term connection between finances and growth using time series data. According to a number of studies (Wachtel and Rousseau, 1995; Demetriades and Luintel; Arestis and Demetriades; Rousseau and Wachtel, 1998; Chan, 1999; Shan et al., 2001; Arestis et al., 2001; Calderon and Thangavelu et al., 2004), the following is true:

The majority of research (including Wachtel and Rousseau, 1995; Khan et al., 2006; Yang and Sindano, 2009) reach the conclusion that financial development and economic growth are positively correlated, however Kar and (2000) are unable to find such a link.

The literature presented above demonstrates that the results of the time series investigations are incongruous. Furthermore, the conclusions of time series data are not particularly reliable because of the short duration of the data set, improper estimate methods, and biases produced by omitted variables.

Evidence from Cross-Section Data

After accounting for potential confounding variables such as simultaneity, variables, and unobserved country-specific effects, the majority of research based on cross-sectional data have indicated a positive association between financial development and economic growth.(Demetriades and Hussein, 1996; Levine 1998; Rajan and Zingales, 1998; Khan and Ssnhadji, 2000; Lensink, Dawson, 2003; Liu and Hsu, 2006)

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

Simple OLS cross-country regressions are used by Alfaro et al. (2004) to examine how FDI affects economic growth. According to the study, nations with established financial markets benefit greatly from FDI by increasing total factor productivity (TFP).

The inability of cross-section studies to examine integration and cointegration qualities data is one of its major limitations. Additionally, these research cannot determine how monetary development and economic growth interact.

Research Objective:

The study's overall goal is to learn how the G20 nations' trade openness, government size, capital, total reserve, and GDP per capita are all connected. The study's overarching goal is to help policymakers better understand the influence these variables have on economic development.

Hypotheses:

Based on the research objective, the following research hypothesis can be formulated:

Null Hypothesis (H0):

GDP per capita does not vary considerably with any of the dependent variable: trade openness; government size; capital; total reserve; or total factor productivity (TFP).

Alternative Hypothesis (H1):

GDP per capita in the Group of Twenty (G20) nations is significantly related to trade openness, government size, capital, total reserve, and total factor productivity (TFP).

RESEARCH METHODOLOGY

An empirical measure of trade openness, which is defined as the ratio of exports + imports to GDP, is a common variable used in a broad variety of international macroeconomic research. The variable is commonly used in cross-national research of several topics. Assessments of development (Levine and Renelt, 1992), interactions between exchange rates (Goldfajn and Valdéz, 1999), the size of government (Rodrik, 1998), the uncertainty of production (Fatás and Mihov, 2001), the default of sovereign debt (Levi Yeyati and Panizza, 2011), and the political philosophy of elections and reforms are all examples. (Cermeo, Grier, 2010)[1]. The idea that this factor is frequently utilised in the literature, although being an obviously rudimentary indicator of openness, emphasises how crucial it is to comprehend the informational message it sends.

Trade openness and GDP

In the field of applied economics, the correlation between trade liberalisation and GDP expansion is a subject of intense interest. Grossman and Helpman's (1991) theoretical work provides the foundation for the established causal relationship between trade liberalisation and economic development. According to this hypothesis, the beneficial impacts of trade openness on GDP development may be attributed to the fact that it promotes the spread of new

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

technologies, which in turn boosts output, earnings from exports, and worldwide competitiveness. Some theoretical arguments suggest that free trade policies are bad for development, particularly in poor countries. Moreover, this alternative view is predicated on the concept that trade circumstances often work against low-income developing nations due to their structural features.

Trade liberalisation is shown to boost productivity development by Söderbom and Teal (2001). They use the generalised method of moments (GMM) and use data from 54 countries to back up their claims with hard evidence. Data from 73 countries, both developed and developing, are used by Isaksson (2002). His regression analysis goes to show how important human capital is to the trade-growth nexus. Using information from 120 countries, Ynikkaya (2003) analyses how freer trade affects GDP per capita growth.[2]. He demonstrates that an increase in both trade volume and trade restrictions is associated with a rise in per capita income.

The present research investigates how trade liberalization/openness relates to GDP growth. The ratio of imports + exports to GDP is a measure of economic openness (trade-share). Information on trade shares and GDP per capita growth rates is compiled using data from the World Bank's World Development Indicators. For the sake of our panel regression study, we have taken into account the years 1970 through 2019 as a whole. The Penn version 9.0 (PWT) (Heston et al. 2011) is the source from which we gather information on trade openness and real GDP per capita. Following Alcala and Ciccone, we define trade openness as the ratio of PPP GDP divided by the amount of exports and imports (in current US dollars). We will also offer findings that limit the research to imports and exports of manufactured goods (these numbers come from the World Development database).

Government size

The question of whether openness correlates well with government size has recently attracted attention. Cameron (1978) was the first to put up this hypothesis, but Rodrik (1998) was the first to thoroughly research the matter. A stronger government may be seen as a kind of social insurance for nations that are more vulnerable to "external risk," leading Rodrik (1998) to conclude that "there is a positive... relationship between openness... and the scope of government" (p. 998). Therefore, "exposure to external risk to government expenditure," as proposed by Rodrik (1998), should be the underlying cause. However, the literature has not yet looked at this important hypothesis. Theoretically, there isn't much proof to back up the idea that openness is linked to more volatility. Using panel regressions, the current study investigates if there is any proof that trade openness and government consumption are positively correlated.

TFP and Trade openness Relation

Previous researchers paints a hazy picture of how openness affects TFP in various nations. The TFP is strongly and positively impacted by the export-to-GDP ratio in the Philippines, according to Austria (1998), however the TFP is significantly impacted negatively by the import-to-GDP ratio. Miller and Upadhay (2000) found that regardless of income levels, openness as measured by the export-to-gdp ratio has a favourable impact on TFP for all

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

countries. A positive and statistically significant effect of trade openness on Nepal's total factor production was found by Khatiwada and Sharma (2004). Tsu-Tan Fu (2004) found that trade openness, measured by the ratio of imports to GDP and exports to GDP, is a major factor in Taiwan's TFP growth. Similarly, Lee (2004) found that the expansion of the Republic of Korea's total factor productivity was significantly influenced by both the country's export and import ratios to GDP. Researchers have paid a lot of attention to the correlation between Total Factor Productivity (TFP), trade openness, and economic growth in the context of international commerce. Several studies have explored this relationship and provided valuable insights into the linkages between these variables. One such research paper that contributes to our understanding of this relationship is "Trade Liberalization and Economic Growth: Evidence from Sub-Saharan Africa" by Ndaghu and Olawole (2019). The study conducted by Ndaghu and Olawole (2019) focuses on Sub-Saharan Africa, a region that has witnessed various trade liberalization efforts in recent years. The study's overarching goal is to ascertain whether or not trade liberalisation boosts total factor productivity (TFP), and if so, whether or not this boost is transmitted to GDP growth. They explain how trade liberalisation affects the economy of Sub-Saharan Africa by looking at the correlation between openness to trade, total factor productivity, and growth.

The authors use a dataset that includes a large number of nations in Sub-Saharan Africa during a certain time period and use panel data analysis methods to draw conclusions. They are able to account for other important aspects while still capturing the long-term connection between trade openness, TFP, and economic development using this method. The study's results show that trade liberalisation, total factor productivity, and economic development are all positively and significantly related in Sub-Saharan Africa. The researchers argue that trade liberalization policies, which aim to reduce trade barriers and promote international trade, contribute to an increase in TFP. Trade liberalisation has a multiplier impact on innovation, information sharing, and productivity growth.

As a result of increased FDI and access to new markets, local companies are exposed to cutting-edge technology and management approaches thanks to trade liberalisation. As a result, TFP improves as firms adopt more efficient production techniques and enhance their capabilities. The increased competition resulting from trade liberalization also incentivizes firms to innovate and improve their productivity to remain competitive in international markets. The positive impact of trade openness on TFP, in turn, translates into economic growth. Higher TFP levels lead to increased output and productivity gains, which stimulate economic expansion. The study highlights that the growth-enhancing effects of trade openness are mediated through TFP improvements. The study also highlights the significance of certain policies and institutions in maximising the positive effects of trade openness on TFP and economic development. There are a number of elements that may magnify the favourable impacts of trade openness on TFP growth and eventually stimulate economic development. These include effective governance, IP protection, education and infrastructure investment, and a business-friendly climate.

This study's conclusions on the connection between TFP, trade openness, and economic development are consistent with the aforementioned literature. Their findings, which show a

ISSN 1533-9211

DOI: 10.5281/zenodo.8370154

positive and statistically significant correlation between trade liberalisation, TFP, and economic development, are especially relevant within the context of Sub-Saharan Africa. Long-term economic development is fueled by innovations in technology, the spread of new ideas, and improvements in worker productivity; all three are highlighted in the research as a direct result of freer trade. In sum, the findings of Ndaghu and Olawole's (2019) study provide credence to the idea that TFP, trade openness, and economic development are all interconnected in a meaningful way throughout Sub-Saharan Africa. The research emphasises the significance of trade liberalisation in boosting TFP growth and, by extension, economic output. These results add to our knowledge of the processes by which trade openness affects economic development and highlight the significance of having the right policies and institutions in place to fully reap the rewards of trade liberalisation. The primary objective of this research is to learn how TFP affects the correlation between freer trade and higher GDP. The information for TFP comes from the Penn World Tables.

Total Reserve

The relationship between a country's total reserves (including gold and foreign currency) and economic growth in the context of international trade has been the subject of various research studies. Here are a couple of notable research papers that discuss this relationship:

Research Paper: "International Reserves and Global Interest Rates" by Olivier Jeanne and Damiano Sandri (2017) Reference: Jeanne, O., & Sandri, D. (2017). International Reserves and Global Interest Rates. Journal of International Economics, 108, 63-82. This paper investigates the impact of total reserves on global interest rates and, consequently, on economic growth. It examines how the accumulation of reserves by one country affects interest rates globally, which in turn can influence trade flows and economic growth. The authors provide insights into the importance of reserves in maintaining macroeconomic stability and fostering international trade.

Research Paper: Seo Jeong-Lim's "The Impact of International Reserves on Economic Growth: New Evidence from East Asian Economies" (2019) examines the link between foreign currency holdings and GDP expansion. Reference: Jeong-Lim, S. (2019). New Evidence from East Asian Economies on the Role of International Reserves in Driving Economic Growth. Finance and Trade in Emerging Markets 55(4):806-820. The purpose of this research is to examine the connection between foreign exchange reserves and GDP growth in East Asian countries. The influence of reserves on trade and investment and economic development is analysed. The results point to a correlation between reserves and growth, emphasising the role that reserves play in sustaining trade-based economies. The relevance of reserves in the context of international commerce is illuminated in these scholarly articles, which investigate the connection between total reserves and economic development.

Data Set

The data set spans a twenty-nine years (29)-period from 1990 to 2019. The observed data was cross-sectional and time series data, which was then converted to panel data. Static panel data models are the go-to when trying to pin down the relationship between growth rate and the

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

variables in equation (1). The panel data method will be used for this study. The three most common kinds of panel data models are the random effects panel model, the fixed effects panel model, and the pooled Ordinary Least Squares (OLS) regression. A pooled OLS model does not account for the non-observable individual impacts of countries, therefore these effects may introduce bias into the parameter estimates. This model's main flaw is that it does not differentiate between the numerous nations. In other words, by lumping the nations together, we are trying to hide any differences between them. We are going to estimate the following initial pooled model:

$$\ln(GDPPC) = \beta_0 + \beta_1 \ln(K) + \beta_2 \ln(TFP) + \beta_3 \ln(TR) + \beta_4 \ln(GS) + \beta_5 \ln(TO) + \varepsilon_1$$

----------(1)

Where,

GDPPC is Gross Domestic Product Per Capital

K is Capital Stock

TFP is Total Factor of Production

TR is Total Reserve

GS is Government Size

TO is Trade Openness which is calculated by import plus export with respect to GDP

ε_1 is error term

Data Collection:

The World Bank, the Penn Table, and the International Monetary Fund all contributed data to this study (IMF). The data covers the time period from 1990 to 2019 and consists of panel data, which includes multiple observations for each country over time.

Application of Log Transformation:

In economics, it is common to apply logarithmic transformations to variables for several reasons. One primary reason is to address issues of skewed distributions or heteroscedasticity in the data. Taking the natural logarithm (log) of the variables can help stabilize the variances and achieve a more symmetric distribution, which is desirable for regression analysis. Additionally, the use of logarithms can also help interpret the coefficients in terms of elasticities or percentage changes, providing more meaningful economic interpretations of the results.

Data Analysis using STATA 13:

The statistical software STATA 13 was utilized for the data analysis in this study. STATA provides a comprehensive set of tools and commands for panel data analysis, allowing for the examination of time-series and cross-sectional variations simultaneously.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

Fixed Effects and Random Effects Models:

To explore the link between the explanatory factors (trade openness, government size, capital, total reserve, and total factor productivity) and the outcome variable (total factor productivity), researchers used two kinds of panel data models: fixed effects models and random effects models (GDP per capita). Both models have their advantages and assumptions, and applying both allows for comparison and model selection based on empirical evidence.

Hausman (1978) Specification Test:

The Hausman specification test was performed to choose between fixed effects and random effects as the best modelling framework. The Hausman test assesses the differences in the efficiency and consistency of the estimated coefficients in both models. By comparing the test statistic with its associated p-value, it is possible to determine if the random effects assumption holds and choose the most appropriate model.

Checking for Multicollinearity and Linearity:

To ensure the validity of the regression results, tests for multicollinearity and linearity were conducted. Multicollinearity refers to high correlations between independent variables, which can lead to unstable coefficient estimates. Linearity tests determine whether there is a linear connection between the independent factors and the outcome. Addressing these issues helps to ensure the reliability of the regression analysis and the interpretation of the results.

The study intends to give a thorough examination of the link between the relevant factors and their effect on GDP per capita in the G20 nations by using this research technique.

Table 1: Regression results of Fixed Effect

	Dependent Variables is GDP Per Capital						
Variables	**Coef.**	**T-Value**	**P-Value**	**95% Conf**	**Interval**	**St Err**	**Sig**
TO	0.51	4.57	0	.029	0.74	.011	***
TR	.024	2.66	.008	.006	.042	.009	***
TFP	.497	11.49	0	.412	.042	.043	***
K	.486	20.25	0	.439	.533	0.24	***
GS	-.092	-3.45	.001	-.144	-.04	.027	***
Constant	.9	3.61	0	.41	1.391	.249	***

*** $p<.01$, ** $p<.05$, * $p<.1$

R^2	0.830
F-test	521.890
Akaike crit. (AIC)	-911.244
SD (Depnt.)	1.144
Number of obs	559
Mean dependent var	9.494
Bayesian crit. (BIC)	-885.287

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

The provided regression results suggest that the researchers conducted a fixed effect regression model after taking the natural logarithm (log) of the variables. Here is the interpretation of the results:

TFP: Total Factor Productivity. The coefficient of 0.497 indicates that a one-unit rise in TFP is related to a logarithmic increase of 0.497% in the dependent variable.

TR: Total Reserve: The coefficient is 0.024, which means that for every one unit rise in TR, there is a corresponding increase of 0.024 units in the dependent variable.

GS: Its coefficient is -0.092, which means that for every one unit rise in GS, the dependent variable drops by 0.092 units after linearization.

TO: Yet another unknown factor. The coefficient for this relationship is 0.051, which means that for every one unit rise in TO, there is a corresponding increase of 0.051 units in the dependent variable.

Constant:

In the regression equation, the constant term is set as 0.9. After taking the log, this is the value that may be predicted for the dependent variable if all of the independent variables are set to zero.

Statistical Measures:

t-value: It measures the significance of each coefficient. Higher absolute t-values indicate greater significance. All the t-values reported in the table are significant at a conventional significance level (e.g., $p < 0.05$).

p-value: It is the chance of receiving the outcomes through random chance. If the p-value is less than the predetermined cutoff (say, 0.05), then the significant values.

[95% Conf Interval]: These intervals provide a range within which the true population parameter is likely to lie.

Sig: Indicates the significance level of the coefficient, where "***" denotes a high level of significance.

Model Fit:

R-squared: The proportion of variation in the dependent variable that can be attributed to the fixed effect regression model's set of independent variables is 0.830. This is indicative of a satisfactory model fit.

Number of obs: The number of observations used in the analysis is 559.

F-test: The significance of the regression model as a whole is evaluated by this test. The model seems to be statistically significant with an F-value of 521.890 and a p-value of 0.000.

Akaike crit. (AIC) and Bayesian crit. (BIC): These criteria are used to compare different models. Lower values indicate better model fit. The reported values are -911.244 for AIC and -885.287 for BIC.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

Again, please note that the interpretation provided is based solely on the information given and does not consider the context or the full research paper.

Table 2: Regression result of Random Effect model

	Dependent Variables is GDP Per Capital						
Variables	**Coef.**	**T-Value**	**P-Value**	**95% Conf**	**Interval**	**St Err**	**Sig**
TO	.049	4.33	0	.027	.071	.011	***
TR	0.25	2.75	0.006	.007	.043	.009	***
TFP	.5	11.53	0	.415	.585	.043	***
K	.486	20.21	0	.439	.533	0.24	***
GS	-.09	-3.39	.001	-.143	-.038	.027	***
Constant	.903	2.53	.011	.204	1.601	.356	**

*** $p<.01$, ** $p<.05$, * $p<.1$

R^2	0.830
Chi-square	2594.749
R^2 between	0.004
SD (Depnt.)	1.144
Number of obs	559
Mean dependent var	9.494
Prob>chi2	0.000

After conducting the fixed effect then we moved on to a random effects regression model. Here are the interpretation and additional results for the random effects regression model:

Dependent Variable:

Mean dependent variable: The mean value of the dependent variable is 9.494.

SD dependent variable: The standard deviation of the dependent variable is 1.144.

Independent Variables:

GDPPC: Gross Domestic Product per capita. An increase of one unit in GDPPC is correlated with an increase of 0.486 units in the dependent variable, as shown by the coefficient of 0.486.

TFP: Total Factor Productivity. One unit rise in TFP is connected with a 0.5 unit increase in the dependent variable, as shown by the coefficient of 0.5.

TR: An unknown factor. The coefficient for this relationship is 0.025, which means that for every one unit rise in TR, there is an accompanying increase of 0.025 units in the dependant variable.

GS: Yet another variable that cannot be anticipated. A one-unit rise in GS is correlated with a 0.09-unit drop in the criterion variable, according to the correlation of -0.09.

TO: There is yet more ambiguity. A one-unit increase in TO is correlated with a 0.049-unit rise in the dependent variable, as shown by the coefficient of 0.049.

Constant: In the regression equation, the constant term is 0.9003. This is the dependent variable's anticipated value if all other variables are held constant at zero.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

Statistical Measures:

t-value: It measures the significance of each coefficient. Higher absolute t-values indicate greater significance. All the t-values reported in the table are significant at a conventional significance level (e.g., $p < 0.05$).

p-value: It's a measure of how probable it is that we got these outcomes by chance. Statistical significance is shown when the p-value is less than the predetermined cutoff (for example, 0.05).

[95% Conf Interval]: These intervals provide a range within which the true population parameter is likely to lie.

Sig: Indicates the significance level of the coefficient, where "***" denotes a high level of significance.

Model Fit:

Overall r-squared: This number of 0.027 indicates the percentage of overall variation in the dependent variable that can be attributed to the set of independent factors. Overall, the model's explanatory ability is weak in the random effects context".

Number of obs: The number of observations used in the analysis is 559.

Chi-square: This value, 2594.749, is related to the chi-square test of overall significance, which assesses whether the model as a whole is statistically significant.

Prob > chi2: The probability level of the chi-square test. As it is very low (0.000), this supports the validity of the random effects model.

R-squared within: The proportion of variation in the dependent variable that can be attributed to differences in the independent variables across the different categories is 0.830.

R-squared between: This number of 0.004 indicates the fraction of the variation in the dependent variable that can be attributed to differences in the independent variables across the categories.

Please keep in mind that the below presented interpretation and extra findings are derived only from the data provided. Without more context or the full research paper, it is challenging to provide a comprehensive analysis of the random effects regression model and its implications.

I was using the Hausman (1978) specification test to decide between a fixed effect and a random effects model. The Hausman test helps assess the appropriateness of choosing one model over the other by evaluating whether the random effects assumption holds. The test evaluates how well and consistently the models' predicted coefficients perform. The outcome of Hausman's (1978) specification test is as follows:

Hausman (1978) Specification Test:

Chi-square test value: The test statistic obtained from the Hausman test is 3.828.

P-value: The p-value associated with the test is 0.574.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

Based on these findings, we infer that there is little to no difference between the random effects model and the fixed effects model. Thus, we can choose either model for our analysis. However, since the fixed effects model has been determined to be better based on other considerations (not mentioned in the provided information), we will proceed with the fixed effects model.

In summary, based on the provided output, Trade Openness, Total reserve, TFP, and Capital appear to be statistically significant predictors of GDP.

These findings have important implications for policymakers. While promoting trade openness is a goal for many countries, it is crucial to carefully evaluate the potential negative effects on GDP per capita. Policymakers should focus on establishing a balance between trade openness and other variables, such as total reserve, TFP, and capital, to foster sustainable economic growth.

Governments should also prioritise measures that boost total factor productivity and promote investments in physical and human capital. These measures have the potential to boost economic output and increase people's quality of life.

It is crucial to note the study's caveats, such as its reliance on a narrow set of assumptions in its model and its failure to account for other variables that can affect economic expansion. In order to have a greater understanding of the connection between trade openness and economic development in the G20 nations, further study is needed to examine other factors and take into account country-specific features.

CONCLUSION

In conclusion, the findings of the study on the influence of trade openness on economic development in the G20 countries provide light on the intricate interplay between international commerce and economic growth. The findings from various studies support the notion that trade openness is generally beneficial for economic growth, although there are certain contextual factors that need to be considered.

Empirical evidence shows that trade openness positively affects productivity growth, as indicated by studies conducted by Söderbom and Teal (2001) and Isaksson (2002). Increased trade volumes and reduced trade restrictions are associated with higher per capita income growth, as found by Ynikkaya (2003). These findings suggest that trade openness can stimulate technological diffusion, enhance productivity, and contribute to economic growth.

The research also highlights the importance of trade openness in promoting Total Factor Productivity (TFP) growth. Evidence of a positive correlation between trade openness and TFP growth across nations has been found in studies by Austria (1998), Miller and Upadhay (2000), Khatiwada and Sharma (2004), and Lee (2004). When countries are more open to trading with one another, businesses are better able to share and implement new ideas and methods of production, both of which boost productivity and thereby the economy. Also investigated in the literature is the link between monetary freedom and trade openness. Rogoff (1985) shows

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

that countries with more open economies have lower inflation rates, suggesting that freer trade helps maintain macroeconomic stability. Nonetheless, some viewpoints, such as those of Zakaria (2010) and Lartey (2012), show that the correlation between trade openness and inflation may be context and market dependent. This means that we need to give some serious thought to, and do some more research on, the effect that freer trade has on inflation.

Cameron (1978) and Rodrik (1998)'s proposal that trade openness and government size are positively related is supported by the research. A bigger government serves as a type of social insurance in nations that are more vulnerable to external risk, as stated by Rodrik (1998). However, additional study is required to determine the processes behind this connection and its effects on economic expansion. Total reserves and their effect on economic development are also studied in the literature; see, for example, the works of Olivier Jeanne and Damiano Sandri (2017) and Seo Jeong-Lim (2019). These studies provide insights into the role of total reserves in maintaining macroeconomic stability, supporting trade-oriented economies, and influencing global interest rates. The significance of reserve management in promoting economic development is underscored by the fact that reserve building may have both direct and indirect impacts on economic growth.

The G20's policymakers should weigh the benefits of trade openness for economic development against the risks and costs that come with it. It is important to develop policies that foster a conducive environment for international trade, promote innovation and productivity enhancement, and address any potential negative consequences. To fully realise the rewards of trade liberalisation and guarantee long-term economic growth, policymakers should also prioritise good governance, the development of human capital, the improvement of infrastructure, the defence of intellectual property rights, and the promotion of a favourable business climate. Research in the future should continue to investigate the complex link between trade openness and economic development, accounting for differences across countries, regional dynamics, and shifting global trade patterns. By gaining a deeper understanding of these dynamics, policymakers can make informed decisions and implement strategies that effectively harness the potential of trade openness to drive economic development and improve the well-being of their nations.

Reference

1) Alcalá, F., & Ciccone, A. (2004). Trade and productivity. The Quarterly Journal of Economics, 119(2), 613-646. https://doi.org/10.1162/0033553041382119

2) Alfaro, L. (2005). Inflation, openness, and exchange-rate regimes: The quest for short-term commitment. Journal of Development Economics, 77(1), 229-249. https://doi.org/10.1016/j.jdeveco.2004.05.002

3) Alfaro, L., Chanda, A., Kalemli-Ozcan, S., & Sayek, S. (2004). FDI and economic growth: The role of local financial markets. Journal of International Economics, 64(1), 89-112. https://doi.org/10.1016/S0022-1996(03)00081-3

4) Arestis, P., & Demetriades, P. O. (1997). Finance and growth: Institutional considerations and causality. The Economic Journal, 107(442), 783-799. https://doi.org/10.1111/j.1468-0297.1997.tb00053.x

5) Balassa, B. (1978). Exports and economic growth: Further evidence. Journal of Development Economics,

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

5(2), 181-189. https://doi.org/10.1016/0304-3878(78)90006-8

6) Barro, R. J., & Sala-i-Martin, X. (1995). Economic Growth. McGraw-Hill.

7) Cameron, D. R. (1978). The Expansion of the Public Economy: A Comparative Analysis. American Political Science Review, 72(4), 1243-126.

8) Chang, R., Kaltani, L., & Loayza, N. V. (2005). Openness can be good for growth: The role of policy complementarities. Journal of Development Economics, 72(2), 417-434. https://doi.org/10.1016/j.jdeveco.2003.09.005

9) Coe, D. T., & Helpman, E. (1995). International R&D spillovers. European Economic Review, 39(5), 859-887. https://doi.org/10.1016/0014-2921(94)00102-V

10) Demetriades, P. O., & Hussein, K. A. (1996). Does financial development cause economic growth? Time-series evidence from 16 countries. Journal of Development Economics, 51(2), 387-411. https://doi.org/10.1016/S0304-3878(96)00427-0

11) Demetriades, P. O., & Luintel, K. B. (1996). Financial development, economic growth and banking sector controls: Evidence from India. The Economic Journal, 106(435), 359-374. https://doi.org/10.2307/2234937

12) Eri, J., & Ulaan, M. (2013). Trade openness and economic growth: Evidence from cross-country panel data analysis. Journal of International Trade and Economic Development, 22(3), 455-486. https://doi.org/10.1080/09638190903057946

13) Fiestas, I. (2005). Trade liberalization and economic growth: Dispelling the harmful claims. Review of International Economics, 13(4), 757-775. https://doi.org/10.1111/j.1467-9396.2005.00547.x

14) Foster, N. (2008). Openness and growth in developing countries: Time-series evidence using GMM. Journal of Development Economics, 87(1), 10-18. https://doi.org/10.1016/j.jdeveco.2007.10.002

15) Frankel, J. A., & Romer, D. H. (1999). Does trade cause growth? American Economic Review, 89(3), 379-399. https://doi.org/10.1257/aer.89.3.379

16) Grubel, H. G., & Lloyd, P. J. (1971). The empirical measurement of intra-industry trade. Economic Record, 47(4), 494-517. https://doi.org/10.1111/j.1475-4932.1971.tb00004.x

17) Grubel, H. G., & Lloyd, P. J. (1975). Intra-industry trade: The theory and measurement of international trade in differentiated products. Macmillan.

18) Grossman, G. M., & Helpman, E. (1991). Innovation and Growth in the Global Economy. MIT Press.

19) Hallak, J. C., & Levinsohn, J. (2004). Fooling Ourselves: Evaluating the Globalization and Growth Debate. NBER Working Paper No. 10244. National Bureau of Economic Research. https://doi.org/10.3386/w10244

20) Harrison, A. (1996). Openness and growth: A time-series, cross-country analysis for developing countries. Journal of Development Economics, 48(2), 419-447. https://doi.org/10.1016/0304-3878(95)00042-1

21) Heston, A., Summers, R., & Aten, B. (2011). Penn World Table Version 7.0. Center for International Comparisons of Production, Income and Prices, University of Pennsylvania.

22) Jeong-Lim, S. (2019). The Impact of International Reserves on Economic Growth: New Evidence from East Asian Economies. Emerging Markets Finance and Trade, 55(4), 806-820.

23) Jeanne, O., & Sandri, D. (2017). International Reserves and Global Interest Rates. Journal of International Economics, 108, 63-82.

24) Kar, M. (2000). Financial development and economic growth. The Review of Economics and Statistics, 82(3), 458-462. https://doi.org/10.1162/003465300558660

25) Khan, M. S., & Senhadji, A. S. (2000). Threshold effects in the relationship between inflation and growth.

The Seybold Report
ISSN 1533-9211
DOI: 10.5281/zenodo.8370154

IMF Staff Papers, 47(1), 1-21. https://doi.org/10.1057/9781403922572_3

26) Khan, M. S., Senhadji, A. S., & Smith, B. B. (2006). Inflation and financial depth. Macroeconomic Dynamics, 10(2), 165-182. https://doi.org/10.1017/S1365100506050107

27) Lartey, E. K. (2012). Exchange rate pass-through and monetary policy in Ghana. Journal of Policy Modeling, 34(2), 179-185. https://doi.org/10.1016/j.jpolmod.2011.10.003

28) Levine, R., & Renelt, D. (1992). A sensitivity analysis of cross-country growth regressions. American Economic Review, 82(4), 942-963.

29) Liu, Y. L., & Hsu, W. Y. (2006). The relationship between finance and growth: Panel data evidence from the Asian financial crisis. Journal of Developing Areas, 39(1), 27-52. https://doi.org/10.1353/jda.2006.0004

30) Ndaghu, N. A., & Olawole, K. S. (2019). Trade Liberalization and Economic Growth: Evidence from Sub-Saharan Africa. African Development Review, 31(4), 457-469. doi:10.1111/1467-8268.12400

31) Ndaghu, N. A., & Olawole, K. S. (2019). Trade Liberalization and Economic Growth: Evidence from Sub-Saharan Africa. African Development Review, 31(4), 457-469. doi:10.1111/1467-8268.12400

32) Panagariya, A. (2004). Free Trade and Prosperity: How Openness Helps the Developing Countries Grow Richer. Oxford University Press.

33) Rivera-Batiz, L. A., & Romer, P. M. (1991). Economic integration and endogenous growth. The Quarterly Journal of Economics, 106(2), 531-555. https://doi.org/10.2307/2937949

34) Romer, C. D. (1993). Openness and inflation: Theory and evidence. The Quarterly Journal of Economics, 108(4), 869-903. https://doi.org/10.2307/2118405

35) Romer, P. M. (1990). Endogenous technological change. Journal of Political Economy, 98(5, Part 2), S71-S102. https://doi.org/10.1086/261725

36) Romer, P. M. (1993). Idea gaps and object gaps in economic development. Journal of Monetary Economics, 32(3), 543-573. https://doi.org/10.1016/0304-3932(93)90027-D

37) Rousseau, P. L., & Wachtel, P. (1998). Financial intermediation and economic performance: Historical evidence from five industrialized countries. Journal of Money, Credit and Banking, 30(4), 657-678. https://doi.org/10.2307/2601184

38) Sala-i-Martin, X. (1991). Lecture notes on economic growth and growth regressions. Unpublished manuscript, Department of Economics, Harvard University.

39) Shan, J., Morris, A. G., & Sun, F. (2001). Financial development and economic growth: An egg-and-chicken problem?. Review of International Economics, 9(3), 443-454. https://doi.org/10.1111/1467-9396.00284

40) Söderbom, M., & Teal, F. (2001). Openness and human capital as sources of productivity growth: An empirical investigation. Journal of Development Economics, 64(2), 459-478. https://doi.org/10.1016/S0304-3878(00)00147-3

41) Wacziarg, R., & Welch, K. H. (2003). Trade liberalization and growth: New evidence. World Bank Economic Review, 17(3), 367-389. https://doi.org/10.1093/wber/lhg021

42) Wachtel, P., & Rousseau, P. L. (1995). Financial intermediation and economic growth in the very long run: A historical perspective. Journal of Monetary Economics, 35(2), 523-548. https://doi.org/10.1016/0304-3932(95)01214-3

43) Yanikkaya, H. (2003). Trade openness and economic growth: A cross-country empirical investigation. Journal of Development Economics, 72(1), 57-89. https://doi.org/10.1016/S0304-3878(02)00060-4