Macroeconomic policy, spillover effects and economic development in the G20

Opeyemi Aromolaran
Department of Economics, University of South Africa, Pretoria, South Africa

Received 13 January 2026
Revised 24 May 2026
22 June 2026
Accepted 22 June 2026

Abstract

Purpose – This study aims to examine the performance of living standards in the G20 using the gross domestic product (GDP) per capita metric, analysing several macroeconomic variables that are crucial to driving economic development.

Design/methodology/approach – The spatial regression techniques were used for the empirical analysis on panel data over the period 2002–2024, while gravity bilateral average trade flow data were derived for the construction of the spatial weight matrix over the period 2002–2021. However, for the unbalanced panel and using the same weight matrix, the Stata command produces the same estimates for periods terminating in 2020, 2021, 2022, 2023 and 2024.

Findings – The empirical findings from the spatial Durbin model show that labour force and gross capital formation directly influence domestic GDP per capita and exhibit positive spillovers to neighbours and the entire G20. However, the labour force does not have a significant main effect. Moreover, gross national expenditure shows only significant positive spillovers to neighbouring countries and the entire G20. The negative significance of manufacturing value added without trade persists with spatial interaction showing a significant negative impact on domestic GDP per capita. With and without interaction, government effectiveness positively influences GDP per capita but negatively spills over to the combined GDP per capita of the neighbours. Also, the effect of nominal effective exchange rates on domestic GDP per capita is positive in both the non-trade and average bilateral trade cases. Government final consumption expenditure positively affects GDP per capita without interaction, while it positively affects domestic GDP per capita and the entire G20 through spatial interaction. Inflation rates positively influence GDP per capita but do not show spillover effects. Without interaction, current health expenditure has a significant negative effect on GDP per capita. The negative effect of health expenditure persists through spatial interaction on both domestic and regional GDP per capita.

Research limitations/implications – One limitation of the study is that it uses an unbalanced panel for the empirical investigation. Moreover, bilateral trade flow data contain missing entries. However, during the construction of the spatial weight matrix, the use of collapsed average flows ensures that every pair of countries has an average trade flow.

Practical implications – The study recommends that the governments of the respective G20 countries provide an enabling macroeconomic environment characterised by effective institutions that improve manufacturing value added, drive gross capital formation and stabilise nominal effective exchange rates.

Originality/value – This study contributes to the discussion of economic growth by considering 19 countries in the G20, based on spatial interaction anchored in a weight matrix of bilateral trade flows.

Keywords Monetary policy, Fiscal policy, Spatial Durbin model, Spatial interaction, World Governance Indicators, G20

Paper type Research article

Introduction

The goal of the G20's macroeconomic stimulus from 2008 to 2010 was more fiscal in nature than monetary policy (Triggs, 2018). From Triggs (2018), the fiscal objective was a "concerted fiscal expansion [. . .] that will, by the end of [2010], amount to US$5 trillion and raise output

JEL Classification — C10, D63, E00, E10, E20, E31, E62, F00, F1, F41, F42, H50

Conflict of interest: This is to declare no conflict of interest.

Journal of Economic Studies
Vol. 53 No. 9, 2026
pp. 258-269
Emerald Publishing Limited
e-ISSN: 1758-7387
p-ISSN: 0144-3585
DOI 10.1108/JES-01-2026-0041

by 4%" (G20, 2009). Regarding monetary policy, the G20 claimed that "interest rates have been cut aggressively, and our central banks have pledged to maintain expansionary policies for as long as needed and to use the full range of monetary policy instruments, including unconventional instruments" (G20, 2009).

A high level of economic development would remain unattainable without a concerted effort of the governments regarding the use of appropriate fiscal instruments. Fiscal instruments inadvertently play critical roles in countries that have achieved a high level of living standards, due to the prevailing level of development, which includes substantial infrastructural facilities, sound medical schemes, human capital development and employment prospects. Moreover, the style of policy measures by monetary authorities has far-reaching implication on investment decisions. The two approaches of fiscal and monetary stances constitute macroeconomic policy. Cui *et al.* (2019) emphasise that in a global economy characterised by interconnectivity, monetary and fiscal policies implemented in an economy can generate far-reaching consequences for other countries. One of the striking voices of fiscal policy is Keynes. John Maynard Keynes is regarded as one of the most significant contributors to early macroeconomic policy thinking, with a fundamental focus on fiscal policy (Keynes, 2009). While Keynesians emphasise the need for the intervention of government, as well as the relevance of fiscal policy in increasing demand in times of economic downturns (Tcherneva, 2011), Laidler (1990) argues that, despite its impact on monetary policy, there is a failure of the monetarist debate regarding the establishment of a long-term theoretical foundation for monetary economics. It is of great practical and theoretical importance to study the impact of coordinating fiscal policy and monetary policy on macroeconomic stability (Chua and Tsiaplias, 2024). Effective policies have the potential to promote a conducive environment for investment and a stable price level, while also accelerating diversification and improving productivity, which underpin an improved standard of living (Akalpler and Duhok, 2018; Heyzer and Mochida, 2009).

The G20 was formulated in 2008, comprising global leaders from economically significant countries in response to the 2008 global financial crisis, following the G8 (Slaughter, 2019). The primary objective of the G20 is to foster international and intergovernmental cooperation, as well as the coordination of policies among economically significant states, in response to economic crises and the stabilisation of the global economy (Slaughter, 2019). The projection in global growth declines from 3.3% in 2024 to 3.2% in 2025 and to 3.1% in 2026. The growth projection for advanced economies is 1.6% in 2025 and 2026, which is 0.2 percentage point lower in both years than in 2024, and projected in the October 2024 World Economic Outlook (WEO). There is a moderate growth projection for emerging market and developing countries, from 4.3% in 2024 to 4.2% in 2025 and 4.0% in 2026. Virtually, there is no change from the WEO update in July, which represents an accumulative upward revision of 0.6 percentage point from the April 2025 WEO (Shape, 2025).

The foregoing statistics indicate that countries in both developing and advanced economies must contend with economic instability, as reflected in their growth projections. While this is the case, what role does spatial interaction among countries contribute to their economic performance? This study focuses on the G20, which comprises a mix of developing and advanced economies, by examining the potency of macroeconomic policy and the potential spillover effects of macroeconomic policy in the neighbourhoods, thereby contributing to the literature. The justification for this study covers the unequal levels of development between the global south and the global north in the G20 economies, and one of the benefits is providing a spatially integrated model for the region. Moreover, the wide range of macroeconomic variables used in the study opens new dimensions for analysing macroeconomic spillovers, especially within the G20. The critical question is as follows: How does a policy stance of any G20 member influence the macroeconomic performance of other member countries? The study, therefore, analyses the impact of macroeconomic policy on G20 gross domestic product (GDP) per capita, accounting for spillover effects.

The study is categorised into five sections, comprising the introduction and literature reviews in sections one and two. In contrast, sections three and four present the methodology and empirical analysis, as well as the discussion of results, while section five covers the conclusion and policy recommendations.

A brief empirical review

This section provides an inventory of previous research comparably relevant to this study, starting with Sarangi *et al.* (2022), which investigated the G20 countries. The authors observed that both informal and formal institutions directly affect economic growth; moreover, they found that the effect of innovation varies with the quality of institutions.

Azis *et al.* (2026) analysed the spatial dynamics and regional spillover impacts of manufacturing GDP growth across provinces in Indonesia, covering 2019 to 2023. The authors used exploratory spatial data analysis, including Global Moran's I, spatial visualisation and the Lisa Cluster Map, thereby identifying patterns of spatial dependence and regional clustering. They found consistent direct spatial autocorrelation, signalling that manufacturing growth is spatially interdependent rather than randomly distributed. The investigation observed three phases of spatial dynamics: spatial decoupling during economic shocks, pre-disruption integration and post-pandemic re-convergence. Specifically, consistent low-low clusters in Papua indicate the presence of spatial low-growth traps. In contrast, a high-high cluster in Sulawesi suggests the emergence of a new growth pole driven by agglomeration forces and spatial spillovers.

Marca *et al.* (2026) examined the role of spatial spillover effects in regional development (GDP per capita) across 5,531 Brazilian municipalities from 2010 to 2021. They integrate sectoral composition, climate shocks, economic complexity and public policies into a spatial econometric framework Generalized Method of Moments - Spatial Durbin Model, (GMM-SDM). The authors found that industrialisation not only propels domestic growth (+1.5%) but also causes negative spillovers (−1.04%), indicating a backwash effect arising from resource concentration. Similar patterns were observed in employment and export complexity, intensifying regional asymmetries by drawing talent away from peripheral areas. The services sector results in negative local effects (−1.7%) but positive spillovers (+1.8%), and agriculture generates modest local gains (+0.38%) and spillovers (+0.15%), especially in modernised regions. Local GDP declines due to hydrological disasters but causes compensatory spillovers, likely through economic relocation. Mixed findings characterise public policies such that there is a local underperformance of vocational training, while housing programs cause positive spillovers via asymmetric absorption capacity.

N.B.: Online appendix empirical reviews continuation.

The current study investigates spillovers of some macroeconomic variables and thereby provides policy measures for economic development. Economic growth is a crucial consideration for economies and will continue to be investigated, given the structural changes that economies undergo over time. However, this study delves into the discussion by considering a panel study of 19 countries in the G20, excluding the European Union, and specifically examining the spatial interaction anchored on a weight matrix of bilateral average trade flows.

Methodology

Theoretical framework and model specification

Long-term economic projections are mostly based on the approach of neoclassical growth models, such as the Solow–Swan model (Solow, 1956; Swan, 1956) and the Ramsey–Cass–Koopmans model (Ramsey, 1928; Cass, 1965; Koopmans, 1965). The theoretical foundation of this study is based on the neoclassical model, as outlined in the study by Liu and McKibbin (2025). A standard production function characterised by constant returns to scale is expressed as follows:

$$Y_t = A_t K_t^{\beta} L_t^{1-\beta} \tag{1}$$

The components in equation one include K, the physical capital; L, the labour and the output is represented by Y, and the output elasticity of capital is β, while t is the time subscript. The efficiency parameter is A. To keep the model simple, the country subscript is omitted. Incorporating human capital (H) to augment the production function, the model is re-specified by Liu and McKibbin (2025) as given in Equation 2.

$$Y_t = A_t K_t^{\beta} (H_t L_t)^{1-\beta} \tag{2}$$

Therefore, the GDP per capita becomes

$$y_t = \frac{Y_t}{P_t} = A_t (k_t)^{\beta} H_t^{1-\beta} \frac{L_t}{P_t} \tag{3}$$

According to the model, $k_t = \frac{K_t}{L_t}$ indicates capital intensity. On the contrary, for the G20, gross capital formation (% of GDP) is used for the empirical investigation.

Situating this study within the context of the neoclassical framework, therefore, y_t is lgdpc, which is the log of GDP per capita, and K constitutes the gross capital formation (gcf). At the same time, the labour force, llbf, represents labour. The human capital (H) proxy used in this study is current health expenditure (hcg). Therefore, the functional relationship becomes:

$$\text{lgdpc} f(gcfllbfhcg) \tag{4}$$

Subsequently, macroeconomic policy measures are introduced, which constitute the policy levers for economic management, as well as World Governance Indicators (WGI) comprising government effectiveness (GE) and regulatory quality. Additionally, the study includes a variable for armed forces personnel. The inclusion of armed forces personnel becomes necessary to minimise insecurity, drive development and stimulate the territorial safety and welfare of the citizens. Other variables include gross national expenditure, manufacturing value added and nominal effective exchange rates. The general functional relationship thus becomes:

$$lgdpc = f(llbfinfgnemvagesgcfrqsafpneergfcehcg) \tag{5}$$

Furthermore, the linear equation is:

$$lgdpc = \alpha_0 + llbf + inf + gne + mva + ges + gcf + rqs + afp + neer + gfce + hcg + \varepsilon \tag{6}$$

Capturing the possible spillovers across the G20 countries, Equation 6 is re-specified in a spatial analysis. Using spatial models for this study is appropriate in order to model interaction among a group of countries, as well as internalising cross-sectional dependence.

According to Belotti *et al.* (2017), Spatial Autoregressive Model (SAR) and Spatial Durbin Model (SDM) can be represented by the following equations. Firstly, the SAR model is specified as contained in Equation 7.

$$y_t = \rho W y_t + X_t \alpha + \gamma + \epsilon_t \quad \text{t} = 1 \ \ldots, T \tag{7}$$

Such that N) provided it is a random effect(RE), but it becomes a vector of parameters in the context of fixed effect (FE). The basic assumptions require the following:

$\epsilon \ N$) and $E(\epsilon \ \epsilon_{js} = 0$, based on $i \neq j$ or $t \neq s$.

In comparable terms, and considering the panel of G20 in this study, Equation 7 is specified as:

$$lgdpc = \rho Wlgdpc + X\alpha + \gamma + \epsilon \tag{8}$$

Where W is a weight matrix of bilateral trade flow, which was row standardised, X constitutes a vector of explanatory variables and γ is the country-specific FE or heterogeneity. At the same time, ϵ is the spatial error term. The statistical significance of the rho coefficient determines if the evidence of spatial interaction exists among the 19 countries of the G20, while α is the coefficient of the explanatory variables.

The SDM model, which generalises the SAR model by including spatially weighted explanatory variables, is expressed as:

$$y = \rho Wy + WX\alpha + \gamma + \epsilon \tag{9}$$

Following the identification of the models above, the specific effects in the SAR and SDM models (static) according to Elhorst (2014), as documented in Belotti *et al.* (2017), can be determined through the following;

The long-term direct and indirect effects based on Equation 8 are $\{(I-\rho W)^{-1}\times(\alpha_k I + \varnothing_k W)\}^{\overline{d}}$ and $\{(I-\rho W)^{-1}\times(\alpha_k I + \varnothing_k W)\}^{\overline{rsum}}$, respectively.

While the long-term direct and indirect effects of the SAR are $\{(I-\rho W)^{-1}\times(\alpha_k I)\}^{\overline{d}}$ and $\{(I-\rho W)^{-1}\times(\alpha_k I)\}^{\overline{rsum}}$.

This study analyses GDP per capita by considering macroeconomic policy levers as well as indicators that promote economic development, such as the WGI, which include GE and regulatory quality. Moreover, living standard is measured by GDP per capita. In contrast, macroeconomic policy levers are measured by Inflation, GDP deflator: linked series (annual %) – inf, and general government final consumption expenditure (% of GDP) – gfce. Other variables include the log of labour force, total (llbf), manufacturing, value added (% of GDP) – mva, armed forces personnel (% of total labour force) and nominal effective exchange rates – neer. While nominal effective exchange rates were obtained from Bruegel data, all other variables were obtained from the World Development Indicators. Moreover, gravity data on trade flow were obtained from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) -Research and Expertise on the world Economy (see Conte *et al.*, 2022). The database was observed to run from 1948 to 2021. However, for this study, bilateral average trade flows were used over the period 2002–2021. The use of the weight of 2002–2021 for a panel study of data span, 2002 to 2024, is based on the assumption that similar trade relationships exist in the G20 over the panel length of macroeconomic variables.

However, the CEPII trade flows data have some missing bilateral trade flows for the set of 19 G20 countries. This problem is solved by using the collapse mean command on bilateral trade flow data in Stata, which yields average bilateral trade flows for every pair of countries.

An unbalanced panel was used for the empirical analysis. The Ditzen *et al.* (2022) spatial command is useful for estimating spatial or network models with unbalanced datasets and for allowing time-varying weights. The command is also appropriate for estimating SDM and SAR models with a mix of Markov Chain Monte Carlo (MCMC) and maximum likelihood estimation (MLE) sampling (LeSage and Pace, 2009). In this study, a time constant weight matrix derived from average bilateral trade flows is used.

Empirical analysis and discussion of results

Online Appendix Table 1 presents the CD-test results for each variable. The outcomes show that nine out of the twelve variables have statistically significant *p*-values, indicating that the null hypothesis of cross-sectional independence is rejected. Such a high degree of cross-sectional dependence among the respective variables indicates that policy impulses in a particular country filter into neighbouring countries in the region, which could be facilitated by

the nature of economic interaction that characterises the area, hence the appropriateness of using a spatial analysis. For instance, according to Afonso and Coelho (2025), cross-section dependence can arise due to factors such as spatial spillover effects, observed common factors, general residual interdependence or unobserved common factors.

The online appendix panel unit root tests provide information on the stationarity of the variables based on the Maddala and Wu (1999) panel unit root test (MW) and the Pesaran (2007) panel unit root test - cross-sectionally augmented IPS (CIPS), while the orders of integration are in the online Appendix Table 2. The online appendix summary statistics describe the major variables, while online Appendix Table 3 presents the summary statistics, with an overall minimum of −16.559 (inf) and an overall maximum of 207.605. Moreover, explanations of the rate of change of living standards and the macroeconomic policy variables are in the online appendix macroeconomic trends, while online Appendix Figure 1 presents the graphs.

Spatial analysis

Among others, the explained variable is GDP per capita, serving as a proxy for living standards. At the same time, macroeconomic policy is measured by monetary policy (Inflation rates) and fiscal policy (government consumption expenditure). The GDP deflator linked series is used as a proxy for inflation rates, as the consumer price index from the World Development Indicators for Argentina is largely unavailable.

Table 1 shows that, in the absence of spatial interaction, the labour force is not significant; however, with spatial interaction in Table 2, a unit increase in labour force increases domestic GDP per capita by 0.555 and causes a significant spillover to the neighbours, increasing the GDP per capita of the remaining 18 countries by 5.933. In general, it increases the region-wide GDP per capita by 6.487. The continuous increase in the magnitude of labour force impact indicates that living standards would improve in an integrated region as spatial interaction intensifies economic activity.

The table also shows that in the immediate context, a unit increase in the inflation rates increases domestic GDP per capita by 0.195%, but it does not have a spatial effect. The positive effect indicates that if prices are relatively stable and moderately increase, thereby encouraging entrepreneurial activities, productivity and living standards would improve. However, Chisti *et al.* (2015) found mixed empirical results in their analysis of inflation and income per capita in five major emerging economies in the BRICS over the period 1999 to

Table 1. Main effects

lgdpc	SAR	SDM
llbf	0.0850(0.161)	0.325(0.199)
inf	0.00224***(0.000854)	0.00195**(0.000806)
gne	−0.000828(0.00160)	0.00152(0.00169)
Mva	−0.0295***(0.00266)	−0.0247***(0.00278)
ge	0.00772***(0.00112)	0.00787***(0.00114)
gcf	0.0103***(0.00196)	0.00931***(0.00193)
rq	0.00113(0.00167)	0.00177(0.00159)
afp	−0.0592**(0.0288)	0.0113(0.0305)
neer	0.00201***(0.000276)	0.00224***(0.000259)
gfce	0.0261***(0.00490)	0.0342***(0.00475)
hcg	−0.0649***(0.00659)	−0.0701***(0.00826)
SAR- ρ sigma_u	0.824***(0.00566)	
	0.00425(0.000319)	
SDM- ρ sigma_u		0.426***(0.0833)
		0.00327(0.000253)

Note(s): ***$p < 0.01$, **$p < 0.05$

Source(s): Author's computation from Stata 19.5

Table 2. Spatial Interaction through the spatial Durbin model

Variables	Direct	Indirect	Total
llbf	0.555**(0.224)	5.933***(1.689)	6.487***(1.802)
inf	0.00158(0.000896)	−0.00956(0.00802)	−0.00798(0.00846)
Gne	0.00349(0.00213)	0.0511**(0.0206)	0.0546**(0.0219)
mva	−0.0248***(0.00333)	−0.00146(0.0283)	−0.0263(0.0305)
ge	0.00755***(0.00114)	−0.00838**(0.00408)	−0.000828(0.00427)
gcf	0.0108***(0.00208)	0.0383**(0.0185)	0.0491**(0.0194)
rq	0.00222(0.00163)	0.0116(0.00797)	0.0138(0.00840)
afp	0.00997(0.0295)	−0.0336(0.199)	−0.0236(0.201)
neer	0.00220***(0.000293)	−0.00109(0.00203)	0.00110(0.00219)
gfce	0.0361***(0.00507)	0.0487(0.0257)	0.0848***(0.0281)
hcg	−0.0733***(0.00846)	−0.0812(0.0414)	−0.154***(0.0439)

Source(s): Author's computation from Stata 19.5

2011. Based on a regression analysis, they found that inflation does not significantly affect per capita income in three economies comprising South Africa, India and Brazil. In contrast, it significantly affects per capita income in Russia and China.

The SDM model shows that, before spatial interaction, a unit increase in manufacturing value added significantly decreases living standards by 2.47%, a decrease that persists into the long-run direct effect through the average trade-flow mechanism, resulting in a decrease in living standards by 2.48%. It implies that a decrease in GDP per capita, which reduces a country's ability to produce, can decrease the manufacturing value added of its neighbours due to low imports, which further loops back to the initial country, whose exports may also decline through the pass-through of bilateral average trade flows. The negative effect of manufacturing value added could arise if a large number of domestic investments are controlled by foreign investors who repatriate their proceeds, thereby reducing the benefits of investment in the host economy.

Although manufacturing value added in relation to GDP per capita was used in this current study to approximate this metric to manufacturing production and economic growth, the negative effect observed in this study contradicts Marconi *et al.* (2016), who employed a dynamic panel data analysis covering 63 economies to investigate Kaldor's first two laws. The authors observed that increased growth in manufacturing production results in higher economic growth (first law) and higher manufacturing productivity (second law).

Moreover, a unit increase in GE causes a significant 0.787% increase in GDP per capita in a non-trading partner's scenario. In bilateral average trade flows, a one-unit increase in GE causes a 0.755% increase in a country's own GDP per capita. Also, a unit increase in GE causes a 0.838% decrease in the GDP per capita of the other 18 countries in the region. An increase in GE is typically associated with higher GDP per capita. It portends the precision in the quality of institutions, good governance and effective policy formulation in promoting the welfare of citizens. Therefore, an economy characterised by GE in providing an enabling environment that fosters economic activity will boost quality of life. Increased business activities, such as exports to partner countries, facilitated by GE that promotes trade partners' confidence, will further feed back into the domestic economy, boosting productivity and well-being. However, the negative effect on the GDP per capita of the remaining 18 countries could arise from increased imports at the expense of their exports from the government's effective economy.

According to Davis (2016, p. 3), "good and effective governance is needed to address the problems of human development", and the effectiveness of government is one of the most crucial influences to decrease poverty, enhancing human development. The study of Azam (2022) investigated the role of governance indicators, which include GE, on the economic growth of some Latin American and Caribbean states. The author deployed the technique of

pooled mean group for the empirical analysis. It was observed that in the long run, GE generates a positive contribution to the growth process. However, in another breadth, Freckleton *et al.* (2012) described that developing economies may be characterised by an increased level of corruption in the process of realising their economic growth aims.

Moreover, the empirical findings show that, in the immediate period, a unit increase in gross capital formation increases a country's GDP per capita by 0.931%, which persists as a long-run direct effect through bilateral average trade flow, resulting in a significant increase in GDP per capita by 1.08%. This outcome underscores the pivotal role that gross capital formation plays in stimulating productivity and improving the welfare of citizens. The increased magnitude of impact in the bilateral trade network implies that a country benefits from maintaining a healthy trade relationship with its partners in the G20. Increased gross capital formation, which expands domestic productivity, would lead to increased exports to trading partners, further enhancing domestic GDP per capita. Moreover, a unit increase in gross capital formation in a particular country causes a significant combined increase of 3.83% in the GDP per capita of the remaining 18 countries. This is quite considerable, most especially if some of the partner countries depend on others for the purchase of specific capital resources that are not locally available in their countries or available at an exorbitant opportunity cost. Therefore, the bilateral trade interaction would facilitate the influx of capital resources that may contribute to boosting the productivity and GDP per capita of neighbouring countries. In addition, the table shows that a unit increase in gross capital formation drives the overall GDP per capita of the region by 4.91%, having a much higher effect relative to the non-trade network. In the immediate term, it was observed that GDP per capita increased by 0.224% for a unit increase in nominal effective exchange rates. This effect becomes 0.220 given the trade flows in the region. Though the magnitude decreases, it nevertheless has a positive effect on domestic GDP per capita. This consistent positive effect can arise if a country trades in goods that are price inelastic and have a limited range of substitutes.

In another development, government final consumption expenditure, a measure of fiscal policy, is found to have positive effects on GDP per capita in the non-bilateral and bilateral trade contexts. Without trade, a unit increase in government consumption expenditure results in a 3.42% increase in a country's GDP per capita. In contrast, it increases domestic GDP per capita by 3.61%, while increasing the G20's GDP per capita by 8.48% under the trade flow spatial interaction mechanism. Expenditure programs characterised by transparency and accountability, void of all forms of corruption and embezzlement, would achieve fiscal targets, such as electricity supply, an adequate road network and effective healthcare services, all of which are pivotal in promoting productivity and improving living standards.

The spillover of government final consumption expenditure occurs through the total effect, with a larger impact on the region's GDP per capita. It implies that a well-coordinated increase in the domestic expenditure program, which minimises production costs, will promote exports at minimum cost and enhance the demand for goods from partner countries. Ease of access to goods, at minimum cost, especially intermediate goods, would drive increased employment, production and living standards in the entire system.

The human capital proxy, current health expenditure, shows that, in the absence of average bilateral trade flows, a unit increase in current health expenditure reduces GDP per capita by 7.01%. The negative effect continued into the spatial interaction space, where GDP per capita in the remaining 18 countries decreased by 7.33%, and the entire region's GDP per capita decreased by 15.4%. The quality of health care a country provides largely determines the effectiveness of its labour force and, by implication, its productivity level and standard of living. Health expenditure programs compromised by corruption and poor health services will ultimately undermine citizens' living standards. Also, the low domestic output would negatively affect exports, which would be sold to partner countries at high prices. These high prices filtering into partner countries' economies would increase production costs, reduce employment and lower GDP per capita across the entire region. A study investigating the relationship between health expenditure and GDP per capita is Dritsaki *et al.* (2025), which

used a dynamic panel Autoregressive Distributed Lag (ARDL) model to evaluate the long- and short-term effects of health expenditure on economic growth in the BRICS countries from 2000–2021. The authors measured economic growth by GDP per capita, while the major exogenous variable is per capita health expenditure. Other control variables include population share, natural capital and education. To validate the model's robustness, additional exogenous variables important to endogenous growth theory were also examined. They found that, in the long run, all exogenous variables significantly influence GDP per capita. The short-run results show that per capita health expenditure is the only positively significant variable influencing GDP per capita. In contrast, the other variables are not statistically significant in the short run.

The selection of the SDM model over the SAR model was determined through the Wald test as presented in Table 3. The test statistic is 137.13, which is statistically significant. It implies that the SDM provide a better fit of the data than the SAR model.

Conclusion and policy recommendations

The G20 is one of the significant global associations of countries, characterised by a profound network of trade that has implications for the respective economies in the region as well as collectively. In light of this, this study examined the performance of GDP per capita, a metric for living standards, alongside macroeconomic policy levers, including government consumption expenditure and monetary policy, using the GDP deflator inflation rate as a measure. Moreover, gross capital formation, labour force, gross national expenditure, manufacturing value added, armed forces personnel and nominal effective exchange rates were included. The study also includes GE and regulatory quality, which are crucial metrics for development drivers.

The analysis was done using the Ditzen *et al.* (2022) Stata command, which handles unbalanced panels. In the unbalanced panel, the Wald test is statistically significant, indicating that the SDM is preferable to the SAR. The empirical findings show that in a non-bilateral trade network, manufacturing value added and current health expenditure significantly decrease GDP per capita. However, inflation rates, GE, gross capital formation, nominal effective exchange rates and government final consumption expenditure significantly increase GDP per capita.

The empirical findings show that while labour force and gross national expenditure have no effect in the non-trade, they do have significant spatial effects. The positive values of the spatial effect of the labour force increase from the direct to the indirect and then to the total effect. These positive outcomes can be maintained through labour force policy measures that facilitate the migration of skilled individuals to other countries by removing or minimising barriers. This will increase labour force flexibility and increase productivity in the region. In another vein, while gross national expenditure does not have a significant direct effect on GDP per capita, the positive spillovers to other countries and the region can be sustained by policy measures in each country that expand aggregate demand, which subsequently has ripple effects across the system.

Moreover, inflation rates positively affect GDP per capita but do not constitute a spatial effect. The positive effect inflation rates have on GDP per capita in this study can be sustained by ensuring they remain within an acceptable range through the management of monetary policy tools to achieve monetary stability.

Table 3. Wald test

Test	χ^2	df	*p*-value
Wald statistic	137.13	11	0.0000

Source(s): Author's computation from Stata 19.5

Manufacturing value added negatively affects domestic GDP per capita through spatial interaction. A substantial subsidy program would be of immense benefit in mitigating the negative impact of manufacturing value-added. GE has a consistent positive effect on a country's GDP per capita, with the spatial interaction context exerting a greater impact. However, it causes a significant negative spillover to the remaining 18 countries. The fostering of the positive effect of a country's GDP per capita and the correction of negative spillovers require that governments in the G20 countries strive to enhance the overall effectiveness of all institutions in the region. Measures should be implemented that promote overall sound institutional quality, respect the rule of law, ensure effective public administration and facilitate appropriate macroeconomic policy formulation. Such healthy institutions would promote increased bilateral trade relationships with some industrialists motivated to install facilities for industrial activities both domestically and in partner countries.

Similarly, gross capital formation has a positive impact on GDP per capita in the non-trade context. However, the magnitude of the positive effect increased across all sections related to bilateral trade relationships. The mutually desirable effect of gross capital formation should be reinforced in the G20 by motivating governments to provide an enabling environment for industrialists to expand their capacity through capital formation.

Moreover, nominal effective exchange rates have a direct impact on GDP per capita in both non-trade and bilateral trade relationships but do not spill over to the neighbours. The exchange rates must be sustained at competitive levels to avoid adverse effects on domestic production.

The study observed that government final consumption expenditure has a positive effect on GDP per capita in the non-trade context, which persists in the long run through the direct and total effects of spatial interaction. These desirable effects of fiscal policy must be sustained by ensuring that government expenditure programs are channelled to productivity-enhancing priority projects rather than white elephant projects, which are usually of low economic value and intended to create a political impression. Also, current health expenditure has a significant negative effect on domestic GDP per capita, which persists in the direct and total effects through spatial interaction. This study recommends high-quality human capital investment in the health sector across the region's countries for a healthy, productive economy.

Data availability

Data and Stata commands would be made available on request.

Limitation of the study

The study's primary limitation is the use of an unbalanced panel, and there are missing bilateral trade flows among pairs of countries, which were addressed by deriving average bilateral trade flows for constructing the spatial weight matrix.

Acknowledgments

DeepSeek AI was used to generate most of the Stata commands for the empirical analysis, brainstorming and to provide insights into the interpretation of the estimates. Also, Grammarly was used to edit the manuscript.

Supplementary material

The supplementary material for this article can be found online.

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Corresponding author
Opeyemi Aromolaran can be contacted at: aromolaranopeyemi123@gmail.com, aromoo@unisa.ac.za