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ARMENIA:
GROWTH SPILLOVERS THROUGH GEOGRAPHY, INSTITUTIONS, TRADE AND LINGUISTIC DISTANCE

by
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This thesis is contributed to my grandmother; whose family came to Lebanon following the genocide that took place in Armenia in 1915. She grew up as an orphan, got married and formed a traditional Armenian family. Recently, she has been diagnosed with cancer, that is why I dedicate my thesis to her.

ABSTRACT
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This research paper studies the importance of spatial interaction and dependence of 11 countries on each other to pursue economic growth during 1995-2019. Two spatial models were conducted, the SAR and SEM models, using four spatial weighting matrices: geography, institutions, trade and linguistic distance.

The results generated from this methodology showed that geography and trade are the most significant channels of growth spillovers between two countries. Armenia's and its neighboring countries' GDP per capita growths decreased during this period, the reason can be due to increasing government spending and growth convergence.

The study concludes with a summary of the whole paper and some open ended questions on the ongoing Russia-Ukraine and Armenia-Azerbaijan-Turkey wars, and the importance in integrated a political aspect when conducting a spatial analysis.

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ABBREVIATIONS

AIC	Akaike Information Criterion
ARM	Armenia
AZE	Azerbaijan
BIC	Bayesian Information Criterion
CL	Common Language
EU	European Union
FDI	Foreign Direct Investment
FSI	Financial Stress Index
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GEO	Georgia
GRC	Greece
GS2SLS	Generalized Two-Stage Least Squares
ID	Institutional Distance
IMF	International Monetary Fund
IRN	Iran
IRQ	Iraq
LBN	Lebanon
MENA	Middle East and North Africa
OLS	Ordinary Least Squares
RUS	Russia
SAR	Spatial Autoregressive Model
SDM	Spatial Durbin Model
SEM	Spatial Error Model
SVAR	Structural Vector Auto-Regression Model
SYR	Syria
TUR	Turkey
UKR	Ukraine
USSR	Soviet Union

CHAPTER I

INTRODUCTION

Globalization is the trending subject in the field of economics. As defined by the Peterson Institute for International Economics, globalization is "the word used to describe the growing interdependence of the world's economies, cultures, and populations, brought about by cross-border trade in goods and services, technology, and flows of investment, people, and information." It is not until the 19th and 20th century that globalization set off. There are several reasons as to why globalization was enhanced in the recent centuries, like the Industrialization Era, also known as the Industrial Revolution which took place during 1760-1840. During this revolution, a full transformation of modes of production occurred. Production shifted from goods being produced in farms and homes to being produced in factories and manufacturing industries. Even the incentive for producing goods changed. During pre-industrialization, people produced goods for their own benefit and survival. Very minimal trade would happen between two people, which was then called "exchange" or "bargain" under a barter system. For instance, people traded animal skins and in return they would get shells as currencies (ConnectAmericas, n.d.). With time, metal coins were developed, exchange markets were formed, and caravan trading was discovered. People started carrying money with them and making small businesses by buying and selling goods. Later on in the mid-18th century, the Industrial Revolution took place and everything was altered. With the steam engine, spinning jenny, water frame, power loom, and other machinery, production increased to large-scale. Factories and manufacturing industries were built where big quantities of goods were produced at high speeds and efficiency rates. Consequently, each city or country started producing goods stemming from its own resources, shaping its own economy. That being said, trade between far cities was possible, even between neighboring countries, springing up economic integration and globalization among countries. These phenomena are still in line until nowadays. Since countries are geographically neighbors, they get influenced from one another. They can learn each other's language, adapt each other's culture, share resources, implement each other's production models and trade with each other, which gives rise to spatial growth spillovers from a host country which can have a positive or negative impact on its neighboring country (CFI Team, 2022). This spatial interaction may occur through many channels such as tourism, trade, labor mobility, foreign direct investments, war, culture, geography, institutions and many more. For instance, countries located on coastlines may face greater economic growths as compared to landlocked countries because of their access to the sea and maritime trade, where landlocked countries trade 30% less than coastal countries (Irwin and Tervio, 2002 and Limao and Venables, 2001). An example of a landlocked country is Armenia. Armenia used to be part of the Soviet Union (USSR), an empire which comprised several republics which were: Armenia, Azerbaijan, Belorussia (Belarus), Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan (Dewdney, John C. et al, 2023). Following the collapse of the USSR, these countries got their independence, notably Armenia's independence from the USSR became on the 25th of December 1991. Under the rule of the USSR, Armenia was characterized with a stable economy, despite the lack of equalities and justice. Independence allowed the republic to focus on becoming a market economy and liberalizing its prices, which permitted people from different economic and social classes and with no political connections to benefit from goods and services that they were prohibited from during the sovereignty of the USSR. However, it cannot be ignored that following Armenia's independence, economic conditions aggravated. Output declined and inflation rose significantly in Armenia, with gross domestic product (GDP) equal to $2.07 billion in 1991 which dropped to $1.27 billion in 1992 and an inflation rate of 3373.8% in 1994[1]. This collapse was the second worse collapse in the entire region, with the worst being Georgia. Many Armenian entities and firms fell apart as most of them were built to provide the USSR with their needs. In addition to Armenia's independence from the USSR, the ongoing war in Nagorno-Karabakh provoked by Azerbaijan and Turkey, deepened the economic situation even more. This gave rise to severe unemployment with 1.8% in 1992 increasing to 6.6% in 1994[2]; as well as poverty which increased by 35 percentage points from 1988 to 1996, for people living below the poverty line. On top of that, migration soared from Armenia to other countries. Despite all the hurdles Armenia had to face, its government and central bank were able to stabilize the situation by implementing strong monetary and fiscal policies, which was a clear success as inflation shrunk from 3373.8% in 1994 to 176% in 1995 and 18.7% in 1996 and GDP gradually increased to reach $1.89 billion in 1998[3]. Later in 1998, Russia underwent an economic decline as well, withal Armenia's economy remained sound and was not majorly affected of the Russian downturn due to its strong policies, in spite of Russia being a huge trading partner with Armenia. Since Armenia is a small and landlocked country, it immensely depended on trade with other

[1] The values for GDP and inflation rate are retrieved from the World Bank Database.
[2] The values for unemployment are retrieved from the World Bank Database.
[3] The values for GDP and inflation rate are retrieved from the World Bank Database.

countries (CIS 7 - Initiative, n.d.). For the republic of Armenia, spatial interaction is a necessary characteristic for it to prosper, whether through trade, remittances from its people who migrated during difficulties, alliances, institutions and many more (Odling-Smee, 2001). In fact, the biggest exporter to Armenia during the year 2000 was Russia, with 12.7% imports, then came Belgium and the United States with 10.7% both and third place was Iran with a percentage of 9.93%[4].

The rest of this paper is divided in the following sections: Section 2 describes some studies conducted on spatial analysis in different regions, implementing different methodological approaches, timeframes and transmission mechanisms. Section 3 states the data used to conduct the two spatial models: Spatial Autoregressive Model (SAR) and Spatial Error Model (SEM) by giving some insights on the methodological aspect of each model. Section 4 presents the results of the spatial models. Section 5 discusses the following results and relates them to the provided literature in Section 2. Lastly, Section 6 concludes the study and provides the readers with some policy recommendations.

[4] Trade shares are retrieved from The Observatory of Economic Complexity (OEC).

CHAPTER II

RELATED LITERATURE

Previous work has been done on the transmission mechanism of growth spillovers between countries. Studies like Hall and Jones (1999), Moreno and Trehan (1997), and Acemoglu et. al (2001) largely emphasize on the role of geography and institutions in providing growth spillovers among countries. Hall and Jones (1999) study that variations in output per worker from one country to another are a result of institutional differences between both countries. They define a country's institutions as its social infrastructure which provides incentives for individual skills acquisition and capital accumulation, determining a country's economy. Through good social infrastructure, more skills can be acquired and more capital can be accumulated, therefore leading individuals and firms to produce more outputs, increasing the country's output per worker and achieving economic growth. Hall and Jones (1999) indeed found a correlation between output per worker and social infrastructure and specifically found that countries are influenced from one another when it comes to institutional differences. They found that countries influenced by Western Europe were more likely to adopt favorable social infrastructure, since Western Europe is where Adam Smith's concepts such as property rights, governmental balances and system of checks were first implemented. Through that, they also analyzed the role of geography in bringing about economic success. They discussed a country's distance from the equator and discovered that countries such as the United States, Canada, Australia, New Zealand and Argentina were mostly correlated with higher output per capita, and the reason for that is because Europeans tended to migrate to places where the population is more scattered, back in the fifteenth century. Other geographic factors were also included in this economic gap between regions such as North America and Latin America, which are climate and soil conditions (Engerman and Sokoloff, 1997). These are important factors of production, especially when it comes to agriculture. In addition to geography, language also played a role in contributing to contrasting economic progress among countries. Countries whose languages have become the mother tongues today were more likely or easier to influence each other. Hall and Jones (1999) use distance from the equator and the extent to which Western European languages have become primary languages today as instrumental variables to test whether they are correlated with social infrastructure. They uncovered that these two instruments were indeed correlated with social infrastructure. Meaning countries farther away from the equator had a positive influence on its own social infrastructure, as well as countries whose languages are now the primary languages also have a positive effect on its social infrastructure. Consequently, good social infrastructure meant favorable institutions to increase a country's output per worker and drive its economy to succeed. Moreno and Trehan (1997) also conducted a research on the importance of a country's location in achieving greater economic growth. They found that growths between nearby countries are related, where a 1 percent increase in the distance-weighted growth rate of the rest of the world causes a 0.8 percent increase in the studied country's growth. The authors discussed several factors behind this relation such as trade, technology, common shocks, interchangeable educational levels or investment rates, and pinpointed trade as the most important factor, where it is easier for nearby countries to trade with each other. However, their results show that studying distance between two countries is more reliable than studying trade between them, in examining economic growth rates. However, Acemoglu et. al (2001)'s results predicted that controlling for geography such as using continents, quality of soil, climate, natural resources, and latitude as dummies in their regression led to insignificant results. This is observed when controlling for continents, specifically for Africa, which gave insignificant results, meaning that Africa is not poor due to its geography, but due to its bad institutions. In fact, they studied the effect of institutions on economic performance across different countries. They revealed that to know about a country's current economic performance, past institutions must be taken into consideration and not just current institutional conditions. Therefore, the authors studied European colonization and how in some countries European colonies' mortality incidences were higher than colonies' mortality in other countries, and due to the high mortality rates, these host countries ended up having extractive institutions instead of inclusive ones, leading to lower economic growth. For instance, where Europeans settled in the United States, Australia or New Zealand, inclusive institutions were set up, while extractive institutions were set up in Congo where European colonies faced high mortality rates. They concluded with the relation that mortality rates and European settlements are highly correlated, the latter being highly correlated with early institutions, and since early institutions were persistent till nowadays, then they are also highly correlated with current institutions, leading finally to large estimates of the effect of current institutions on income per capita (with a 2SLS coefficient of 0.94), therefore on the economy as a whole. Acemoglu et. al (2001) also used Hall and Jones's (1999) dependent variable being output per worker instead of their own income per capita, and a score of 0.98 was estimated. So, it did not matter whether output per worker or income per capita was used in the regression. Grossman and Helpman (1991) and Vamvakidis (1998) examined the role of trade and openness in achieving economic growth.

Grossman and Helpman (1991) examined the role of trade in generating more growth. They looked at the stock of knowledge as the channel through which trade takes places between countries. Their results point out that with lower trade barriers, more contact would be created between locals and foreigners, and the opposite is true. Some policies promoting trade are import and export subsidies, while other policies impeding trade are tariffs and export taxes. As trade increases, stock of knowledge exchanged between countries augments leading to better learning and growth, and vice versa. Vamvakidis (1998) also agrees with the hypothesis that trade generates growth among countries. His study shows that countries having open neighbors will grow much faster than countries having closed neighbors. This can be seen in the coefficient of regressions 7 and 8 which is equal to 0.39 percent faster GDP growth in the presence of open neighboring countries such as the United States, Canada, Europe and East Asia. However, a smaller coefficient of annual growth is observed for countries having closed neighbors such as Sub-Saharan Africa. Vamvakidis's results conclude that countries benefit more from having developed neighboring countries than from having fast-growing neighbors, as they domestically grow more due to the positive spillover effects from their neighbors. Although this is not true for countries having neighbors with closed economies as their spillover effects are insignificant. This spillover effect is mainly due to the extent of a country's openness and the presence of regional trade agreements between two countries. Other studies show the impact of these transmission mechanisms on the growth of a region such as East Asia versus Sub-Saharan Africa (Easterly and Levine, 1998) and the Middle East and North African (MENA) region (Andreano et. al, 2013 and Moriyama, 2010). Easterly and Levine (1998) take the case of Sub-Saharan Africa in studying the underlying cause of bad policy adoption, hence slowing down long-run growth.

They hypothesize that ethnic diversity, particularly ethnolinguistic diversity, directly influences a country's economic performance and indirectly through other economic channels such as public policies, education, financial development and infrastructure. Their growth regression results show that long-run growth is declining in Sub-Saharan Africa, since the dummy variable for Sub-Saharan Africa is negative and significant. This slow growth is correlated with different economic factors being assassinations, schooling, financial depth, fiscal surpluses, and black market premiums. Easterly and Levine's (1998) outcomes reveal that ethnic diversity is the main cause behind poor economic measures, and that is due to the fact that contrasting ethnicities lead to the formation of different interest groups, which in turn adopt different policies and economic measures that benefit their interests, shedding light on racism, struggle for power, wars of independence, alliances, bribery, rent-seeking behavior and various other unfavorable characteristics that a country may acquire. The aftermath of ethnic diversity can be clearly observed in Sub-Saharan Africa, as compared to East Asia which is on the other side of the coin, characterized as having a long-run 'growth miracle'. This mentioned study by Easterly and Levine (1998) show that ethnolinguistic disparities between countries in the same region affect each other's growth progress. While the former authors look into growth in Sub-Saharan Africa, Andreano et. al (2013) explore growth in the MENA region. The latter investigate a method called conditional convergence to understand and bridge the gap between poor and rich countries. Conditional convergence is one out of three types of convergence, the other two being absolute convergence and convergence clubs. Andreano et. al (2013) use the classification of convergence provided by Galor (1996). Galor (1996) defines absolute convergence as the steady-state to which all economies converge; conditional convergence as the different steady-states to which different economies converge and that is due to several determinants such as factor endowments or institutions specific to each country's economy; and convergence clubs are defined to be the various steady-states to which economies with analogous characteristics converge. Andreano et. al (2013) use the conditional convergence to study how poor economies in the MENA region converge to the rich ones. Their results confirm their hypothesis and show that in fact poor countries converge to rich countries by developing and growing through numerous factors, most importantly human capital and technological development. To reach this finding, the authors use single variables to estimate β-convergence, which are: investment/GDP, inflation rate, neighboring countries' average GDP, population [15-65 years], fertility rate, birth life expectancy, migration rate, governance indicator #2, secondary school progression, value added share of agriculture and mining sectors, and index of export/import. They also add some spatial dummies which divide countries into groups based on their economies, religious, geographical and social features. However, the estimates of the spatial analysis turn out to be insignificant. Andreano et. al (2013) conclude that contrasting convergence rates are observed across the MENA countries, and in order to address this issue, structural reforms must be implemented to achieve convergence and a sustained economic growth in this region. Another research conducted around the topic of growth spillovers is an IMF Working Paper written by Moriyama (2010). Moriyama based his work on the global financial crisis that occurred in 2007-2008 and the Lehman shock which led MENA emerging markets to be significantly affected. He used an index called Financial Stress Index (FSI) to set out how global crisis was transmitted from advanced countries to emerging countries in the MENA region. The FSI consists of several indicators: the exchange market pressure index and market-based price indicators (stock market volatility, stock market returns, banking sector, and sovereign spreads). All of these measures are normalized in order to have the FSI. The rationale behind this index is that a higher FSI in an advanced economy means that there is increased financial stress in that particular economy. He moves on to study how this financial stress is transmitted to MENA emerging economies, and finds that spillover effects can occur through several channels: directly from advanced countries, directly from the Gulf Cooperation Council (GCC) countries, indirectly from advanced countries through GCC countries, or through production activities happening in advanced economies. Either way, increased financial stress in advancing economies are passed on onto emerging markets in the MENA region. This transmission between countries occurs through trade, since countries are generally trade partners, especially when talking about trade between advanced and emerging economies. The word trade encompasses many aspects; it can be trade of goods and services, human capital, stocks and bonds, knowledge, resources, money and many more. In this working paper, Moriyama mentions three types of trading channels which are: goods and services, remittances and foreign direct investments, portfolio and bank loans. Consequently, an advanced economy under high financial stress will lead emerging countries to suffer a drop in demands of goods and services, lower inflows of remittances into the countries, and a halt to capital inflows. Therefore, through these channels, spillovers of financial stress will reach emerging economies and will render them to having slower economic growth. Baysoy and Altug (2021) also studied growth spillovers in the MENA region but through geography, institutions and trade. They carried out a spatial analysis in examining the spatial spillovers across the MENA region rooting from the three mentioned channels. The SAR was implemented for this spatial analysis. Their SAR outputs suggest that growth spillovers among MENA countries occur mainly through geographical and institutional similarities, with positive and significant estimates of geography weighting matrices (0.43%) and institutional weighting matrices (0.40% and 0.42% respectively for institutional weighting matrices and linguistic weighting matrices) on GDP per capita growth, with the largest impact being that of geography. However, the trading weighting matrices had a 0.25% effect on GDP per capita, being relatively low compared to the estimates of the other weighting matrices. Therefore, bilateral trade is not an important transmission mechanism of growth spillovers among MENA countries. In addition to all these studies, another IMF working paper also undertook a spatial analysis, but this time it targeted one specific country which is Armenia. Ayvazyan and Daban (2015) studied the impact that size, geographical sources and global shocks have on Armenia's economy. They used the structural vector auto-regression model (SVAR) to conduct this analysis. The outcomes of this paper reveal that global shocks are transmitted to Armenia mainly through remittances and external borrowing, with 28% and 31% respectively, while the trade and exports channels have a lower impact. These spillovers are for the most part transferred from Russia and the European Union (EU) countries, this is because they are the strongest economies in terms of tourism, trade, and transferring remittances, as well as the fact that they have good financial relations with Armenia. Since these transmission mechanisms contribute greatly to the construction, services and industry sectors, these sectors are usually the most affected in case of global shocks. Therefore, any global shock affecting Russia and the EU, affects Armenia negatively as well. Another recent IMF study analyzed a specific case where Russia's downturn affected its neighboring countries. Stepanyan et. al (2015) explored the spillover channels through which Russia's economic collapse influences the economic conditions of its neighboring countries, such as Armenia, Azerbaijan, Kyrgyzstan, Serbia, Czech Republic, Moldova and many other countries. They state that Armenia depends largely on Russia's exports. The former imports include energy (greater than 20% of total energy consumption), remittances (make up 20% of Armenia's GDP), and foreign direct investments (FDI) (more than 5% of Armenia's GDP is in FDI). Whereas Armenia does not provide much to Russia, with exports between 2-5% to Russia. The authors predict the output decline for Russia's neighboring countries using a Flexible System of Global models, in case of a potential greater shock, and they estimate that Armenia would face a -3% output loss following a Russian growth shock. This estimate would be amplified in the case of Armenia as Russian remittances consist of a significant part of its GDP. All the above mentioned studies and researches analyze spatial interactions between different regions and countries. Each study uses a unique methodological tool and approach to conduct the result. Moreover, some literature carried out on Armenia show interesting ideas that can be investigated even more thoroughly.

In this paper, I will study the spatial growth spillovers from the following countries, Azerbaijan, Georgia, Greece, Iran, Iraq, Lebanon, Russia, Syria, Turkey and Ukraine on Armenia, the main country of study. I will use the same methodological approach as that of Baysoy and Altug (2021) with the same transmission channels which are the geographical location, institutional similarities and bilateral trade, but for the above mentioned set of countries over a 24-year timeframe (1995-2019). Three models will help me in conducting this spatial analysis, which are the SAR and SEM, similar to Baysoy and Altug (2021). This study will not contribute to the literature in terms of the methodology, as numerous studies have been done on spatial analysis whether among countries or different regions using the

SAR and SEM models such as Permaia et al. (2019) which used the SAR model, and Glass et al. (2012) which used the SEM model, as well as Wilhelmsson (2002), Mahmood et al. (2020), Cordera et al. (2017) and Ryu et al. (2017) which used the two models together. However, this study will contribute to the literature in terms of the choice of countries, as there are several spatial analyses conducted for Armenia, whether within the regions of Armenia such as (Chakhoyan, 2017), or within a set of countries (Jiao et al., 2020 and Ashraf et al., 2022), but not with the set of countries chosen in this paper. Therefore, this research has an advantage of other studies in the aspect of discovering the channels through which Armenia has grown most, whether through its geographical location, institutional similarities, bilateral trade or linguistic distance. In fact, some insights on the results show that the highest correlation is between geography and trade and by increasing a neighboring country's GDP per capita growth, the studied country's GDP per capita growth increases as well, mostly through the geography and trade channels. While the two spatial models have close results, they also have distinct outcomes.

CHAPTER III

ANALYTICAL FRAMEWORK

To study the growth of countries, it is not enough to look only at growth at the country-level, but it is also necessary to look at the interaction between countries and regions. The growth of Armenia may well depend on the growth of its neighboring countries, or even countries located farther but that have significant relations with Armenia such as Lebanon, Syria, Iraq, Russia and Ukraine. It is important here to define what is meant by “neighboring countries.” As per the definition provided by the National Geographic Society (n.d.), two countries become neighbors when there is a border that separates them. This border, whether physical or political, not only separates the land between two countries, but also their cities, political systems and economies. However, Anselin (2003) mentions what is known as first and second-degree neighboring countries, where first- degree neighboring countries are those that share common borders, and second-degree neighboring countries are those that share borders with the specified country’s neighbors. Also, countries not only can be geographical neighbors, but also geo-economic and geo-political neighbors. Geo-economic neighbors are those countries that are located in strategic locations characterized by transport, trade with other countries and tourism. Geo-political countries are those having political relations with other countries (Dimitrov, 2015). In fact, having diverse degrees of proximity and different characteristics of neighbors is principal when studying the spatial interaction among countries. Following the above, it is critical to account for the spatial dependence among countries when studying the growth of a specific country, as this concept would make the spatial results more consistent and unbiased, giving off the exact spillover effects across countries (LeSage and Pace, 2009). In economics, many studies have been done on growth of countries through different growth models, whether accounting for spatial interactions or not. The upcoming subsections present the traditional growth regressions used in literature, and the three spatial growth models applied in this study.

A. Theories of Growth

Throughout time, economists have come across many different theories and models of growth to analyze the growth of firms, countries or regions. The followings models are growth models studied by economists, that do not consider spatial interactions.

1. Classical Growth Theory

The classical growth theory is an economic theory led by economist Adam Smith. He believed that for an economy to grow, factors of production, specifically capital and labor, should play an important role. This idea was believed to be accurate by many as it occurred during the Industrial Revolution, where more advanced factors of production were invented. With the advancement of tools and machines, people would become specialized, thus increasing productivity. He thus concluded that with the higher productivity and efficiency of labors, more output can be produced and profit can be made, using this profit for capital accumulation and investments, thus entering a growth loop. Another classical growth theorist, David Ricardo, agreed with Adam Smith and highlighted the role of technology and the fact that natural resources are limited. Despite this once great theory, the classical growth theory did not continue its objective and was rejected with time (Kenton, 2021).

2. Neoclassical Growth Model

The neoclassical growth model invented by Robert Solow took the classical growth theory and added to it technological progress as an endogenous factor contributing to growth, next to capital accumulation and labor growth rate. He explains that through technological progress, labor become more productive and efficient, therefore increasing the production of output. The production function for this model took the following form:

$$Y = Af(K,L) \tag{1}$$

where Y represents income or the economy's GDP, A is the technological progress, K shows the capital and L is the labor force. This model assumes that in the short-run, the economy reaches a steady-state where the economy's growth is constant due to diminishing rates of return, whereas in the long-run, technology determines growth. The neoclassical growth model was largely used by many economists and contributed to many researches, to state a few: Romer (1990), Acemoglu et. al (2001) and Prasad et. al (2007).

3. Endogenous Growth Theory

The endogenous growth model was invented by economists Paul Romer and Robert Lucas, during the 1980s. It states that growth is the product of endogenous factors and not of exogenous one such as technological progress in the neoclassical growth model. They focus on the role of knowledge and how educating, training and developing labor's skills lead to sustained growth in the long-run (CFI Team, 2022).

B. Spatial Growth Models

In this section, a simple growth regression is introduced as an empirical benchmark to form a comparison between results generated from this simple growth regression and different spatial growth models. The following subsections will discuss the two spatial models applied to generate the results of this study, which are the SAR and SEM models.

1. Simple Growth Model

The standard growth equation provided by Durlauf et. al (2005) is used and represented as in Baysoy and Altug (2021):

$$g_{it} = \gamma \ln(Y_{i,\tau}) + X^*_{i,t}\theta + \epsilon_{it} \quad (2)$$

$$= X_{i,t}\beta + \varepsilon_{it},\ \ i = 1,\ldots,N;\ t = 1,\ldots T.$$

where $g_{it} = (\ln Y_{i,t} - \ln Y_{i,\tau})/(t-\tau)$ is the average growth rate of GDP per capita of country i between times t and τ, $Y_{i,t}$ is the level of GDP per capita for country i, $Y_{i,\tau}$ is country i's level of GDP per capita of the whole time span, and $X^*_{i,t}$ is a vector representing all the explanatory variables which are physical capital, human capital and total factor productivity, and it also includes the constant term. For consistency with the remainder of this paper, the above growth equation is transformed to the following notation: $g_t = X_t\beta + \epsilon_t$. The below three spatial models are an extension of the simple growth model accounting for spatial dependencies between two spatial units. These spatial units can be countries, regions, or even nongeographic units. These spatial models fit linear regressions such as the below:

$$y_i = \beta_0 + x_{i,1}\beta_1 + x_{i,2}\beta_2 + \ldots + x_{i,k}\beta_k + \epsilon_i \quad \text{for } i = 1,\ldots,N \tag{3}$$

where i represents the unit from 1 to N, y_i is the dependent variable for unit i, $x_{i,1}$ is the first independent variable for unit i, $x_{i,2}$ is the second independent variable for unit i, β is the coefficient for each independent variable and ϵ_i is the error term for unit i.

2. Spatial Autoregressive Model (SAR)

The spatial autoregressive or simultaneous autoregressive model is a spatial model which allows for outcomes in one spatial unit to be affected by (i) outcomes in nearby areas (ii) covariates from nearby areas (iii) and errors from nearby areas. It includes spatial lags of the outcome variables, covariates and spatially autoregressive errors[5] Therefore, this model shows that the dependent variable of a given spatial unit is influenced not only by itself, but by its neighbors as well (Baysoy and Altug, 2021):

$$g_t = \rho W g_t + X_t\beta + \mu + \varepsilon_t,\ t = 1, \ldots, T \tag{4}$$

$$\varepsilon_t \sim N(0, \sigma^2_\varepsilon I_N) \text{ and } E(\varepsilon_{it}, \varepsilon_{js}) = 0,\ i \neq j \text{ and/or } t \neq s$$

where ρ is the spatial autoregressive coefficient, W is the spatial weighting matrix which captures spatial linkages between units and μ is a vector of parameters to be estimated.[6]

[5] The description of the SAR model is retrieved from the STATA Spatial Autoregressive Models Reference Manual: Release 17.
[6] Equation (4) is retrieved from The Stata Journal (2017) 17, Number 1, pp. 139-180.

3. Spatial Error Model (SEM)

The second model used to find spatial interaction between countries is the spatial error model. The SEM model not only accounts for its own estimate of dependent variable, but also the estimates of its independent variables. It looks at the spatially dependent error term as well as the spatially autocorrelated error term. This means that factors not included as independent variables deemed as the error terms, influence the estimate of the dependent variable. Many papers demonstrated usage of the SEM model such as: Glass et al. (2012), Akar et al. (2016) and Houlden et. al (2021). The SEM equation is as follows[7]:

$$g_t = X_t\beta + \mu + \upsilon_t \quad (5)$$

$$\upsilon_t = \lambda W\upsilon_t + \epsilon_t \quad (6)$$

where υ_t represents the spatially autocorrelated error term and λ is the spatially autocorrelation coefficient.

C. Spatial Weighting Matrices

The spatial weighting matrix is a very important aspect in spatial analysis. Without spatial weighting matrices, it is not possible to quantify the spatial patterns and interactions between spatial units. This matrix is composed of spatial units, which can be countries, regions or even nongeographic units, as well as the values representing the weights which depict the strength of the spatial dependence between two spatial units. Hence, greater weights denote stronger spatial dependence between two spatial units and smaller weights imply weaker spatial dependence. There are different methods in constructing spatial

[7] The description of the SEM model and Equations (5) and (6) is retrieved from The Stata Journal (2017) 17, Number 1, pp. 139-180.

weighting matrices based on the hypothesis being tested in the spatial analysis. In this paper, four spatial weighting matrices are used: Geographical, Institutional, Linguistic Distance and Trade weighting matrices.

1. Geographical Weighting Matrix

The geographical weighting matrix is formed from the distance between each pair of countries. Several studies have used distance-based spatial matrices to conduct spatial analyses. For instance, Sapna et. al (2018) tested the spatial distribution of river water quality in India using the inverse distance weighting method. While Abreu et al. (2004) study the relationship between space and growth by using distance. Mayer and Zignago (2011) constructed a dyadic geography dataset using city-level data based on longitudes and latitudes, which consists of the distances between each pair of countries[8]. The calculations of the weights are done based on the inverse distance equation from Baysoy and Altug (2021):

$$w_{ij}^{GEO} = (1/d_{ij}) / (\sum_j 1/d_{ij}) \quad (7)$$

$$w_{ij}^{GEO} = 0 \text{ if } i=j \quad (8)$$

$$0 < w_{ij}^{GEO} \leq 1 \text{ if otherwise}$$

where i represents country i and j represents country j. The geodesic weight matrix is row normalized where each row sums to one, to consider countries that may have an unequal number of neighbors.

[8] The distance estimates are retrieved from the CEPII GeoDist Dataset "Dyadic File"

2. Institutional Weighting Matrix

The institutional weighting matrix is implemented extensively in literature. To name a few studies, Arbia et al. (2010) explored the geographical and institutional determinants of the spatial distribution of regional output per worker for European regions. Another spatial analysis identifying the spillover of economic growth across regions also used institutional distance-based weighting matrices (Ahmad and Hall, 2012). The institutional weighting matrix is formed using the indices of six different institutional dimensions,[9] by constructing an index showing the institutional distance (ID) or cultural distance as proposed by Kogut and Singh (1988). The following approach used by the former authors, Ahmad and Hall (2012) and Baysoy and Altug (2021) is applied, using the inverse institutional distance index similar to the geography weighting matrix:

$$ID_{ij} = \frac{\sum [(I_{ik} - I_{jk})^2] / V_k]}{n} \quad (9)$$

$$w_{ij}^{INST} = (1/ID_{ij}) / (\textstyle\sum_j 1/ID_{ij}) \quad (10)$$

$$w_{ij}^{INST} = 0 \text{ if } i=j \quad (11)$$

$$0 < w_{ij}^{INST} \leq 1 \text{ if otherwise}$$

where k is the institutional dimension, I_{ik} is the index of institutional dimension k for country i, I_{jk} is the index of institutional dimension k for country j, V_k is the variance of institutional dimension k for the countries of study, n is the number of institutional dimension being six. The institutional weighting matrix is also row normalized.

[9] The six institutional dimensions are: Control of Corruption, Government Effectiveness, Political Stability and Absence of Violence/Terrorism, Voice and Accountability, Regulatory Quality, and Rule of Law. These dimensions are retrieved from the World Governance Indicators Database provided by the World Bank.

3. Linguistic Distance Weighting Matrix

The linguistic distance weighting matrix is considered by some authors as another institutional weighting matrix, such that linguistic distance is believed to be a type of institutional proximity (Haynie, 2014; Delaere et al., 2012; and Chen et al., 2012). Chiswick and Miller (2005) define linguistic distance as the extent to which two languages are similar or dissimilar. It is stated that countries sharing the same language, share the same culture and norms as well, thus making linguistic distance a proxy for institutional proximity. Following the methodology of Arbia et. al (2010)'s linguistic distance weighting matrix, the common language (CL)[10] index formed by Melitz and Toubal (2014) must be used. The weighting equation retrieved from Baysoy and Altug (2021) is:

$$w_{ij}^{LANG} = \frac{CL_{ij}}{\sum_{i \neq j} CL_{ij}} \quad (12)$$

$$w_{ij}^{LANG} = 0 \text{ if } i=j \quad (13)$$

$$0 < w_{ij}^{LANG} \leq 1 \text{ if otherwise}$$

where CL_{ij} shows the common language between countries i and j. CL is a binary index with values closer to 1 meaning both countries have a high linguistic proximity, while values equal to 0 mean that there are no linguistic similarities between both countries whatsoever.

[10] The common language (CL) estimates are retrieved from the CEPII Language Dataset.

4. Trade Weighting Matrix

Trade is another component used in constructing spatial weighting matrices. Similar to the previously mentioned weighting matrices, the trade weighting matrix also has a rich literature on its application. Ho et. al (2013) find that trade is a significant component in testing for spatial dependence among countries through trade weighting matrices. Another spatial analysis on the influence of introducing the Euro on the countries of the Eurozone found that the Euro currency led to a significant increase in trade among Eurozone countries and their neighbors. This result was reached through a methodology including trade weighting matrices (Kelejian et al., 2012). For this weight construction, bilateral trade (imports and exports between countries[11]) is utilized in the below, determined by Baysoy and Altug (2021):

$$w_{ij}^{TR} = \frac{m_{ij}+x_{ij}}{\sum_{i \neq j} m_{ij}+x_{ij}} \tag{14}$$

$$w_{ij}^{TR} = 0 \text{ if } i=j \tag{15}$$

$$0 < w_{ij}^{TR} \leq 1 \text{ if otherwise}$$

where m_{ij} is the value of imports between countries i and j, and x_{ij} is the value of exports between countries i and j.

D. Variable Description and Data

The countries of study for this spatial analysis are the following: Armenia (ARM), Azerbaijan (AZE), Georgia (GEO), Greece (GRC), Iran (IRN), Iraq (IRQ), Lebanon (LBN),

[11] Imports and exports estimates between countries are retrieved from the UNcomtrade database.

Russia (RUS), Syria (SYR), Turkey (TUR) and Ukraine (UKR). The data is organized as a panel form over a period of 24 years (1995-2019) post Armenia's independence from the USSR. In this analysis, the five-year averages of GDP per capita growth are calculated and viewed as the dependent variable, *g*. The following macroeconomic variables are appointed as independent variables: the log of the initial values of GDP per capita for the preceding five years, denoted as $\ln Y_{i,t-5}$; population growth of each country as annual percentages[12], *n*; government consumption spending as a share of GDP, *gov/gdp*; trade balance (exports minus imports) as a share of GDP, *tb/gdp*; investment as a share of GDP to proxy for savings[13], *inv/gdp*; and a political rights rating index is added as an independent variable[14], *pol.rights*. All data, variables and weights, are gathered over the period 1995-2019. Appendix A provides the description of the dependent and independent variables for this study (Table 4).

[12] GDP per capita growth and Population growth estimates are retrieved from the World Bank Databank.
[13] Government consumption spending as a share of GDP and Trade balance as a share of GDP and are retrieved from the Penn World Tables 10.0; Investment as a share of GDP are retrieved from the Penn World Tables 10.1.
[14] Political rights rating estimates are retrieved from the Freedom House (Country and Territory Ratings and Statuses, 1973-2022).

CHAPTER IV

ESTIMATED RESULTS

A. Correlation Between Spatial Matrices

It is important to test for the correlation between different spatial weighting matrices in order to better understand the spatial relationships among countries and to identify any spatial pattern between them. Table 1 shows the correlation coefficients between the four different weighting matrices used for this study: Geographical, Institutional, Linguistic Distance and Trade weighting matrices.

Table 1. Correlation Between Spatial Matrices

	$W^{GEO}.u$	$W^{INST}.u$	$W^{TR}.u$	$W^{LANG}.u$
$W^{GEO}.u$	1			
$W^{INST}.u$	0.1256	1		
$W^{TR}.u$	0.2438	0.0988	1	
$W^{LANG}.u$	0.0576	0.1638	0.1937	1

Subsequent to Le Sage and Pace (2009), the correlation coefficients are formed from the product between each spatial weighting matrix and a standard normal random variable u. The table shows that the correlation between the geographical and trade weighting matrices is the highest (24.38%), while the lowest correlation is between the geographical and linguistic distance weighting matrices (5.76%). Many reasons can be behind the high correlation between geography and trade. Naturally speaking, neighboring countries are more likely to trade with each other as they share borders together, so the smaller the distance between two countries, the larger the trade between them. This correlation is backed up by the previously mentioned literature of Moreno and Trehan (1997), which discovered that trade is the most important factor in achieving economic growth, with a 1 percent increase in the distance-weighted growth rate of the rest of the world causes a 0.8 percent increase in the studied country's growth. This can be seen in this study, as the bordering countries of Armenia, which are Azerbaijan, Georgia, Turkey, and Iran, have the greatest trade (exports and imports), with Georgia, Iran and Turkey among the top 5 out of the 10 trading partners mentioned in the beginning of this paper. However, the low correlation between geography and linguistic distance also makes sense, as languages borrow some words and expressions from other languages despite the geographic proximity of countries. For instance, the Turkish and Arabic languages are closely related to each other; they use similar words such as "Kitap" in Turkish and "Kitab" in Arabic which both mean "Book", "Sabah" meaning "Morning", and "Kahve"/ "Qahwa" meaning "Coffee." Despite the geographical distance between Turkey and the Arab world, they have close languages. The opposite is also true where two countries can be close to each other such as Iran and Iraq, but speak different languages; Iranians speak Persian while in Iraq, the official language is Arabic. Also, the second highest correlation is between the trade and linguistic distance weighting matrices, meaning that countries with similar languages trade more. This can clearly be seen in the case of Armenia and Russia as Armenia was part of Russia during the USSR and until today, the Russian language is taught and spoken abundantly in Armenia; leading to huge amounts of trade between them with more than $1 billion of exports and imports on average during 1995-2019.

B. Control for Heterogeneity

Before starting with the estimated results, it is of utmost importance to control for heterogeneity between variables as heterogeneity can arise easily in spatial analysis due to dissimilarities in characteristics of different spatial units; in this case countries. By isolating the effects of the interested variables in this study, reliable and unbiased results can be generated. To control for unobserved heterogeneity and spatial dependence, and to capture spatial variations, two tools are used in spatial analysis: random effects and fixed effects. Random effects or fixed effects can be used depending on the studied spatial units and the research question. A random effects model shows that the unobserved heterogeneity varies randomly across the units of study, and it controls for these variations. While the fixed effects model assumes that the heterogeneity is constant across all the units, and also controls for them. Mutl and Pfaffermayr (2008) also mention that a spatial fixed effects model is used when targeting the effects of specific spatial units, while a random effects model is preferred when targeting a larger set of units. To know which effect to use in this study, there is a statistical test called the Hausman Test, which, when performed, shows which model, random effects model or fixed effects model must be used in the research. The Hausman Test compares the estimated coefficients of the random effects with those of the fixed effects. The null hypothesis states that the random effects model is the appropriate model to use. If the calculated test statistic is greater than the critical value, then the null hypothesis is rejected and the fixed effects model is preferred. However, when the opposite is true with a test statistic less than the critical value, then the null hypothesis is accepted, meaning that the random effects model is the appropriate model to use. In this paper, the null hypothesis is accepted and the random effects model is used for the SAR and SEM models with the different weighting matrices.

C. Spatial Results

1. Model Selection Criteria

Table 2. Spatial Autoregressive Model (SAR)

	OLS	W^{GEO}	W^{INST}	W^{TR}	W^{LANG}
$lnY_{i,t-5}$	-2.498^{***}	-3.157^{**}	-3.746^{**}	-3.870^{**}	-3.352^{***}
	(-7.80)	(-3.25)	(-2.98)	(-3.06)	(-3.93)
n	0.195	0.326	0.309	0.337	0.296
	(1.49)	(1.09)	(0.93)	(1.04)	(0.97)
gov/gdp	-53.94^{***}	-48.82^{***}	-49.62^{***}	-46.56^{***}	-50.19^{***}
	(-17.61)	(-5.00)	(-5.19)	(-4.10)	(-4.83)
tb/gdp	8.444^{***}	6.849	8.398^{*}	7.716^{*}	7.290^{*}
	(6.58)	(1.93)	(2.32)	(2.23)	(2.22)
inv/gdp	8.521^{**}	12.56	13.25	13.94	13.44
	(2.94)	(1.77)	(1.75)	(1.84)	(1.88)
pol.rights	0.320^{*}	0.384	0.447	0.400	0.412
	(2.16)	(0.76)	(0.75)	(0.66)	(0.85)
ρ	-	0.293^{***}	0.206^{*}	0.290^{**}	0.276^{***}
	-	(3.79)	(1.99)	(2.82)	(3.56)
Observations	275	275	275	275	275
R^2	0.664	0.669	0.659	0.641	0.666
AIC	1454.486	1405.699	1414.521	1407.997	1404.828
BIC	1479.804	1441.876	1450.689	1444.165	1440.996

Notes:

1. Dependent variable is the five-year averages of GDP per capita growth.
2. Let $p = \Pr(\Xi \geq \xi)$ where Ξ denotes the relevant test statistic under the null hypothesis and ξ is its observed value.
3. Standard errors are in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.3.1.a Model Selection Criteria

To start with the model selection criteria, the R^2 and Akaike and Bayesian information criteria (AIC and BIC) will be discussed. The R^2 is a statistical test which explains the extent of the variation of the dependent variable by the independent variables. In the above results, the R^2 ranges from 0.641 to 0.669, meaning that the models explain 64.1% to 66.9% of the variation in the dependent variable, which is the GDP per capita growth. The lowest percentage (64.1%) of variation in GDP per capita growth is through the trade channel and the highest percentage (66.9%) of variation in GDP per capita growth is through the geography channel. This result is supported as studying distance between two countries is more reliable than studying trade between them, in examining economic growth rates (Moreno and Trehan, 1997). The R^2 resulting from the spatial models with the geography and linguistic distance are higher than that resulted by the ordinary least squares (OLS) model, signifying that integrating spatial components better explains the variation of GDP per capita growth than the OLS model. The AIC and BIC are used to test the goodness-of-fit of the model. The models with the lowest AIC and BIC values are considered as the best fitting models. Generally, Table 2 shows that the four spatial models have lower AIC and BIC estimates than those of the OLS model, meaning that spatial models are best fitting to the data, with the lowest values for the model with the linguistic distance weight matrix.

2. OLS Results

Starting off with the OLS results, population growth positively impacts GDP per capita growth, but it is not significant. Armenia, Georgia, Russia and Ukraine were part of the USSR, which were under a centrally planned economy. Following the fall of the USSR, these countries transformed into market-oriented economies and implemented market-oriented reforms and policies. With population growth, greater private sector participation and competition took place in these countries, which led to greater productivity, new investments, job creations and more contribution to GDP per capita growth (Sibe et al., 2016; Aslund, 2002). However, the impact of population growth on GDP per capita growth is not that major, and that can be due to the presence of other countries in the study like Lebanon, Syria, Iran, Iraq where their population growths negatively affected GDP per capita growth (Baysoy and Altug, 2021). The political rights rating index positively impacts GDP per capita growth and is significant at the 5 percent level. This can be explained by the average political rights rating across the 11 countries during 1995-2019, which is a rate of 4.77, closer to 7, with 1 being the best rating and 7 being the worst, therefore explaining the weak significance. The positive relationship between political rights rating and GDP per capita growth is also explained by the fact that some of these economies separated from the USSR's centralized regime, where political rights such as rights to vote, express, and run for office were enhanced, which come hand-in-hand with market-oriented economies, thus promoting GDP per capita growth. Other countries such as Lebanon, Syria, Iran, Iraq and Turkey were also not lucky enough to be characterized by a perfect democratic regime with full human rights. This positive relationship is in fact backed up by several studies like Heo and Tan, 2001; Acemoglu and Robinson, 2000; Gerring et. al, 2005; and Keefer and Knack, 2007. Per capita growth five years prior to each year, government expenditure as a share of GDP, investment as a share of GDP and trade balance as a share of GDP, all have significant impacts on GDP per capita growth. The results show that increasing preceding GDP per capita growths and government consumption spending negatively impact current GDP per capita growths by a score of -2.498 and -53.94 respectively. Behind this result is the conditional convergence hypothesis which states that poor regions tend to grow faster and converge over time with richer regions. The 11 countries of study are developing countries and countries of war and economic change, especially during the timeframe 1995-2019. During these years, the ex-USSR countries and the Arab countries experienced immense growths as discussed previously. Consequently, the conditional convergence hypothesis is accepted as these countries grew a lot in the beginning years and then their growths gradually declined with time, thus explaining the negative value (Baysoy and Altug, 2021). The negative significant coefficient of government spending consumption can be explained by the governments' lack of targeting of projects that contribute greatly to GDP growths or large amounts of spending but inefficiently. This is not surprising as this set of countries have had corrupted governments over time, where based on the Corruption Perceptions Index 2019[15], 7 out of 11 countries have ranked between 91st and 162nd out of 180 countries, with Syria not being ranked as it does not have sufficient data.

It cannot be inferred that the negative coefficient for government consumption spending might be due to the crowding out effect, because the crowding out effect leads to a decrease in private investments. However, Table 2 shows that an increase in investments positively and significantly affect GDP per capita growth by a score of 8.521. This of course is caused by investments in human capital as population growths increase, technological progress and capital accumulation, which all lead to increased efficiencies and productivities, causing growths in GDP per capita in the countries (Schultz, 1961 and Pritchett, 2001). Last but not least, an increase in the trade balances of these countries lead to an increase in GDP per capita

[15] The Corruption Perceptions Index 2019 are gathered from the Transparency International database.

growth. As mentioned above, with the emergence of market-oriented economies, liberalization of trade policies took place and countries opened up to other countries (Ndoma, 2010 and Zahonogo, 2016). Hence, with more trade openness, these countries were able to export and import more. Following that, revenues generated through exports can be used to finance investments, create new jobs and employ more people, as well as opening up to new markets can increase customer bases and sales, improve production and demand, and increase competition. All these components lead to GDP per capita growths (Subasat, 2002 and Hultman, 1967).

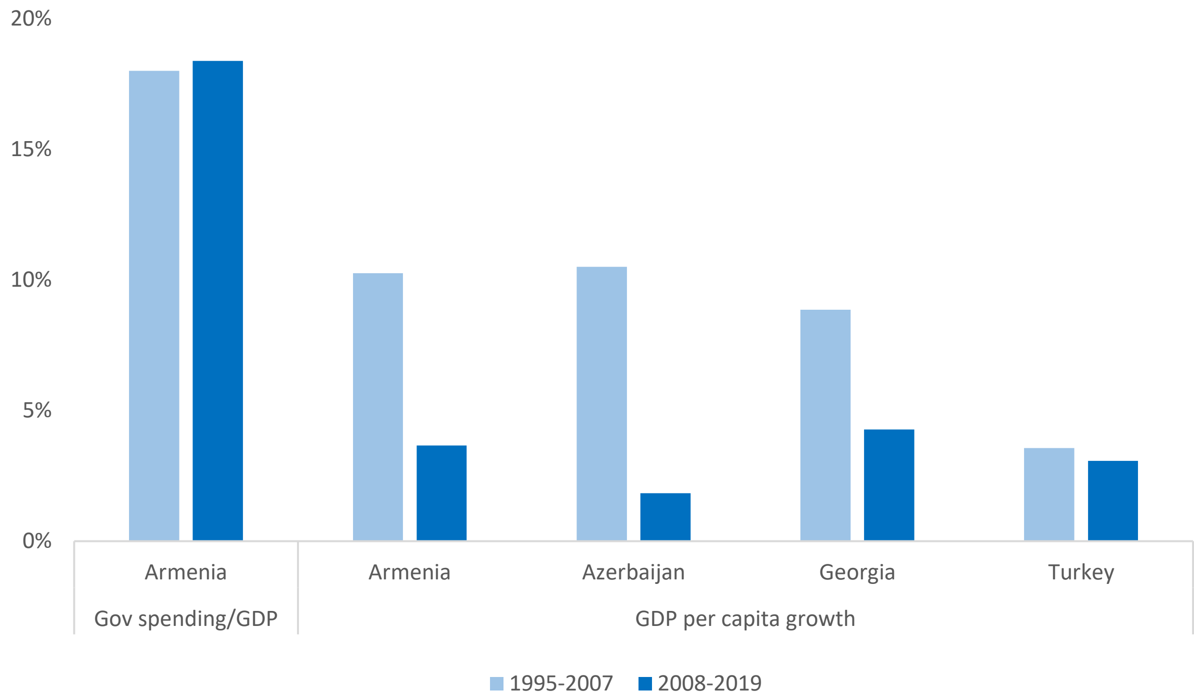
3. SAR Results

This analysis provided a general explanation of the OLS results, however, spatial analysis is to be conducted. The next four columns in Table 2 show the SAR results with the different spatial weighting matrices: geographical, institutional, trade and linguistic distance. The results generated are homogeneous across all the weights. Similar to the OLS, the SAR models show negative and significant results for preceding GDP per capita growths and government consumption spending as a share of GDP. However, trade balance as a share of GDP has weaker significance and investment as a share of GDP positively affects GDP per capita growth but is not significant, as compared to the OLS results. Population growth and the political rights rating index also have a positive influence on the growth rate of GDP per capita, but not significant. What differentiates the SAR model from the basic OLS regression is the spatial autocorrelation coefficient ρ. The spatial autocorrelation coefficient shows the extent to which there is spatial dependence between two countries; how much a country's growth is dependent on its neighboring country's growth. The parameter ρ clarifies that a 1%

increase in neighboring countries' GDP per capita growth rates, increases a country's GDP per capita growth by 29.3%, 20.6%, 29% and 27.6% respectively with the geographical, institutional, trade and linguistic distance weights. The highest dependence as seen is through the geography and trade channels and the lowest dependence is through institutions, which was previously supported during the analysis of the statistical tests by Moreno and Trehan (1997). Overall, there is spatial dependence among the 11 countries; the growth of one country depends on the growth of its neighboring country through the distance between them and the extent of trade taking place due to their geographical locations. This growth is mostly affected by the government consumption spending in a country. For instance, the results infer that if government consumption spending as a share of GDP increases in Armenia, GDP per capita growth will decrease as the Armenian government may be spending inefficiently, halting production. Since Turkey is a neighboring country of Armenia and the second highest trade balance for Armenia among the remaining countries is with Turkey (around $140 million), then a decrease in GDP per capita growth in Armenia will cause a decrease in GDP per capita growth in Turkey as well.

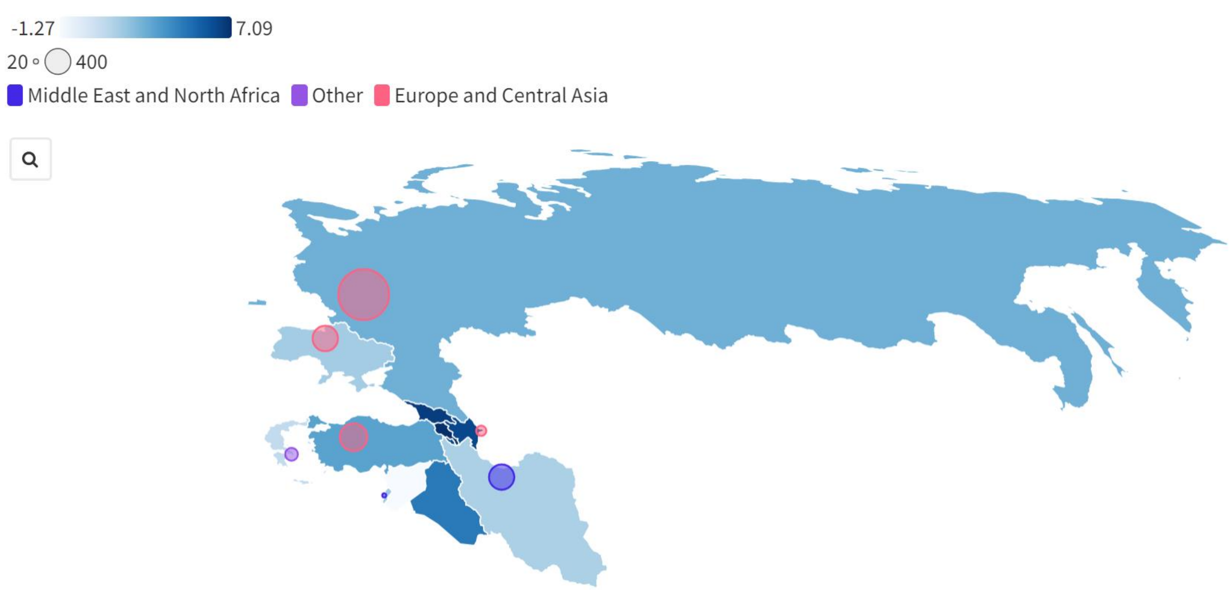
In fact, Figure 1 shows that the above example is correct. As government consumption spending as a share of GDP increases in Armenia from 18% during 1995-2007 to 18.4% during 2008-2019, GDP per capita growth decreases from 10.26% during 1995-2007 to 3.67% during 2008-2019. Based on the SAR results, a decrease in Armenia's GDP per capita growth should lead to a decrease in the GDP per capita growths in Azerbaijan, Georgia and Turkey, since they are neighboring countries. This can be seen in Figure 1 as the GDP per capita growth rates of Azerbaijan, Georgia and Turkey decreased from 1995-2007 to 2008-2019.

Figure 1. Relationship Between Government Consumption Spending and GDP Per Capita Growth



Source: World Bank; Penn World Tables 10.0

Figure 2. Spatial Dependence Through Geography and Trade



Source: World Bank Official Boundaries

Figure 2 shows the GDP per capita growths of all countries of study as well as the trade balances of the 10 countries with Armenia as averages during 1995-2019. The GDP per capita growth is observed as the colors of the countries. The darker the color of a country, the greater the GDP per capita growth during this period and vice versa. The circles show the trade balances of each country with Armenia. The smaller the size of the circle, the less the trade balance of that country with Armenia. As seen in Figure 2, Armenia's GDP per capita during this period is the greatest out of all other countries with a growth rate of 7.09%. As discussed previously and as seen in Figure 1, spatial dependence among countries is the greatest with the geographical weighting matrix, meaning countries close to each other influence each other's growth rates. Therefore, Azerbaijan and Georgia should also have high GDP per capita growth rates, which can be seen in Figure 2 as the colors of these two countries are dark. Turkey also being a neighbor of Armenia, has a lighter color compared to Azerbaijan and Georgia. However, the trade balance between Turkey and Armenia is large ($140 billion), which is also supported by the SAR results, where following geography, countries are spatially dependent on each other through trade.

4. SEM Results

Based on the model selection criteria of Table 3, the R^2 shows that out of the four spatial models, the ones with the trade and linguistic distance weighting matrices best explain the variation in GDP per capita growth with 61.7% each. In general, the percentages are lower than those of the SAR model, even lower than the OLS R^2, meaning the OLS explains the dependent variable best. The AIC and BIC criteria show that the best fitting model is the trade model with the lowest AIC and BIC values, compared to the other spatial models. Moving on to the independent variables, unlike the SAR model, the coefficients shown in Table 3 are generally higher than those in Table 2. The SEM model shows that GDP per capita growths for preceding five years barely has significant results; the only significant result is with the trade weight, only at the 5% level. Government consumption spending and trade balance as a share of GDP almost have the same impact as resulted in the SAR model. However, investment as a share of GDP shows weak significance in most of the spatial models, while it was not significant in the SAR model.

Table 3. Spatial Error Model (SEM)

	OLS	W^{GEO}	W^{INST}	W^{TR}	W^{LANG}
$lnY_{i,t-5}$	-2.498***	-4.564	-4.748	-4.229*	-4.319
	(-7.80)	(-1.60)	(-1.76)	(-2.34)	(-1.86)
n	0.195	0.244	0.323	0.335	0.256
	(1.49)	(0.92)	(0.98)	(1.01)	(0.90)
gov/gdp	-53.94***	-49.57**	-48.79***	-48.21***	-49.49***
	(-17.61)	(-3.23)	(-3.40)	(-3.53)	(-3.45)
tb/gdp	8.444***	7.168	8.421*	8.041*	7.275
	(6.58)	(1.51)	(2.33)	(2.21)	(1.81)
inv/gdp	8.521**	15.06*	14.10	14.63*	14.25*
	(2.94)	(2.17)	(1.95)	(1.99)	(2.24)
pol.rights	0.320*	0.386	0.419	0.314	0.405
	(2.16)	(0.58)	(0.61)	(0.52)	(0.62)
ρ	-	0.369	0.347*	0.305	0.341
	-	(1.71)	(1.96)	(1.79)	(1.79)
Observations	275	275	275	275	275
R^2	0.664	0.597	0.589	0.617	0.617
AIC	1454.486	1420.416	1420.416	1419.014	1420.308
BIC	1479.804	1456.584	1456.584	1455.182	1456.476

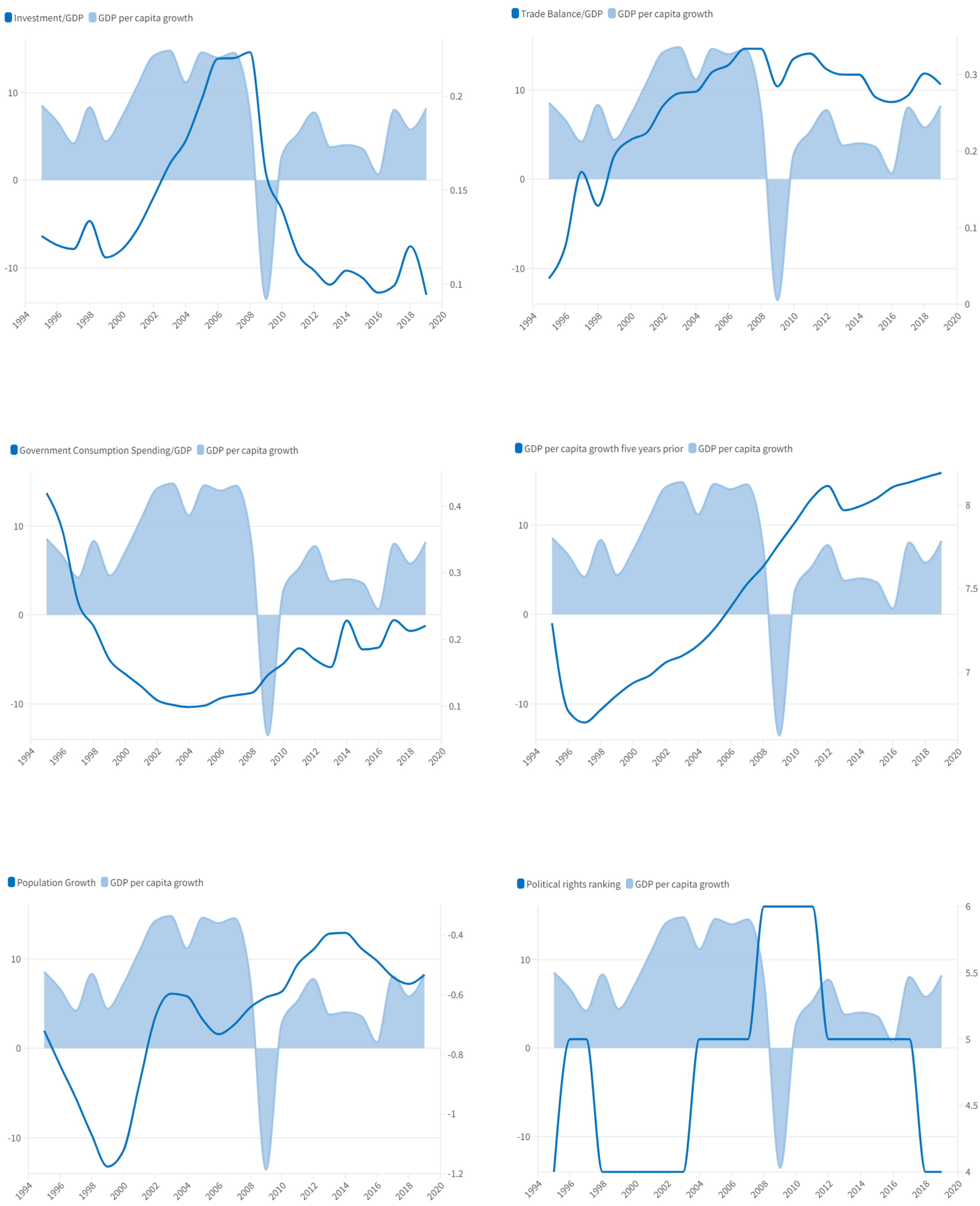
Notes:

1. Dependent variable is the five-year averages of GDP per capita growth.
2. Let p = Pr(Ξ ≥ ξ) where Ξ denotes the relevant test statistic under the null hypothesis and ξ is its observed value.
3. Standard errors are in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Similar to the SAR model, the population growth and political rights ranking variables do not have any significant impacts on GDP per capita growth. The spatial autocorrelation coefficient ρ has a weaker influence in this model than in the SAR. The only significant result is with the institutional weight, where a 1% increase in neighboring countries' GDP per capita growth increases the addressed country's GDP per capita growth by 34.7%. To wind up, the results generated from the SAR model are more significant and show more spatial dependence through the spatial autocorrelation coefficient, than the results of the SEM model. Figure 3 shows the general trend lines of each independent variable and the dependent variable throughout the study's timeframe.

Figure 1. The Trend Lines of the Independent and Dependent Variables (1995-2019)



D. Robustness Checks

In order to check the reliability and robustness of the results, the same spatial models are run again using different effects: time fixed effects and spatial-time fixed effects. The results are shown in Tables 5, 6, 7 and 8 of Appendix B. In general, the results generated from the SAR and SEM models using time fixed and spatial-time fixed effects are homogeneous with the results generated using the random effects models. These checks help ensure that the results are robust and not biased, and the analysis and conclusions drawn from these results are not affected by any particular assumption.

MODEL LIMITATIONS

Despite the many advantages of the SAR and SEM models and their many uses in previous literature, these models also have limitations. The SAR model assumes homogeneity across its spatial units, meaning that the relationship between countries and their neighbors are the same. However, this may not always be true as one country's relationship with its neighbor may differ from another country's relationship with its neighbor. Also, this model is limited to spatial data and the spatial autocorrelation between units. If no spatial data is inputted and the variables of one unit are not correlated with the values of another unit, then the model is not appropriate for analysis (Anselin, 1995; Rupasingha et. al, 2006; Le Sage and Pace, 2009). The SEM model has the same general limitations as any spatial model such as the collected data need to be spatial, a large amount of data is needed, and interpretation of results are complex. In addition, the SEM model assumes that the error terms are homoscedastic, meaning that the error terms have constant variance. While in some cases homoscedasticity is preferred, in other cases, alternatives for the SEM model can be used such as the Spatial Durbin Model (SDM) and the Generalized Two-Stage Least Squares (GS2SLS) model, where heteroscedasticity is preferable (Anselin, 2009 and Saputro et al., 2019).

CONCLUSION

To wrap up, this paper studied the importance of spatial interaction and dependence of countries on each other to pursue economic growth. Two spatial models were conducted, the SAR and SEM models, with the former model analyzing the outcome of its own dependent variable and the latter taking into consideration its independent variables as well. This study included 11 countries which are: Armenia, Azerbaijan, Georgia, Greece, Iran, Iraq, Lebanon, Russia, Syria, Turkey and Ukraine, over a period of 24 years from 1995 to 2019. As the study revolves around Armenia, this timeframe was chosen following Armenia's independence from the USSR and its many distinct relations with the rest of the 10 countries. Four different channels were chosen through which economic growth takes place among countries, which are: geography, institutions, trade and linguistic distance. The results generated from this methodology showed that the highest correlation of the four channels is between geography and trade, while the lowest correlation is between geography and language. The outcomes of the SAR and SEM random effects models convey that government consumption spending as a share of GDP and GDP per capita growth five years prior have the most significant negative effects on GDP per capita growth, with trade balance and investment as a share of GDP having positive weak significance on the dependent variable. In addition, the model showing the most spatial autocorrelation between the host country and its neighboring countries is the one with geographical and trade spatial weighting matrices (SAR), while the SEM model shows that the model including the institutions weighting matrix shows a significant spatial autocorrelation as well. To conclude the results, it can be deduced that Armenia's GDP per capita growth is affected mostly from government consumption spending and GDP per capita growth prior to five years, and through its geographical and trade interactions with its neighboring countries. However, important questions should be asked to further contribute to this study: How will the war between Russia and Ukraine affect these 11 countries? Armenia being in bad terms with Turkey and Azerbaijan these past three years, what will happen to the spatial interaction between them? To what extent are politics and economics interconnected and what are some other spatial channels that highlight the political relation among countries?

APPENDIX A
VARIABLE DESCRIPTION

The dependent and independent variables used for this study as described in Section 3.4 are: *g*, $lnY_{i,t-5}$, *n*, *gov/gdp*, *tb/gdp*, *inv/gdp*, and *pol*.rights. Their mean, standard deviation, minimum and maximum values, as well as the number of observations are represented in the descriptive table below.

Table 4. Descriptive Statistics of Variables

Variable		Mean	Std. dev.	Min	Max	Observations
Country	overall	6	3.166925	1	11	N = 341
	between		3.316625	1	11	n = 11
	within		0	6	6	T = 31
year	overall	16	8.957416	1	31	N = 341
	between		0	16	16	n = 11
	within		8.957416	1	31	T = 31
g	overall	2.199029	6.093138	-24.11893	20.19185	N = 327
	between		2.072542	-.6117545	5.755679	n = 11
	within		5.768911	-23.29356	18.91542	T-bar = 29.7273
Y_t	overall	8.245656	.8192545	6.701751	10.08885	N = 327
	between		.7697495	7.144597	9.811835	n = 11
	within		.3489266	7.186204	8.998171	T-bar = 29.7273
n	overall	.7251263	1.749407	-6.852118	9.97197	N = 341
	between		1.219235	-.8334689	2.910717	n = 11
	within		1.305778	-7.873536	9.270426	T = 31
gov	overall	.2340099	.0941409	.0771954	.713587	N = 319
	between		.0395942	.1716064	.3062654	n = 11
	within		.0862139	.0751478	.7099212	T = 29
tb	overall	.2918256	.178222	1.30e-06	1.381145	N = 319
	between		.1116689	.1630534	.5523982	n = 11
	within		.1427975	.0246492	1.120572	T = 29
inv	overall	.1954037	.0875437	-.0018129	.5214286	N = 319
	between		.0637982	.1087485	.3003825	n = 11
	within		.0628656	.0083461	.5227174	T = 29
pol	overall	4.768328	1.759594	1	7	N = 341
	between		1.679268	1.225806	7	n = 11
	within		.7246016	2.510264	7.090909	T = 31

APPENDIX B
ROBUSTNESS CHECKS

Tables 5, 6, 7 and 8 are robustness checks with different effects. Table 5 shows the SAR model with time fixed effects, Table 6 shows the SAR model with spatial-time fixed effects, Table 7 shows the SEM model with time fixed effects, and Table 8 shows the SEM model with spatial-time fixed effects.

Table 5. Spatial Autoregressive Model (SAR) with time fixed effects.

	W^{GEO}	W^{INST}	W^{TR}	W^{LANG}
$lnY_{i,t-5}$	-2.194**	-2.244**	-2.296**	-2.263**
	(-2.59)	(-2.77)	(-2.61)	(-2.61)
n	0.249	0.213	0.220	0.226
	(0.98)	(0.80)	(0.83)	(0.84)
gov/gdp	-48.66***	-49.55***	-48.75***	-49.62***
	(-8.69)	(-9.50)	(-8.88)	(-8.99)
tb/gdp	7.135*	7.383*	7.432*	7.286*
	(2.24)	(2.34)	(2.30)	(2.36)
inv/gdp	7.332	6.815	7.300	7.289
	(1.09)	(1.10)	(1.10)	(1.10)
pol.rights	0.276	0.290	0.276	0.292
	(0.89)	(0.87)	(0.85)	(0.91)
ρ	0.177	-0.107	0.106	0.123
	(1.00)	(-0.56)	(0.96)	(0.91)
Observations	275	275	275	275
R^2	0.6848	0.6462	0.6722	0.6782
AIC	1414.015	1417.579	1416.752	1415.881
BIC	1442.949	1446.513	1445.686	1444.815

Notes:

1. Dependent variable is the five-year averages of GDP per capita growth.
2. Let $p = Pr(\Xi \geq \xi)$ where Ξ denotes the relevant test statistic under the null hypothesis and ξ is its observed value.
3. Standard errors are in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6. Spatial Autoregressive Model (SAR) with spatial-time fixed effects

	W^{GEO}	W^{INST}	W^{TR}	W^{LANG}
$lnY_{i,t-5}$	-7.292***	-7.416***	-7.335***	-7.261***
	(-4.19)	(-3.92)	(-4.26)	(-4.47)
n	0.472	0.448	0.461	0.446
	(1.54)	(1.37)	(1.45)	(1.43)
gov/gdp	-42.66***	-43.34***	-42.08***	-44.11***
	(-3.62)	(-3.78)	(-3.44)	(-3.74)
tb/gdp	6.259	7.395	7.126	6.602
	(1.67)	(1.90)	(1.81)	(1.91)
inv/gdp	12.30	12.26	13.12	13.20
	(1.59)	(1.56)	(1.59)	(1.63)
pol.rights	0.767	0.896	0.826	0758
	(1.44)	(1.64)	(1.45)	(1.45)
ρ	0.210	-0.0765	0.142	0.217
	(1.57)	(-0.37)	(1.42)	(1.79)
Observations	275	275	275	275
R^2	0.4134	0.3740	0.4041	0.4333
AIC	1313.51	1318.408	1315.693	1311.9
BIC	1342.444	1347.343	1344.627	1340.834

Notes:

1. Dependent variable is the five-year averages of GDP per capita growth.
2. Let p = Pr($\Xi \geq \xi$) where Ξ denotes the relevant test statistic under the null hypothesis and ξ is its observed value.
3. Standard errors are in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7. Spatial Error Model (SEM) with time fixed effects

	W^{GEO}	W^{INST}	W^{TR}	W^{LANG}
$lnY_{i,t-5}$	-2.296**	-2.531**	-2.318*	-2.329*
	(-2.64)	(-3.07)	(-2.55)	(-2.54)
n	0.221	0.227	0.213	0.224
	(0.80)	(0.79)	(0.77)	(0.79)
gov/gdp	-49.84***	-52.77***	-50.22***	-49.86***
	(-9.66)	(-9.03)	(-8.69)	(-9.57)
tb/gdp	7.566*	8.509**	7.588*	7.779*
	(2.39)	(2.81)	(2.33)	(2.13)
inv/gdp	7.049	8.328	6.884	6.900
	(1.10)	(1.39)	(1.09)	(1.05)
pol.rights	0.292	0.343	0.276	0.284
	(0.89)	(0.99)	(0.81)	(0.83)
ρ	-0.0267	-0.713***	-0.0637	-0.0671
	(-0.13)	(-4.62)	(-0.60)	(-0.39)
Observations	275	275	275	275
R^2	0.6640	0.6639	0.6640	0.6640
AIC	1417.851	1402.665	1417.359	1417.624
BIC	1446.785	1431.599	1446.293	1446.558

Notes:

1. Dependent variable is the five-year averages of GDP per capita growth.
2. Let $p = Pr(\Xi \geq \xi)$ where Ξ denotes the relevant test statistic under the null hypothesis and ξ is its observed value.
3. Standard errors are in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Spatial Error Model (SEM) with spatial-time fixed effects

	W^{GEO}	W^{INST}	W^{TR}	W^{LANG}
$lnY_{i,t-5}$	-7.420***	-7.514***	-7.446***	-7.478***
	(-4.15)	(-4.06)	(-4.05)	(-4.05)
n	0.526	0.507	0.451	0.512
	(1.25)	(1.40)	(1.38)	(1.39)
gov/gdp	-43.83***	-44.44***	-43.65***	-44.13***
	(-3.94)	(-3.80)	(-3.68)	(-3.73)
tb/gdp	8.413*	7.605*	7.504	8.423
	(2.11)	(2.12)	(1.88)	(1.86)
inv/gdp	12.31	13.91*	12.36	13.33
	(1.56)	(2.18)	(1.57)	(1.81)
pol.rights	0.973	1.146	0.900	0.960
	(1.78)	(1.85)	(1.54)	(1.75)
ρ	-0.189	-0.595*	-0.0409	-0.202
	(-0.85)	(-2.14)	(-0.26)	(-1.25)
Observations	275	275	275	275
R^2	0.3904	0.3772	0.3856	0.3943
AIC	1317.353	1308.02	1318.596	1317.116
BIC	1346.287	1336.954	1347.53	1346.05

Notes:

1. Dependent variable is the five-year averages of GDP per capita growth.
2. Let p = Pr(Ξ ≥ ξ) where Ξ denotes the relevant test statistic under the null hypothesis and ξ is its observed value.
3. Standard errors are in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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