International Journal of Business and Economic Sciences Applied Research

Volume 14, Issue 3

INTERNATIONAL HELLENIC UNIVERSITY - KAVALA CAMPUS

International Journal of Business and Economic Sciences Applied Research

A: Agios Loukas, P.C. 65404, Kavala, Greece
E: https://ijbesar.ihu.gr

Contents

Editorial Board of IJBESAR

AIM AND SCOPE

The **International Journal of Business and Economic Sciences Applied Research** (IJBESAR) is a blind peer-reviewed, scholarly journal devoted to publishing high-quality papers and sharing original business and economics research worldwide. The Journal considers only manuscripts that have not been published (or submitted simultaneously), at any language, elsewhere. Contributions are in English. The authors retain the copyright of their work without restrictions. The Journal is issued both in electronic form (for free) and in printed form as annual volume (free for the authors). The Journal accepts 9 types of articles defined as follows:

1. **Research Articles**: A research article is a regular article which aims to present new findings.
2. **Letters to the Editor**: A letter to the editor is a short article which aims to present new findings that require fast publication procedures.
3. **Notes**: A note is an article (regular or short) which aims to present rather new findings.
4. **Comments**: A comment is a short article that makes comments on another article already published by this journal or replies to a comment;
5. **Review Articles**: A review article is an article which aims to present comprehensively already existing findings.
6. **Lecture Notes:** A lecture note is a short review article.
7. **Monographs:** A monograph is a thesis of one or more authors on a unique subject; apart from the standard reviewing procedures, a monograph must also be accepted from a committee of specialists appointed by the Editor.
8. **Innovations**: An innovation is an article which aims to present new procedures or devices.
9. **Selected conference articles**: Upon an agreement with a conference committee, selected papers may be published by the Journal in a special section. In this case the editor will appoint in collaboration with the conference committee guest editors.

ETHICAL NOTES

An author is a person who has a substantial contribution to the article; all other contributions should be mentioned as acknowledgements. Authors should cite only the articles which have contributed to their work; unnecessary citations should not be listed. Authors should present their work as objectively as possible. Arguments that discriminate people by race, sex, origin, religion, etc. are not accepted. Bogus results must not be given. Reviewers should not take advantages from the manuscript; instead, they should help the authors to improve their work. Reviewers should not criticize in public the manuscripts. The Editor guarantees the anonymity of the reviewers.

International Journal of
Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

Corruption and Foreign Direct Investment Inflows: Evidence from West Africa

William Bekoe†[1], Talatu Jalloh[2], Wassiuw Abdul Rahaman[1]

[1]Department of Economics, University of Ghana
[2]Post-graduate Student, Department of Economics, University of Ghana

ARTICLE INFO

Article History

Received 20 April 2021;
Accepted 21 September 2021

JEL Classifications
H6, H63, H68

Keywords:
Foreign Direct Investment, Corruption, Corruption Threshold, West Africa, Panel Autoregressive Distributed Lag (ARDL) Model

ABSTRACT

Purpose:
The study investigates the effect of corruption on FDI inflows to West Africa, and also establishes a threshold level of corruption for the sub-region.
Design/Methodology/Approach:
Using secondary data for the period 1999-2018, the study adopted a panel Autoregressive Distributed Lag (ARDL) model to carry out regression analysis. However, to ensure results accuracy and validity, a cross section dependence test, panel unit root test and panel cointegration test was carried out.
Findings:
The results indicated that in the long-run, corruption adversely affects the inflow of FDI to West Africa, thus lending support to the grabbing hand hypothesis. The study found the long-run threshold level of corruption for West Africa to be 6.3, indicating that below this level FDI inflow cannot be discouraged by corruption otherwise, FDI inflows could be discouraged.
Research limitations/Implications:
The findings from the study suggests that governments from West Africa should focus on mechanisms that will strongly discourage people from engaging in corruption, such as reducing the delays in business registration, strengthening and ensuring of effective monitoring of public institutions, as well as introducing the practice of penalty and exhortation in the public sector.
Quality/Value:
The present study contributes to the literature by investigating the effects of corruption on the inflow of FDI to West Africa using a more appropriate macro panel estimation technique, the panel Autoregressive Distributive Lag (ARDL) technique. Furthermore, it provides a threshold level for corruption on FDI inflows in West Africa.

1. Introduction

Foreign Direct Investment (FDI) has over the years become a highly sought-after resource, especially in developing countries, due to its tendency to stimulate growth, provide jobs and transfer technology and skills (Akonnor, 2018;

†Corresponding Author:William Bekoe
Email: wbekoe@ug.edu.gh/ wbekoe80@yahoo.com

DOI: 10.25103/ijbesar.143.01

UNCTAD 2010; Ayanwale, 2007). Statistics from the United Nations Conference on Trade and Development [(UNCTAD) 2019] show a remarkable growth in global FDI inflows over the past decades. A similar experience is observed for Africa and other developing regions. Nevertheless, the African continent lag in terms of the value of FDI inflows it receives in comparison to Asia, Latin America and the Caribbean. Besides that, the data showed that FDI inflow across sub-regions in Africa varies substantially. For instance, between 1999-2018, North Africa attracted an annual FDI inflow of around US$12 billion on average (representing 2.3% of its GDP); West Africa (US$9 billion, being 2.2% of GDP); East Africa (US$8 billion and 3.5% as a share of GDP); Southern Africa (US$5 billion and 1.7% as a share of GDP); and Central Africa (US$4 billion and 3.7% as a share of GDP).

Despite being the second-largest recipient of FDI in Africa, the amount of FDI flow into West Africa has been declining consistently since 2011 (see UNCTAD Stats, 2019). Between 2011 and 2018, for instance, FDI inflows to the sub-region declined by almost by 50%. In 2018 alone, despite the 11% increase in FDI inflows to Africa, the sub-region experienced a whopping 15% decline in FDI inflows-the lowest over the period. The level of FDI inflows to the sub-region also constituted 1.5% of GDP compared to the sub-Saharan African levels of 2.4% of GDP and the World's average of 2.3% over the period 1999 to 2018. The situation is worrisome, more so, when the continent of Africa has been identified as a major recipient of FDI towards the realization of the Africa Continental Free Trade Area Agreement (ACFTAA) (UNCTAD, 2019). Aside from that, the current trend compromises each country's effort to achieve the Sustainable Development Goals (SDGs) and become non-aid reliant.

Moreover, most of the countries in the West African sub-region are highly endowed with natural and mineral resources - a major attraction for FDI inflows (Dunning, 2000; Asiedu, 2006; Anyanwu, 2011). However, equally important in influencing FDI inflows is the level of corruption (Asiedu 2006[2]; Fahad and Ahmed, 2016; Okafor *et al*., 2017; Largarde, 2017), since it can serve as a useful yardstick for assessing the business climate in a country (International Finance Corporation: World Bank Group, 2019). It can starve countries of genuine investors and further inhibit societal progress (Andvig, 2008). Furthermore, it has been suggested that many African countries attract less FDI due to rampant corruption, poor and non-growing economies (UNCTAD, 2001 as cited by Habib and Zurawicki, 2002). Although no country is immune from corruption, the practice, however, is more widespread in Africa (Hanson, 2009), of which West Africa is no exception.

Two strands of arguments exist in the literature regarding the effect of corruption on FDI inflows, namely the Grabbing Hand Hypothesis (see, Mosikari and Eita, 2018; Luu *et al*.,2019 and Kasasbeth *et al*., 2018) and the Helping Hand Hypothesis (see, Omodero, 2019; Gossel,2018; Donaubauer *et al*.,2018 and Hasan *et al*., 2017). Whilst the former argues that corruption deters FDI, the latter contends that corruption encourages FDI inflows. Aside from empirical findings lacking consensus on this debate, empirical studies on the subject area are also biased towards global, regional, national and firm-level studies, against sub-regional level studies (see Quazi et al., 2014, Fahad and Ahmad, 2017; and Epaphra and Massawe, 2017). The need to conduct a sub-regional analysis independently, therefore, becomes paramount especially when sub-regions have diverse cultures with distinct regulatory environment (Anyanwu and Yameogo, 2015). Moreover, it is evident from the literature that studies that employed macro panel data in the subject area (see, Quazi et al., 2014; Fahad and Ahmed, 2016; Gossel, 2018), ignored the possibility of correlation between residuals in different cross-sectional units (see Pesaran, 2004) and slope heterogeneity[3], partly due to the estimation techniques adopted. The consequence is the possibility of compromising on the validity and accuracy of results. More so, there is lack of consensus in the literature on the minimum level/threshold of corruption beyond which FDI inflows into a region could be discouraged.

In view of the above, the present study seeks to fill the literature gaps in the subject area by investigating the effects of corruption on the inflow of FDI to West Africa, by adopting the panel Autoregressive Distributive Lag (ARDL) technique. The study also attempts to establish a minimum level/threshold of corruption beyond which FDI inflows into West Africa could be discouraged. Recommendations from the study would not only serve as useful guide to governments and policymakers, but also for potential foreign investors into the West African sub-region and Africa at large.

The study progress as follows: A review of related studies is presented in Section 3; an overview of corruption and FDI in West Africa in Section 3; Section 4 presents the methodology which consists of theoretical framework, empirical

[2] According to two separate surveys conducted by the World Business Environment (WBE) and the United Nations Conference on Trade and Development (UNCTAD) on thousands of firms in 1999/2000, Asiedu (2006) observed that corruption ranks highest as a constraint to FDI inflows to Africa on each survey.

[3] Standard panel estimation techniques, fixed effect, random effect and General Methods of Moments (GMM), assume slope homogeneity (Eberhardt, 2011).

DOI: 10.25103/ijbesar.143.01

model specification, estimation technique and data sources; Section 5 presents and discusses the results, whilst Section 6 provides the conclusion and recommendations for the study.

2. Literature Review

Over the years, several theories have been propounded in the quest to understanding the activities of FDI. Examples include the Product Life Cycle Theory (Vernon, 1966), the Market Imperfection Theory (Hymer, 1976) and the Internationalization Theory (Buckley and Casson, 1976). Common among these theories is the idea that the willingness of firms to engage in foreign investment is directly or indirectly influenced by the possibility of capitalizing on some form of monopoly advantage. However, the most widely adopted theory for explaining FDI activities is the Eclectic Paradigm, developed and refined by Dunning (1977, 1995, 2000).

Dunning (2000) posits that the extent, geography and industrial composition of FDI undertaken by Multination Enterprises (MNEs) are contingent on the configuration of three sets of advantages: ownership, locational and internalization. Ownership advantage (O), refers to the competitive advantage of the firm seeking to engage in FDI, in terms of production technique and innovative capabilities. Thus, the greater the competitive advantage of the firm investing, relative to domestic firms, the likelier they are to engage in FDI. Locational advantage (L) refers to the attractiveness of alternative countries or regions for FDI, because of the existence favourable investment climate such as: large market size, lower transportation and communication costs, better infrastructure, favourable trade policies towards FDI, fiscal incentives, political stability, quality institutional set-up, macroeconomic stability (Vernon 1966; Dicken and Lloyd, 1977). Internalization advantage (I), provides firms with alternative ways to organize the creation and exploitation of their core competencies, given the locational advantages of different countries or region.

Moreover, corruption is identified as one of the determinants of locational advantage (Habib and Zurawicki, 2002), but the association between corruption and FDI remains unclear and mainly divided along two strands of hypotheses, namely, the Grabbing Hand Hypothesis (GHH) and Helping Hand Hypothesis (HHH). In support of the former, Shleifer and Vishny (1993) argue that corruption acts as an unofficial tax burden, thus more distortionary and costly than tax, due to its illegality and secrecy on an investor. In a country with corruption-induced uncertainty, a firm's profit is likely to be eroded (Wei, 1997). Nonetheless, Bardhan (1997), Lui (1985), Leff (1964) argue in favour of the latter. For example, Bardhan (1997) argue that in a rigid administration with pervasive and cumbersome regulations, corruption can be the necessary grease for the system's squeaking wheels. Also, jurisdictions with weak tax enforcement mechanism, paying bribes might help firms avoid the constraints imposed by an excessive government through taxes (Goodspeed *et al*., 2011).

Empirical evidence on the corruption-FDI nexus is mainly divided between the GHH and HHH. In support of the GHH, Hines (1995) conducting a firm-level study and Habib and Zurawicki (2000) in a global level study found corruption to deter FDI. However, both studies adopted cross-sectional estimation techniques, which ignore the possibility of unobserved time-invariant effects. By using panel data techniques, the study by Asiedu (2006) found corruption to negatively impact FDI inflows. Similar finding was observed in two global studies by Fahad and Ahmed (2016) and Luu *et al*., (2019). The study by Abotsi and Iyavarakul (2015) did not only find corruption to impact negatively on FDI, but further established a threshold level for corruption in Africa, using the quadratic method. The study found the threshold level to be 44.5 on a scale of 0 (most corrupt) to 100 (least corrupt). Below this level, the study suggests that corruption will deter FDI inflows; but otherwise, if it is above that level. Oktay (2017) on the other hand, found high levels of corruption to have an ultimate negative effect on FDI, despite finding an initial positive effect for both former Soviet Union countries, and the Central and Eastern European countries.

Ignoring the immoral and unethical side of corruption, some studies have revealed that corruption can encourage FDI, in line with the helping hand hypothesis. For example, Omodero (2019) and Hasan *et al*., (2017) found corruption to significantly encourage FDI inflows for Nigeria and China respectively. However, the study by Hasan *et al*., (2017) has a strong possibility of suffering from omitted variable bias as the authors failed to include relevant control variables in the estimated model. Also, Gossel (2018) found corruption to be attractive for foreign investors in Africa, due to the weak regulatory framework[4]. Meanwhile, Cuervo-Cazurra (2008) suggested that the helping hand hypothesis is more prevalent in developing countries, where appropriate market institutions are yet to be fully established.

In conclusion, it was evident from the literature review that the relationship between corruption and FDI has no consensus. Also, dearth on sub-regional studies exists, while panel studies ignored the possibility of cross-section dependence and slope heterogeneity (Eberhardt, 2011). Therefore, besides augmenting the few existing sub-regional

[4] However, the study revealed that as democratic capital accumulates, the usefulness of this association might be outlived, and over time, corruption will become a deterring factor in attracting FDI inflows.

DOI: 10.25103/ijbesar.143.01

studies, the study also adopts the panel Autoregressive Distributed Lag (ARDL) model, to remedy the aforementioned methodological challenges.

3. Overview of FDI and Corruption in West Africa

FDI in West Africa

West Africa remains one of the most strategic and influential sub-regions in Africa. Most of the countries in West Africa sit along the Atlantic Ocean, thus, facilitating trade. Also, it plays host to some of the biggest economies in Africa, as well as countries that are highly endowed in minerals and natural resources, such as, Ghana (gold), Nigeria (oil), Niger (uranium), Guinea (Bauxite), and so on (Jalloh, 2013). This makes the sub-region an attractive spot for FDI operations.

However, it is until recently that the sub-region's fame with FDI inflows came into the limelight. (see Figure 1). In the 1970s and 1980s, FDI inflows into the sub-region averaged US$520 million (representing 0.57% of GDP) and US$705 million (0.51% of GDP) respectively. However, by the 1990s, after years of severe economic struggles, countries in the sub-region adopted series of economic reforms in line with recommendations from the Bretton Wood Institutions (Heidhues and Obare, 2011). Since then, FDI inflows to the sub-region has improved significantly (Figure 1). In the 1990s FDI inflows was US$2.1 billion (representing 2% of GDP) on average, accounting for over US$1.4 billion more than the 1970s and 1980s levels. The amount of FDI inflows tripled between 2000-2009 to US$6.5 billion (representing 2.3% of GDP). As evident from Figure 1, however, since 2011, the sub-region has consistently experienced a decline in FDI inflows. Between 2011 and 2018, the value of FDI inflows fell by 50%, while the 2018 value was the lowest for over a decade (UNCTAD, 2019).

However, there is a stark difference among FDI recipients within the sub-region. The top three recipient countries, between 1999 and 2018 on average, are Nigeria with FDI inflows of US$4 billion, Ghana (US$2 billion) and Cote d'Ivoire (US$400 million), while Guinea Bissau accounted for the lowest, US$13 million (UNCTAD statistics, 2019). These countries together account for almost 70% of the FDI inflows into the sub-region, as they constitute the mineral and natural resource-rich countries (see UNCTAD statistics, 2019). For example, in 2018, Ghana's US$2.9 billion FDI inflow was primarily channelled to the natural and mineral resource sector, while Nigeria enjoyed reinvestment earning by major oil companies (UNCTAD, 2019). Nevertheless, FDI inflows as a share of GDP for Liberia accounted for 23.8% of GDP on average from 1999 to 2018, followed by Cape Verde (7.5%), Sierra Leone (6.8%), Niger (5.7%) and Guinea (3.9%).

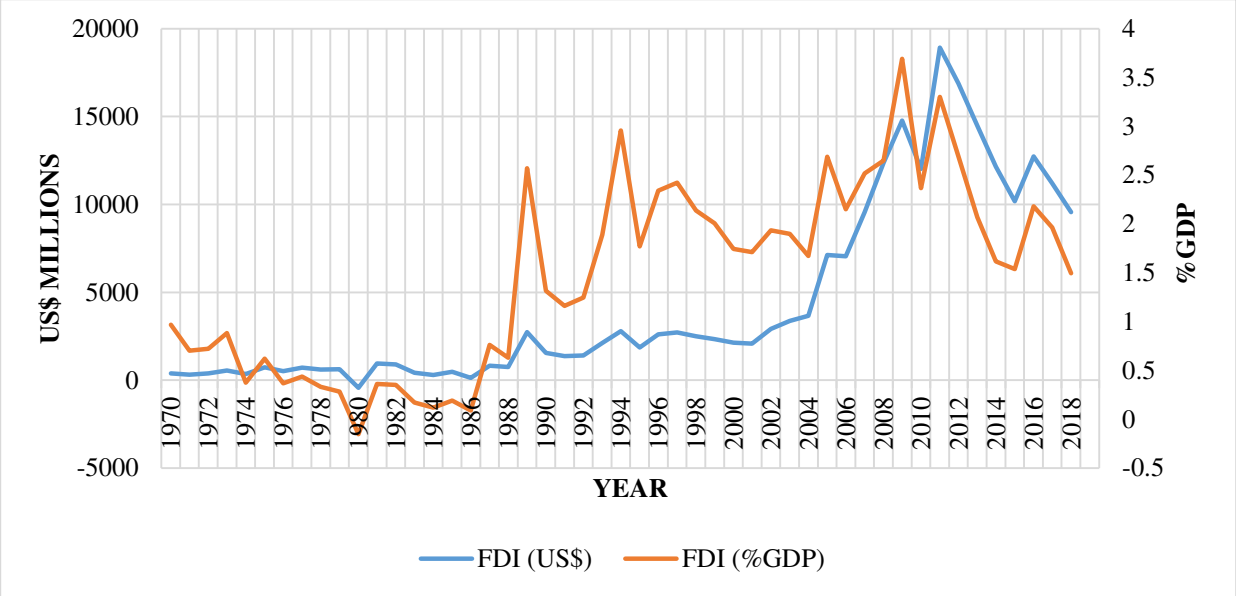


Figure 1: FDI Inflow trends into West Africa in value term and as a percentage of GDP (1970-2018).
Source: Authors' computation using UNCTAD statistics, (2019)

Corruption in West Africa

DOI: 10.25103/ijbesar.143.01

Corruption is one of the major obstacles facing countries, not only because it inhibits a country's ability to attract FDI inflows, but also due to its tendency to undermine and distort public policy, which can lead to resource misallocation (Largarde, 2017. West African countries are no exception to corruption, and in fact, instances of corruption are many and widespread in all forms[5] in majority of the countries (see Global Corruption Report, 2009; Chêne, 2010; Pring and Vrushi, 2019; Rahman, 2019). By employing available corruption data from the World Bank, Transparency International and other sister institutions, Figure 2 shows the average corruption scores amomg West African countries. It evident from the figure that it is only Cape Verde that reported a positive average corruption score of 0.78, making it the least corrupt country in the sub-region. The rest of the countries occupy the negative segment on the number line, indicative of the extent of corruption in the sub-region. Guinea Bissau had the least average corruption score of -1.27, making it the most corrupt country in the sub-region. The average corruption score for the West African sub-region of -0.62 for the period 2000-2018, performs poorly compared with South Africa's score of -0.25, Eastern Africa's average score of -0.53 and the North African average score of (-0.56).

In recent times, however, efforts to combat this menace have been stepped up by several countries. For instance, West African countries are party to the African Union Convention on Preventing and Combating Corruption (AUCPCC), as well as the United Nations Convention Against Corruption (UNCAC). Furthermore, most countries in the sub-region have established Anti-Corruption Agencies; Auditor General Offices; enacted public procurement acts; and created more space for civil society organizations, the media and opposition parties to participate in the governance process of respective countries (Lee-Jones, 2019; Shipley, 2018a and 2018b; Global Corruption Report, 2009; Chêne, 2010).

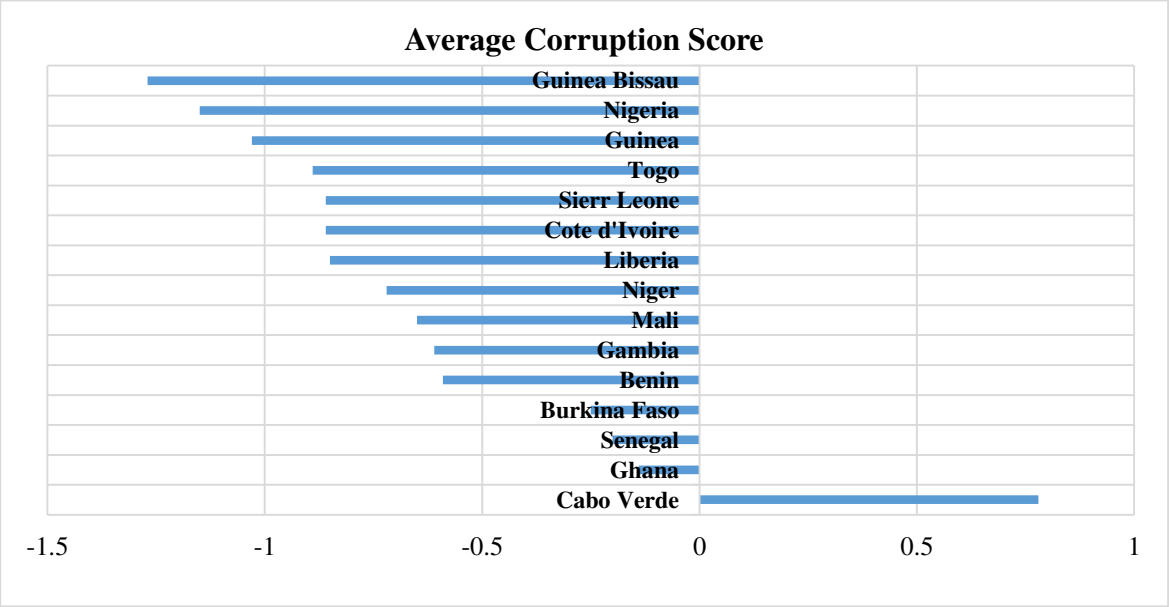


Figure 2: West African Countries Average Corruption Score (2000-2018)
Note: Values are shown on a scale of −2.5 (most corrupt)to + 2.5 (least corrupt).
Source: Authors' computation using data from the World Bank's World Governance Indicator (2019).

4. Methodology

Theoretical Framework

An extended version of a model developed by Kaufman and Wei (2000) is used as the underpinning theoretical framework for the paper. In the original framework, the existence of regulatory burdens or red-tape such as tax or delay in getting permits or licenses experienced by a foreign investment firm might be lowered by paying bribes. In the study, Kaufman and Wei (2000) developed a simple Stackelberg model between a corrupt public official and a firm. Kaufman and Wei (2000) presented the problem faced by the firm in the equation below;

[5] Petty, bureaucratic, grand and political corruption

DOI: 10.25103/ijbesar.143.01

$$e_i = h_i - s(b_i) \quad (1)$$

Where: e_i is the effective harassment[6]; is nominal harassment[7]; b_i is the amount of bribe paid by the firm, and $s(b_i)$ is a function that describes how the payment of bribe help to reduce effective harassment. The function is assumed to be twice differentiable and concave $(s_b > 0 \; and \; s_{bb} < 0)$. If the nominal harassment, h_i, is held constant, then the linear relationship between bribery and effective harassment is negative. The implication is that the more the bribe paid by the firm the lower the effective red tape, even though paying bribes has a decreasing return function.

For simplicity, it is assumed that the pre-bribe profit[8], π_i, is known. Hence, the objective of the firm now is to maximize after-bribe profit, π_i^*, given as:

$$\pi_i^* = w(e_i)\pi_i - b_i \quad (2)$$

Where: w is a function of effective harassment and a product of pre-bribe profit. And to maximize the after-bribe profit, we take the first-order condition (FOC):

FOC[9] $(\frac{\partial \pi_i^*}{\partial b_i})$: $$-w_e(h_i, b_i)s_b(b_i)\pi_i = 1 \quad (3)$$

The first-order condition result shows an implicit function that relates to the optimal level of bribe firm i would pay and the nominal harassment rate. But for the maximization condition to be satisfied, the second-derivative must be negative, and this was determined (see Appendix 1).

Totally differentiating the first-order condition, equation (3), yields the optimal bribery schedule, $b_i = B(h_i)$:

$$-\left\{\frac{\partial w_e}{\partial e_i} \cdot \frac{\partial e_i}{\partial b_i} s_b \pi_i db + \frac{\partial w_e}{\partial e_i} \cdot \frac{\partial e_i}{\partial h_i} s_b \pi_i dh + w_e s_{bb} \pi_i db\right\} = 0 \quad (4)$$

$$(w_{ee}s_b^2 + w_e s_{bb})db - w_{ee}s_b dh = 0 \quad (5)$$

From (4), we can solve for $\frac{db}{dh}$;

$$\frac{db}{dh} = \frac{w_{ee}s_b}{w_{ee}s_b^2 - w_e s_{bb}} > 0 \quad (6)$$

From (6), the bribery schedule is upward sloping implying that the higher the nominal harassment the more bribe the firm find optimal to give. This is very likely from the firm's perspective because the more the harassment, the more the firm would pay. Similarly, from the public official's perspective, if he wants more bribe, he would harass more.

Without loss of context, an extension to Kaufman and Wei (2000) model is made to incorporate FDI. Similar to Ardiyanto (2012), FDI can be introduced as a function of after-bribe profit, π_i^*;

$$FDI_i = f\{\pi_i^*(b_i)\} \quad (7)$$

The relationship between FDI and corruption (measured by bribes) can be deduced by chain rule as follows:

$$\frac{\partial FDI_i}{\partial b_i} = \frac{\partial FDI_i}{\partial \pi_i^*} \cdot \frac{\partial \pi_i^*}{\partial b_i} \quad (8)$$

From equation (8), analysis of the effect of corruption on FDI, from the viewpoint of the GHH and HHH, can be done. For the GHH, $\frac{\partial \pi_i^*}{\partial b_i} < 0$, because bribes are expected to decrease after-bribe profit. Whereas $\frac{\partial FDI_i}{\partial \pi_i^*} > 0$, since the

[6] Defined as the red-tape faced by the firm after paying the bribe.

[7] Defined as the harassment imposed by the public official on the firm before any bribe is paid. It can be, for example, the number of days it takes a firm to get a permit.

[8] The profit that the firm would have attained without any harassment.

[9] See Appendix 1 for derivation.

DOI: 10.25103/ijbesar.143.01

motivation for FDI is positively correlated with after-bribe profit for the firm. Hence, the overall effect would be the case where FDI is discouraged by corruption, $\frac{\partial FDI_i}{\partial b_i} < 0$. Conclusively, a country with high-level corruption attracts less FDI.

For the case of the HHH, the analysis start with the pre-bribe profit (π_i) which is the difference between a firm's revenue and cost. In line with the calculation of economics profit, cost is not only considered in its explicit form, but also in its implicit form, like the time it takes a firm to get a permit. Putting it into perspective, imagine a firm that has a container to clear for its production in a corrupt country. The clearance process at customs can take weeks for firms, and the longer the time, the higher the cost incurred by the firm due to storage cost at the port. But beyond that, if the firm's production hinges on the inputs in the container stuck at the port, then the firm would be technically losing revenue. In this case, corruption in the form of bribery can be a useful instrument that can substitute for a weak regulatory environment. Thus, $\frac{\partial \pi_i^*}{\partial b_i} > 0$, because corruption in the form of bribery will have a beneficial effect on after-bribe profit, and $\frac{\partial FDI_i}{\partial \pi_i^*} > 0$ since the desire to engage in FDI is positively correlated with after-bribe profit. The total effect, in the end, will be $\frac{\partial FDI_i}{\partial b_i} > 0$, implying that the higher the level of corruption in a country, the more the FDI it attracts.

Empirical Model Specification

Following the extended theoretical framework, and in line with the OLI framework the empirical model is constructed in a linear form as;

$$FDI_{it} = \gamma_0 + \gamma_1 CORR_{it} + \gamma_2 GDPPC_{it} + \gamma_3 INF_{it} + \gamma_4 NR_{it} + \gamma_5 TOP_{it} + \gamma_6 PI_{it} + \varepsilon_{it} \quad (9)$$

where: FDI is Foreign Direct Investment Inflows, CORR is Corruption, GDPPC is Gross Domestic Product Per Capita, INF is Inflation, NR is Natural Resources, TOP is Trade Openness and PI is Political Instability. γ_0, γ_i *and* ε_{it} denote the intercept, parameters to be estimated and the disturbance term respectively. The variables employed conforms to the OLI framework that argues the movement of FDI is mainly influenced by a combination of factors including the market, political, policy and institutional factors. All the variables are expressed in levels except FDI, GDPPC and INF which are expressed in natural logs.

For this study, Net Foreign Direct Investment inflow per capita was used as a proxy measure for FDI. Corruption (CORR) is measured using the control of corruption variable from the World Governance Indicators (WGI), with a scale of -2.5 (most corrupt) to 2.5 (least corrupt). However, for ease of interpretation and in line with Luu *et al.* (2019), the values were rescaled using the formula: $CORR = (2.5 - COC^*) \times 2$, where: CORR is the value created for the new scale and COC^* is the control of corruption value on the original scale. The new scale runs from 0 (least corrupt) to 10 (most corrupt). Generally, corruption inhibits FDI inflows because of the additional cost it creates for investors (Cuervo-Cazurra, 2008)and therefore expected to be negatively signed.

Gross domestic product per capita (GDPPC) is used as a proxy measurement for market size. A large market size provides multinational corporations (MNCs) an opportunity for more revenue generation, profit maximization and the realization of economies of scale (Tsikata, 2005). Hence, the larger the market size, the more the inflow of FDI. Thus, this variable is expected to carry a positive sign.

Trade Openness (TOP), defined as the sum of import and export as a percentage of GDP, measures how open a country's economy is to the rest of the world (Luu *et al.*, 2019). The more open a country's economy, the likelier it is to adopt favourable economic policies that can be appealing and safer for foreign investors (Quazi *et al.*, 2014). Hence, its sign is expected to be positive.

A country's natural resource is a major factor that influences natural resource-seeking FDI (Dunning, 2000; Asiedu, 2006; Anyanwu, 2011). Therefore, the availability of natural resources can be a good conduit for attracting FDI. Total Natural Resource Rent as a percentage of GDP was used as a proxy measure for a country's Natural Resource (NR) endowment, and it is expected to carry a positive sign.

Inflation (INF), defined as the consumer price index, is used as macroeconomic stability measure (Asiedu, 2006). High levels of inflation rate affect society negatively by eroding the purchasing power of consumers, leading to a fall in demand for goods and services and subsequently the profits of businesses (Sayek, 2009). Foreign investors would desist from investing in such countries, INF is thus expected to be negatively signed.

DOI: 10.25103/ijbesar.143.01

The World Governance Indicator's (WGI) political stability and absence of violence or terrorism scale is used to measure Political Instability (PI). Like the corruption variable, PI is also rescaled using the same formula[10]. When the occurrence is frequent, PI tends to intensify concerns over the safety of investors' assets (Tsikata, 2005), such that investors will find such locations unattractive for FDI inflows. Therefore, it is expected that the sign of PI is negative.

Estimation Techniques

To account for slope heterogeneity and cross-sectional dependence, the study employed the Panel Autoregressive Distributive Lag (ARDL) Model. This technique performs better in a macro panel study (Smith and Feurtes, 2016; Chen, 2018). Unlike the panel ARDL model, standard panel estimators tends to ignore some of the potential issues that come along with large T panels namely: heterogeneity of slope, non-stationarity and Cross-Section Dependence (CSD) because they assume slope homogeneity among cross-section units (Eberhardt, 2011). As such, standard panel estimators might not be idle in similar studies. It is in this spirit that, the panel ARDL model is adopted for this study. The model is a dynamic heterogeneous model developed by Pesaran *et al*., (1999). It has the advantage of allowing for variables to be differenced and lagged at the same time, which helps to mitigate and eliminate any simultaneity bias and endogeneity problem respectively (Clemens *et al*., 2012). As such, equation (9) is represented in a panel ARDL form as;

$$FDI_{it} = \eta_i + \sum_{l=1}^{p} \delta_{il} FDI_{i,t-l} + \sum_{l=0}^{q} \lambda_{1l} CORR_{i,t-l} + \sum_{l=0}^{q} \lambda_{2l} GDPPC_{i,t-l} + \sum_{l=0}^{q} \lambda_{3l} INF_{i,t-l} + \sum_{l=0}^{q} \lambda_{4l} NR_{i,t-l} + \sum_{l=0}^{q} \lambda_{5l} TOP_{i,t-l} + \sum_{l=0}^{q} \lambda_{6l} PI_{i,t-l} + \nu_{it} \quad (10)$$

Where: p and q are lags of the dependent variable and independent variable respectively; δ_{il}, the coefficient of the lagged dependent variable, are scalars; λ_{il} are $k \times 1$ coefficient vectors; η_i is the specific cross-section unit effect (in our case country); and ν_{it} is the random error term assumed to be independently distributed with mean 0, variances $\sigma_i^2 > 0$ and finite fourth-order moment.

To establish the equation that reflects the error correction term which highlights the speed of adjustment term and long-run relation in a linear form, equation (10) is re-parameterize to become;

$$\Delta FDI_{it} = \eta_i + \theta_i\left(FDI_{i,t-1} - \gamma_0 - \gamma_1 CORR_{it} - \gamma_2 GDPPC_{it} - \gamma_3 INF_{it} - \gamma_4 NR_{it} - \gamma_5 TOP_{it} - \gamma_6 PI_{it}\right) + \sum_{l=1}^{p} \delta'_{il} \Delta FDI_{i,t-l} + \sum_{l=0}^{q} \lambda'_{2l} \Delta CORR_{i,t-l} + \sum_{l=0}^{q} \lambda'_{2l} \Delta GDPPC_{i,t-l} + \sum_{l=0}^{q} \lambda'_{3l} \Delta INF_{i,t-l} + \sum_{l=0}^{q} \lambda'_{4l} \Delta NR_{i,t-l} + \sum_{l=0}^{q} \lambda'_{5l} TOP_{i,t-l} + \sum_{l=0}^{q} \lambda'_{6l} \Delta PI_{i,t-l} + \upsilon_{it} \quad (11)$$

To establish the threshold of corruption, equation (11) is expressed in a non-linear form as;

[10] $PI = (2.5 - PS^*) \times 2$, where: PI is political instability and $PS^*$is the political stability and absence of violence variable. it is rescaled from -2.5 (least stable) to 2.5 (most stable), to 0 (most stable) to 10 (least stable). Therefore, the closer a value is to 0, the less politically unstable a country is and vice-versa.

DOI: 10.25103/ijbesar.143.01

$$\Delta FDI_{it} = \eta_i + \theta_i\left(FDI_{i,t-1} - \gamma_0 - \gamma_1 CORR_{it} - \gamma_2 CORR_{it}^2 - \gamma_3 GDPPC_{it} - \gamma_4 INF_{it} - \gamma_5 NR_{it} - \gamma_6 TOP_{it} - \gamma_7 PI_{it}\right) + \sum_{l=1}^{p} \delta_{il}' \Delta FDI_{i,t-l} + \sum_{l=0}^{q} \lambda_{2l}' \Delta CORR_{i,t-l} + \sum_{l=0}^{q} \lambda_{2i}' \Delta CORR_{i,t-l}^2 \sum_{l=0}^{q} \lambda_{3l}' \Delta GDPPC_{i,t-l} + \sum_{l=0}^{q} \lambda_{4l}' \Delta INF_{i,t-l} + \sum_{l=0}^{q} \lambda_{5l}' \Delta NR_{i,t-l} + \sum_{l=0}^{q} \lambda_{6l}' TOP_{i,t-l} + \sum_{l=0}^{q} \lambda_{7l}' \Delta PI_{i,t-l} + \upsilon_{it} \quad (12)$$

Where: $\theta_i = -\left(1 - \sum_{l=1}^{p} \delta_{il}\right)$, measures the reaction level of the system to any shock, referred to as the speed of adjustment. It is expected to be negative (below negative 2) and statistically significant. $\gamma_{i,for\ i=1,2,\ldots,7}$, the vector of long-run coefficients; and the terms in the bracket reflects the regression for the long-run relationship between the dependent variable and independent variables. Equation (12) is used to determine the threshold level for corruption. In line with Abotsi and Iyavarakul (2015) and Oktay (2017), the study expects $\gamma_1 > 0 \; and \; \gamma_2 < 0$, and must be statistically significant. Implying that corruption at some initial level has a positive influence on FDI but afterwards, doubling or increase in the level of corruption will change the influence to negative[11].

The re-parameterized panel ARDL model is used to estimate both the Mean Group (MG) estimator and the Pooled Mean Group (PMG) estimator, for which the Hausman (1978) test is applied to decide on the appropriate estimator. Both estimators are likelihood ratio tests which are appropriate for heterogeneous panel studies in which T is greater than N (Smith and Fuertes, 2016).

The MG estimator as developed by Pesaran and Smith (1995) involves estimating separate regressions for each group and averaging the slopes over groups. This approach allows for coefficients to differ across countries for both the short-run and long-run, thus imposing no restrictions on the coefficients. The test performs better with large N and large T panels, but it's unlikely to be a good estimator when T or N is small (Pesaran *et al*., 1999). Alternatively, the PMG estimator, proposed by Pesaran *et al*., (1999), involves both pooling and averaging. The PMG estimator has the advantage of being applied to models in which variables are integrated of different orders. However, the PMG will be inefficient if slope heterogeneity holds in the long run. Nevertheless, PMG is quite appealing when studying small sets of similar countries (Onuoha *et al*., 2018).

Data

The study utilized an unbalanced panel data for 15 countries in West Africa over the period 1999-2018. Data for the study were sourced from the World Bank online database (2019) -World Development Indicators (WDI, 2019) and World Governance Indicators (WGI, 2019), and the United Nations Conference on Trade and Development (UNCTAD) online data (2019).

5. Results

To appreciate the preliminary relationship between corruption and FDI, a scatter plot of the average values of each country on FDI per capita and corruption was conducted (Figure 5.1). In general, the plot shows an inverse relationship between corruption and FDI per capita. For example, Cape Verde recorded the least average corruption score (around 3.5) and receives the highest average FDI per capita. Conversely, Guinea Bissau registered the highest corruption score and received the lowest average per capita FDI. Overall, most of the countries that recorded low FDI per capita on average score high on the corruption scale on average.

[11] Thus, exhibiting decreasing returns for FDI inflows.

DOI: 10.25103/ijbesar.143.01

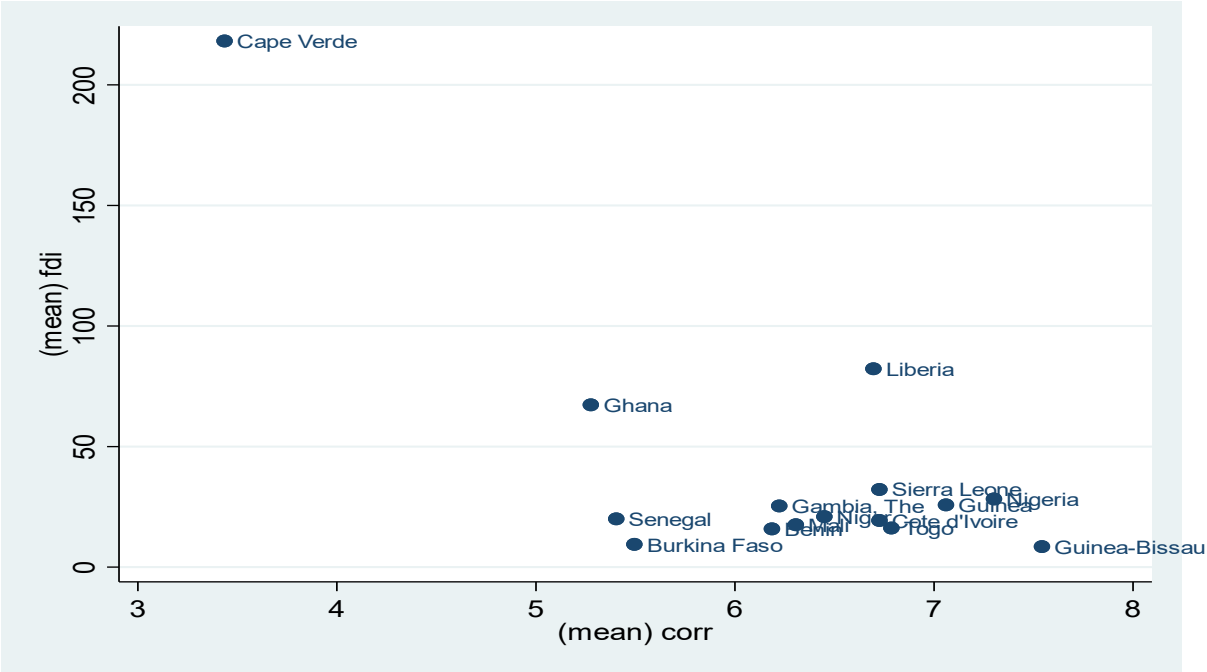


Figure 3. 1: Average FDI per capita (unlogged) and average corruption (1999-2018)
Source: Stata 15 output

Cross Section Dependence (CSD) Test

The Pesaran (2004) CSD test was used in the study. Unlike other tests[12], it can be applied on pre (or post)-estimation[13], and has the advantage of being applied to a variety of panel models (Baltagi, 2005). It is based on the average pair-wise correlation coefficients of the Ordinary Least Squares (OLS) residuals from individual regressions in the panel and is robust to structural breaks in the slope coefficients and (or) error variances with the correct size for small samples and satisfactory power (Pesaran, 2004).

Nonetheless, for this paper, the post-estimation[14] test was conducted, since tests to validate the reliability of a regression result is conducted on the residuals (Anderson *et al.*, 2020). Results from Table 5.2 show that there is no presence of CSD in both models, Model 1 (Linear model) and Model 2 (Non-linear model).

Table 1. Pesaran (2004) Cross-Section Dependence test on the residuals Results

	Model 1	**Model 2**
Cross-section dependence test	0.636	0.625
	(0.525)	(0.532)

Note: values in parenthesis represent P-Value and values, not in parenthesis represents test value. Also, no asterisks imply no significance. H_0: Cross-section independence.
Source: Authors' computation using output from Stata

The Panel Unit Root test

The Im-Peasran-Shin (2003) panel unit root test was adopted based on the outcome of the CSD test. The test, unlike the others[15], have the advantage of being applied to an unbalanced panel. The test is based on the average of individual

[12] Breusch and Pagan (1980) Langrage Multiplier test and Pesaran et al. (2008) Langrange Multiplier adjusted tests.
[13] The pre-estimation is done on the series while the post-estimation is done on the residuals.
[14] It was conducted at the back of the fixed-effect model estimation.

DOI: 10.25103/ijbesar.143.01

unit root statistics and can be adopted in dynamic heterogeneous panels. The test allows for serial correlation in residuals and heterogeneity dynamics and error variances across groups (Barbieri, 2006).

Table 2. Im-Pesaran-Shin (2003) Panel Unit Root Test Results

Variable	Demean Without trend	Demean With trend
LOGFDI	I(0)	I(0)
CORR	I(0)	I(1)
LOGGDPPC	I(0)	I(1)
LOGINF	I(1)	I(1)
NR	I(0)	I(0)
TOP	I(1)	I(1)
PI	I(0)	I(0)
CORRSQ	I(0)	I(1)

Note: Demean was used because it helps to mitigate the problem of cross-sectional dependence (Levin and Lu, 1992).
Source**:** Authors' computation using output from Stata.

The results, as presented in Table 5.3, shows that the variables were stationary with and without trend, albeit some at level and others after first differencing. The variables LOGFDI, NR and PI were stationary at level with and without trend, while TOP and LOGINF were stationary after first difference in both cases, leaving CORR and LOGGDPPC with mixed results for the case of trend and no trend.

The Panel Cointegration Test Results

The Pedroni (1999, 2004) cointegration test was utilized for this study since it is the only cointegration test[16] that can be used for unbalanced panels. The test is a residual-based test designed for the heterogeneous panel. Pedroni (1999, 2004) proposed seven residual-based test statistic, of which, four are based on pooling along the within dimension, while the other three are pooled along the between dimension. The test was conducted to check for a long-run relationship, and it was tested on the null hypothesis of no cointegration. The simple decision rule is that at least four of the seven residual-based test statistic must be significant to reject the null. Table 5.4 present the results for the cointegration test. From the results, the study rejects the null of no cointegration for both models.

Table 3. Pedroni's (1999, 2004) Cointegration Test Results

	Model 1	Model 2
Panel:		
V	-4.86***(0.000)	-5.53***(0.000)
Rho	3.56***(0.000)	4.26***(0.000)

[15] Like Levin and Lin (1992), Maddala and Wu (1999), Hadri (2000), etc (see Barbieri, 2005; Baltagi, 2005; Eberhardt, 2011).
[16] Others include, Westerlund (2007), Kao (1999), Gengenbach, Urbain and Westerlund (2009) and McCoskey and Kao (1998).

DOI: 10.25103/ijbesar.143.01

T	-3.59***(0.000)	-2.37***(0.009)
ADF	-4.14***(0.000)	-2.64***(0.004)
Group:		
Rho	5.14*** (0.000)	5.89***(0.000)
T	-4.57***(0.000)	-4.21***(0.000)
ADF	-4.10***(0.000)	-3.13***(0.001)

Note: ADF is Augmented Dickey-Fuller t-statistics; t is Phillip and Perron t-statistics; rho is the modified Phillip and Perron t-statistics, and v is the modified variance ratio statistics. The Null hypothesis is no cointegration, while the alternative is that all panels are cointegrated. The asterisks, ***, ** and *, represents the level of significance at the 1%, 5% and 10% respectively. Values in parenthesis are p-values.
Source: Authors' computation using Stata 15 output**.**

Pooled Mean Group (PMG) Results

Based on the Hausman (1978) test result, the PMG was deemed appropriate for our analysis. Table 5.5 present the long and short-run panel estimate results for the linear and non-linear model represented by Model 1 and Model 2 respectively. The results from Table 5.5 revealed that the adjustment terms (ECT) in both models were highly significant with the expected sign and within an acceptable region. The results suggest that any short-run disequilibrium in the model can be corrected at the 57 and 60% adjustment speed annually for Model 1 and Model 2 respectively. These results further support the existence of a long-run relationship in both models. All the long-run variables were significant under Model 1 except Trade Openness (TOP) and Political Instability (PI), while for Model 2, only TOP was insignificant. Furthermore, all the significant variables carried their expected signs. However, except the intercept and ECT, no variable was significant for the short-run panel estimates. The discussion of the Models proceed as follows:

Model 1

The results under Model 1 investigates the effect of corruption on FDI inflows to West Africa. The result from the model revealed that ceteris paribus, a one-point increase in the level of corruption (CORR) can reduce per capita FDI inflows to West Africa by 15 percentage point, implying that corruption discourages the movement of FDI into the sub-region in the long-run. The finding is in line with the GHH, consistent with the study's expectations, and corroborate the findings of Fahad and Ahmad (2016) and Luu *et al.* (2019). Therefore, in general, locations with a high level of corruption increases the risks and uncertainty associated with investment – a dislikeable feature for any foreign investor – due to its illegality and secrecy (Shleifer and Vishny, 1993). As a result, foreign investors might desist from investing in such locations, because corruption acts as an additional unofficial tax burden that increases the cost of doing business.

The results also showed that ceteris paribus, a 1 percentage point increase in Gross Domestic Product Per Capita (GDPPC) can raise the inflow of FDI per capita to West Africa by 0.91 percentage point in the long-run. The finding is in agreement with the theory of market-seeking FDI or horizontal FDI and is in line with findings from Quazi *et al.* (2014). Generally, the GDPPC is used to reflect the purchasing power of the average consumers, thus, foreign investors looking to expand their market find such locations appealing.

Also, it was observed from the result that a 1 percentage point increase in the level of inflation (INF) can lead to a reduction in the inflow of FDI per capita to West Africa by 0.67 percentage points in the long-run, all else constant. The result implies that the higher the level of inflation the lower the inflow of FDI. Thus, investing in a country with less degree of market uncertainty is preferable to foreign investors because it tends to be more stable economically and provide lower risk for investment. The findings support previous studies by Asiedu (2013), Abotsi and Iyavarakul (2015), and Gossel (2018).

DOI: 10.25103/ijbesar.143.01

Aside from that, the result also showed Natural Resources (NR) to attract FDI inflows to West Africa. The result shows that a 1 percentage point increase in NR can raise the inflow of FDI per capita to West Africa by 0.02 percentage point, ceteris paribus, in the long-run. The finding is consistent with the theory of natural resource-seeking FDI. Therefore, natural resources, especially oil, can attract FDI inflows (Anyanwu and Yameogo, 2015). As such, the higher the abundance in natural resources, the more likely is the inflow of FDI holding all else equal. However, Trade Openness (TOP) and Political Instability (PI) were found to be insignificant in the long-run. Furthermore, no variable was significant for the short-run panel estimates.

Table 4. PMG Estimation Results

	Model 1	**Model 2**
	LONG-RUN	
CORR	-0.154*** (0.026)	1.413*** (0.285)
LOGGDPPC	0.909*** (0.112)	0.803*** (0.125)
LOGINF	-0.665*** (0.088)	-0.612*** (0.093)
NR	0.0184*** (0.002)	0.014*** (0.002)
TOP	-0.0002 (0.001)	-0.0001 (0.0004)
PI	-0.017 (0.017)	-0.060*** (0.013)
CORRSQ		-0.112*** (0.021)
	SHORT RUN	
ECT	-0.572***(0.111)	-0.595***(0.190)
D.CORR	0.062 (0.103)	0.21 (1.639)
D.LOGGDPPC	0.344 (0.534)	0.644 (0.673)
D.LOGINF	0.791 (1.607)	0.334 (1.541)
D.NR	-0.039 (0.044)	-0.033 (0.022)
D.TOP	0.006 (0.005)	0.010 (0.007)
D.PI	-0.046 (0.043)	-0.056 (0.044)
D.CORRSQ		-0.0561 (0.044)
Cons	0.705***(0.178)	-2.147**(0.700)
N	225	225
Log Likelihood	265.042	285.058

Standard errors in parenthesis. *p < 0.1, ** p < 0.05, *** p < 0.01
Note: The lag-structure of the models was ARDL (1, 0, 0, …, 0).
Source: Authors' computation using STATA 15 output

DOI: 10.25103/ijbesar.143.01

Model 2

Model 2 answers the study's second objective, which is to determine a threshold level for corruption in West Africa. In line with expectations from equation (12), the coefficient of CORR and CORRSQ (corruption square) under Model 2 were found to be statistically significant with the required signs in the long-run. Thus, indicating that corruption has a positive influence on FDI inflow initially but doubling the level of corruption or making it widespread, will have a negative influence in the end (Abotsi and Iyavarakul 2015; Oktay, 2017).

Having met the pre-conditions, the threshold level was determined by solving the derivative of the dependent variable, per capita FDI inflow (LOGFDI), with respect to the variable of interest, corruption (CORR) (see Appendix 2). The study found the threshold level of corruption to be 6.3[17]. The result explains that the inflow of FDI to a country in West Africa could not be discouraged once the level of corruption is below 6.3 but beyond that level, the inflow of FDI would be discouraged. This threshold level is close to the level established by Abotsi and Iyavarakul (2015)[18] of −0.27, which translate into 5.54 on the study's rescale. Based on the result, only seven countries had an average score equal or below the threshold level: Cape Verde (3.4), Ghana (5.3), Senegal (5.4), Burkina Faso (5.5), Benin (6.2), Gambia (6.2) and Mali (6.3). The remaining eight countries failed to meet the threshold level with Guinea Bissau averaging the worst score, 7.5. The pre-condition for a corruption threshold level in the short-run panel estimate was met, however, the variables were statistically insignificant.

6. Conclusion and Recommendations

In analysing corruption and FDI inflows into West Africa, the study investigated the long and short-run effect of corruption on FDI inflow, as well as to determine the threshold corruption level. The result revealed that corruption has a negative effect on FDI in the long-run, suggesting that corruption act as an obstacle to the inflow FDI in West Africa. The result was found to be consistent with the "grabbing hand" hypothesis. However, in the short-run corruption was found to share a positive association with FDI inflows into the sub-region albeit statistically insignificant. In response to the other objective, a threshold level of corruption was established only for the long-run. It was suggested that corruption levels below the threshold level cannot discourage FDI inflows to West Africa and above that level, corruption can discourage FDI inflows. Also, the market size, macroeconomic condition and natural resources were also found to have an influence on FDI inflows to West Africa in the long-run. Based on the findings, the authors recommend that West African governments direct focus on mechanisms that will strongly discourage people from engaging in corruption by reducing unnecessary delays and ensuring that the consequences are dire. With this, the level of corruption could be reduced and FDI activities will become attractive. Furthermore, governments, particularly in countries that had a score above the threshold level, should intensify efforts to fight corruption and reduce it to at least the threshold level which is just enough for attracting FDI. This can be done by strengthening, and ensuring effective monitoring of public institutions and agents while recognising and providing a reward for honesty.

References

Abotsi, A.K. and Iyavarakul, T., 2015. Tolerable level of corruption for foreign direct investment in Africa. *Contemporary Economics*, 9(3), pp. 249-270.

Akonnor, K. T., 2018. The Impact of Foreign Direct Investment (FDI) on Economic Growth: A Comparative Study of East and Central Africa. *Doctoral dissertation*, University of Ghana.

Anderson A. D., Thomas A. W. and Dennis J. S., 2020. *Statistics*, Encyclopedia Britannica, Inc.

Andvig, J. C., 2008. Corruption in Sub-Saharan Africa and its sources of evidence. Norwegian Institute of International Affairs (NUPI), *Working Paper* 744.

Anyanwu, J.C., 2011. Determinants of foreign direct investment inflows to Africa, 1980-2007. *African Development Bank Group*. pp. 1-32.

Anyanwu, J.C. and Yameogo, N.D., 2015. What drives foreign direct investments into West Africa?" An empirical investigation. *African Development Review*, 27(3), pp.199-215.

Ardiyanto, F., 2012. Foreign direct investment and corruption. *Doctoral Dissertation*, Colorado State University.

Asiedu, E., 2006. Foreign direct investment in Africa: The role of natural resources, market size, government policy, institutions and political instability. *World economy*, 29(1), pp.63-77.

Asiedu, E., 2013. Foreign direct investment, natural resources and institutions. International Growth Centre, wp 47.

[17] Equivalent to -0.65 on the original scale.

[18] The threshold by Abosti and Iyavarakul (2016) was done for Africa.

DOI: 10.25103/ijbesar.143.01

Ayanwale, A. B., 2007. FDI and economic growth: Evidence from Nigeria. African Economic Research Consortium, Nairobi, *AERC Research Paper* 165.
Bardhan, P., 1997. Corruption and development: a review of issues. *Journal of economic literature*, 35(3), pp. 1320-1346.
BBC, 2019a. BP to pay billions for suspicious Senegal gas deal. https://www.bbc.com/news/av/world-africa-48475068/bp-to-pay-billions-for-suspicious-senegal-gas-deal (August, 2020).
Bellos, S. and Subasat, T., 2012. Corruption and foreign direct investment: A panel gravity model approach. *Bulletin of Economic Research*, 64(4), pp. 565-574.
Blundo, G., and Olivier de Sardan, J. P., 2006. Everyday Corruption in West Africa., *G. Blundo and JP Olivier de Sardan, JP.*
Buckley, P. J., and Casson, M. C., 1976. The future of multinational enterprise. Macmillan, London.
Chakrabarti, A., 2001. The determinants of foreign direct investments: Sensitivity analyses of cross-country regressions. *kyklos*, 54(1), pp. 89-114.
Chande, K. A., 2014. Africa rising: Corruption and foreign direct investment inflows. *CMC Senior Theses Paper 1023.* https://scholarship.claremont.edu/cmc_theses/1023
Chêne M., 2010. Overview of corruption and anti-corruption in Sierra Leone. Anti-Corruption Helpdesk, Transparency International, *U4 Anti-Corruption Resource Centre.*
Clemens, M. A., Radelet, S., Bhavnani, R. R., and Bazzi, S., 2012. Counting chickens when they hatch: Timing and the effects of aid on growth. *The Economic Journal*, 122(561), 590-617.
Cuervo-Cazurra, A., 2008. Better the devil you don't know: Types of corruption and FDI in transition economies. *Journal of International Management*, 14(1), pp. 12-27.
Dicken, P., and Lloyd, P. E., 1977. Location in space: A theoretical approach to economic geography. Loanna Cotler, London.
Dunning, J. H., 1995. Reappraising the Eclectic Paradigm in an Age of Alliance Capitalism. *Journal of International Business Studies*, 26, pp. 461-491.
Dunning, J. H., 1977. Trade, location of economic activity and the MNE: A search for an eclectic approach. *The international allocation of economic activit*, Palgrave Macmillan, London, pp. 395-418.
Dunning, J. H., 2000. The eclectic paradigm as an envelope for economic and business theories of MNE activity. *International business review*, 9(2), pp.163-190.
Eberhardt, M., 2011. September. Panel time-series modeling: New tools for analyzing xt data. In *2011 UK Stata Users Group meeting.*
Fahad, A. Y., and Ahmed, M., 2016. The Impact of Corruption on Foreign Direct Investment (FDI) in Post-Conflict Countries: A Panel Causality. Test. *Journal of Advanced Social Research*, 6(3), pp. 1-12.
Goodspeed, T., Martinez-Vazquez, J., and Zhang, L., 2011. Public policies and FDI location: Differences between developing and developed countries. *FinanzArchiv/Public Finance Analysis*, pp. 171-191.
Gossel, S. J., 2018. FDI, democracy and corruption in Sub-Saharan Africa. *Journal of Policy Modeling*, 40(4), pp. 647-662.
Gui-Diby, S. L., and Renard, M. F., 2015. Foreign direct investment inflows and the industrialization of African countries. *World Development*, 74, pp. 43-57.
Hanson, S., 2009. Corruption in Sub-Saharan Africa, *Washington, DC.*
Hasan, M., Rahman, M. N., and Iqbal, B. A., 2017. Corruption and FDI inflows: Evidence from India and China. *Mediterranean Journal of Social Sciences*, 8(4 S1), 173.
Heidhues, F. and Obare, G.A., 2011. Lessons from structural adjustment programmes and their effects in Africa. *Quarterly Journal of International Agriculture*, 50(892-2016-65193), pp. 55-64.
Hines Jr, J. R., 1995. Forbidden payment: Foreign bribery and American business after 1977, *National Bureau of Economic Research*, Working Paper 5266.
Hymer, S. H., 1976. International operations of national firms: A study of foreign direct investment. MIT press, USA.
Im, K. S., Pesaran, M. H., and Shin, Y., 2003. Testing for unit roots in heterogeneous panels. *Journal of econometrics*, 115(1), pp. 53-74.
International Finance Corporation (IFC), 2019. Country Private Sector Diagnostic: Growing Burkina Faso's Private Sector and harnessing it to bolster economic resilience. World Bank Group.
Jalloh, M., 2013. Natural resources endowment and economic growth: The West African Experience. *Journal of Natural Resources and Development*, 3, pp. 66-84.
Kaufmann, D., and Wei, S. J., 2000. Does 'grease money' speed up the wheels of commerce? *IMF Working Paper* WP/00/64.
Lagarde, C., 2017. Addressing corruption with clarity, Speech at the Brookings Institution. https://www.imf.org/en/News/Articles/2017/09/18/sp091817-addressing-corruption-with-clarity (August, 2020).
Lee-Jones K., 2019. Liberia: Overview of corruption and anti-corruption. Anti-Corruption Helpdesk, Transparency International, U4 Anti-Corruption Resource Centre.
Leff, N. H., 1964. Economic development through bureaucratic corruption. *American behavioral scientist*, 8(3), pp. 8-14.
Lui, F. T., 1985. An equilibrium queuing model of bribery. *Journal of political economy*, 93(4), pp. 760-781.
Luu, H.N., Nguyen, N.M., Ho, H.H. and Nam, V.H., 2019. The effect of corruption on FDI and its modes of entry. *Journal of Financial Economic Policy.*
Okafor, G., Piesse, J., and Webster, A., 2017. FDI determinants in least recipient regions: The case of Sub-Saharan Africa and MENA. *African Development Review*, 29(4), pp. 589-600.
Oktay, K., 2017. Effect of Corruption on FDI in transition economies: evidence from causality analysis. *Uluslararası İktisadi ve İdari İncelemeler Dergisi, (19)*, pp. 25-42.

DOI: 10.25103/ijbesar.143.01

Omankhanlen, A. E., 2011. The effect of exchange rate and inflation on foreign direct investment and its relationship with economic growth in Nigeria. *Economics and Applied Informatics,1*, 1.
Omodero, C.O., 2019. Effect of corruption on foreign direct investment inflows in Nigeria. *Studia Universitatis Vasile Goldiş, Arad-Seria Ştiinţe Economice*, *29*(2), pp. 54-66.
Onuoha, F. C., Okonkwo, I. C., Okoro, P., and Okere, K., 2018. The causal relationship between Foreign Direct Investment (FDI) and the macro-economy of selected West African countries: Panel ARDL/Granger Causality Analysis. *African Research Review*, *12(1)*, pp.140-163.
Pedroni, P., 1999. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and statistics*, *61(S1)*, pp. 653-670.
Pedroni, P., 2004. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory*, *20*(3), pp. 597-625.
Pesaran, M. H., and Smith, R., 1995. Estimating long-run relationships from dynamic heterogeneous panels. *Journal of econometrics*, 68(1), pp. 79-113.
Pesaran, M. H., Shin, Y., and Smith, R. P., 1999. Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, *94(446)*, pp. 621-634.
Peseran, H., 2004. General Diagnostic Tests for Cross Section Dependence in Panels. University of Cambridge and IZA Bonn, *Discussion paper* No.1240.
Pring, C., and Vrushi, J., 2019. Global Corruption Barometer: Africa 2019, Transparency International.
Quazi, R., Vemuri, V., and Soliman, M., 2014. Impact of corruption on foreign direct investment in Africa. *International Business Research*, 7(4), 1.
Rahman K., 2019. The Gambia: Overview of corruption and anti-corruption. Transparency International Anti-Corruption. *Helpdesk Answer*.
Sayek, S., 2009. Foreign direct investment and inflation. *Southern Economic Journal*, 76(2), pp. 419-443.
Scott, W. R., 2001. Institutions and organizations (2nd [thoroughly rev. and expanded] ed.), Thousand Oaks, CA.[etc.]: Sage.
Shipley T., 2018a. The Role of civil society in fighting corruption in Cote d'Ivoire. Anti-Corruption Helpdesk, Transparency International, U4 Anti-Corruption Resource Centre.
Shipley T., 2018b. Country profile: Senegal Overview of corruption and anti-corruption, Transparency International, *U4 Helpdesk Answer 2018:14*. U4 Anti-Corruption Resource Centre.
Shleifer, A., and Vishny, R. W., 1993. Corruption. *The quarterly journal of economics*, 108(3), pp. 599-617.
Smith, R. P. and Fuertes, A. M., 2016. Panel Time Series. Cemmap course notes.
Teixeira, A. A., and Guimarães, L., 2015. Corruption and FDI: Does the Use of Distinct Proxies for Corruption Matter? *Journal of African Business*. 16(1-2), pp. 159-179.
Tsikata, D., 2005. Determinants of Foreign Direct Investment in Sub-Saharan Africa. MPhil dissertation, University of Ghana.
Udenze, O., 2014. The effect of corruption on foreign direct investments in developing countries. *The Park Place Economist*: Vol. 22, http://digitalcommons.iwu.edu/parkplace/vol22/iss1/17 (July, 2020).
United Nations Conference on Trade and Development, 2010. Investing in a Low-Carbon Economy. *World Investment Report*, New York and Geneva: United Nations.
United Nations Conference on Trade and Development, 2019. Special economic zones, *World Investment Report*, New York: United Nations.
United Nations Conference on Trade and Development, 2019. *UNCTAD Statistics*, https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en (July, 2020).
Vernon, R., 1966. International trade and international investment in the product cycle. *Quarterly journal of economics*, 80(2), pp. 190-207.
Wei, S. J., 1997. Why is corruption so much more taxing than tax? *Arbitrariness kills*, (No. w6255).
Wei, S. J., 2000. How taxing is corruption on international investors?" *Review of economics and statistics*, 82(1), pp. 1-11.
World Development Indicators databank, 2019. *The World Bank Databank*, https://databank.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/1ff4a498/Popular-Indicators (July, 2020).

World Governance Indicators databank. 2019. *The World Bank Databank*. https://databank.worldbank.org/source/worldwide-governance-indicators (July, 2020)

DOI: 10.25103/ijbesar.143.01

APPENDIX

Appendix 1: Derivation of the Second-order condition

Recall and re-writing equation (3) gives;

$$-w_e(h_i, b_i)s_b(b_i) = \frac{1}{\pi_i}$$

Taking second-order condition on the above,

$$\frac{\partial^2 \pi_i^*}{\partial b_i^2} = -\{w_{ee}(-s_b)s_b + w_e(h_i, b_i)s_{bb}(b_i)\} = -\{w_{ee}(-s_b^2) + w_e(h_i, b_i)s_{bb}(b_i)\} < 0$$

Where: $w_e < 0,\ w_{ee} < 0,\ s_b > 0\ and\ s_{bb} < 0$; thus, satisfying the maximization condition.

Appendix 2: Calculation of the Threshold Level of Corruption for West Africa

$$\frac{\partial LOGFDI_{it}}{\partial COC_{it}} = 1.413 - 0.224 \times COC_{it} = 0$$

Solving the above equation gives:

$$COC_{it} = \frac{1.413}{0.224} = 6.308$$

Appendix 3: Summary of Variable Description and the 15 countries considered in the study.

Variable	Description	Source	Expected sign
FDI	US dollars at current prices per capita	UNCTAD (2019)	
CORR	Perception index measured on a scale of -2.5 to 2.5 (later rescaled)	World Bank's WGI (2019)	Negative
GDPPC	Current US$	World Bank's WDI (2019)	Positive
INF	Consumer price index with 2010 as the base year	UNCTAD (2019)	Negative
TOP	$\left(\frac{Export\ + Import}{GDP}\right) \times 100$	World Bank's WDI (2019)	Positive
NR	Total natural resources rent as a percentage of *GDP*	World Bank's WDI (2019)	Positive
PI	Perception index measured on a scale of -2.5 to 2.5 (later rescaled)	World Bank's WGI (2019)	Negative
COUNTRIES			
Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo.			

Appendix 4: Descriptive Statistics

DOI: 10.25103/ijbesar.143.01

Variable	Obs.	Mean	Std. Dev.	Min	Max
LOGFDI	300	1.57	0.347	-0.39	2.64
CORR	270	6.24	1.047	3.1	8.12
LOGGDPPC	299	2.825	0.341	0	3.57
LOGINF	300	1.95	0.18	1.23	2.41
NR	284	11.105	7.667	.37	53.63
TOP	299	69.013	34.734	20.72	311.35
PI	270	6.03	1.63	2.56	9.8

Appendix 5: Matrix of Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) LOGFDI	1.000						
(2) CORR	-0.482	1.000					
(3) LOGGDPPC	0.580	-0.447	1.000				
(4) LOGINF	0.212	-0.052	0.412	1.000			
(5) NR	0.040	0.484	-0.281	0.091	1.000		
(6) TOP	0.344	-0.146	0.027	-0.035	0.251	1.000	
(7) PI	-0.208	0.647	-0.076	-0.019	0.394	0.005	1.000

Appendix 6: Mean Group ARDL Results for Both the Short and Long-Run

	Model 1	Model 2
LONG-RUN		
CORR	0.175 (0.380)	77.26 (81.28)
LOGGDPPC	-3.647 (2.062)	-1.062 (1.332)
LOGINF	4.252 (2.580)	3.260 (2.788)
NR	0.008 (0.041)	0.143 (0.146)
TOP	-0.034 (0.029)	0.029 (0.036)
PI	-0.195 (0.180)	0.0041 (0.207)
CORRSQ		-6.288 (6.567)
SHORT-RUN		
ECT	-1.497***(0.303)	-1.76***(0.406)
D.CORR	0.0692 (0.327)	-22.51 (16.39)
D.LOGGDPPC	0.778 (1.352)	2.315 (2.248)
D.LOGINF	-6.865 (5.000)	-4.193 (7.608)

DOI: 10.25103/ijbesar.143.01

D.NR	-0.003 (0.041)	0.009 (0.046)
D.TOP	-0.005 (0.011)	0.003 (0.008)
D.PI	-0.145 (0.191)	0.0797 (0.170)
D.CORRSQ		1.680 (1.300)
_Con	-6.710 (4.979)	-88.50 (89.39)
Hausman Test (H_0: Difference in coefficient not systematic)		
Prob>Chi	0.999	1.000

DOI: 10.25103/ijbesar.143.01

International Journal of
Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

Foreign Direct Investment and Productivity Growth in Eastern European Countries*

Özcan Karahan[1], Olcay Çolak[2]

[1] Bandırma Onyedi Eylül University, Department of Economics

[2] Uşak University, Department of Economics

ARTICLE INFO

Article History

Received 4 August 2021;
Accepted 5 December 2021

JEL Classifications
F21, F23, D24, O52

Keywords:
Foreign Direct Investment
Productivity Growth,
Eastern European Country

ABSTRACT

Purpose:
Our study aims to investigate the technological spillover effects of Foreign Direct Investment flows to Eastern European Countries. This study has guided by new growth theories arguing that Foreign Direct Investment has a significant potential for improving the productivity growth rate of host countries through technology transfer.

Design/methodology/approach:
The impact of potential spillover effects associated with FDI flows on productivity growth has been examined by constructing the baseline specification of which Gersl et al. (2007) and Stancik (2009) based on Cobb-Douglas type production function. Through the baseline model, we performing conventional linear panel data models namely the fixed effect and random effect. For the robustness of the empirical findings, we also employ **a** dynamic panel data estimator in the framework of the GMM technique.

Findings:
Results based on the fixed effect estimator show that there are no horizontal and forward spillovers while positive backward spillovers prevail in both manufacturing and services sectors, that is also confirmed by the findings of the dynamic panel data (GMM) estimator.

Research limitations/implications:
Our findings regarding the presence of positive backward spillovers versus the absence of horizontal and forward spillovers are consistent with the results of most empirical studies dealing with Eastern European Countries. However, our study has also revealed that these results do not differ between the manufacturing and service sectors in Eastern European Countries.

Originality/value:
In the literature focusing on Eastern European Countries, many studies investigate the presence of the spillover effect by not making a distinction between the manufacturing and services sectors. Our study is one of the first to examine how spillovers from FDI affect domestic firms in two different sectors namely manufacturing and services. Thus, this study contributes to related literature by showing whether the spillovers from FDI exist differently in the manufacturing and services sector or not.

1. Introduction

After the new growth theories proposed by Romer (1986, 1990), Lucas (1988) and Grosman and Helpman (1991) the importance of technology as an endogenous determinant of growth has been emphasized, and gaining access to new technology has become a very important factor for the sustainable growth. Thus, a new challenge has arisen for developing countries to achieve high growth rates and reach the level of developed countries. Because developing countries have a very low capacity to produce new technology due to some structural problems. In order to overcome this challenge, international technology transfer has become the biggest agenda item for developing countries. This agenda has also been valid for the transition economies in Eastern European Countries (EECs) to catch up with the developed economies in the European Union. In this context, economists have recommended Foreign Direct Investment (FDI) made by Multinational Companies (MNCs) as the most important channel for international technology transfer.

Foreign direct investment has become a driving force of growth for the developing economy by bringing not only new capital but also new technology and know-how. Thus, FDI inflows make a significant contribution to the

†Corresponding Author: Özcan Karahan
Email: okarahan@bandirma.edu.tr

DOI: 10.25103/ijbesar.143.02

production level of the host country in direct and indirect ways. FDI inflows directly contribute to the level of income growth and indirectly affect productivity in the host country. The direct benefit from FDI inflows to host country production capacity arises from its positive impact on the level of domestic capital stock. In this way, FDI inflow increases the production level of the local economy by expanding the investment stock of the host country. Besides this direct effect, FDI inflow indirectly affects the host country's production level through new technology transfer. The fact of transferring knowledge and technology parallel with FDI inflows is a feature that makes FDI much more useful for the host country's economy. Thus, the foreign firm's presence affects the production process of the host country positively and contributes to an increase in the domestic productivity of the economy.

The indirect advantages provided by FDI on the host country's production level via technology transfer are called the spillover effect. In the case of the spillover effect, multinational companies (MNCs) make a significant contribution to the efficiency of the production process of local companies through new technology transfer. During the spillover effect from FDI, domestic firms can easily reach advanced production knowledge and better managerial expertise. That means the presence of foreign companies affects the productivity of domestic companies in the economy. In general terms, the spillovers from FDI are defined as benefits for indigenous firms through the enlargement of their efficiency in the production process. Thus, local firms gain impressive efficiency in their production processes and consequently, they become the engine of economic growth based on productivity.

Spillovers from FDI generate efficiency gains to domestic firms in both the same industry and different industries. Efficiency gains from incoming FDI to domestic firms in the same industry are regarded as horizontal spillovers. The existence of foreign companies also increases the efficiency of domestic firms in different industries, which is called vertical spillovers. Vertical spillovers operate via two channels of transmission mechanism as backward spillovers and forward spillovers. Vertical technology transfers taking place from FDI to domestic suppliers and buyers are called backward spillovers and forward spillovers, respectively. Thus, the presence of vertical spillovers from FDI can take place through both backward and forward linkages in cross-industries.

Technology diffusion channels of FDI as indicated above have increased their importance and attracting FDI has become a popular way for technology transfer policy. Eastern European Countries (CECs) struggling with a large technological deficiency have also shown a considerable effort for technology transfer via FDI inflows. Therefore, these countries have created special incentives in order to attract FDI in the last decades. Thus, an important experience has emerged to empirically analyse the spill over effect of FDI in EECs. Accordingly, this study tries to determine the spillover effect of FDI on productivity growth using the yearly panel data set over the period of 2008-2014 in 10 Eastern European Countries including Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia. Our study is one of the first to examine how FDI presence affects domestic firms in two different sectors namely manufacturing and services. While analysing the impact of FDI on domestic firm productivity in EECs, we deal with the spillovers from FDI in the manufacturing and services sectors separately.

The rest of the paper is organized as follows. Section 2 reviews the empirical literature focusing on FDI spillovers. Section 3 explains the data and methodology. Section 4 shows the empirical results. The final section concludes and makes some policy implications.

2. Review of Literature

Foreign Direct Investment can contribute to the economic growth in the host country through technology spreads (spillovers) called indirect impact. In this section, we review the studies examining the contribution of FDI to economic growth through enhancing the efficiency of production capacity. In addition, we consider the researchers that try to determine the contributions offered by FDI inflows to the productivity of local firms in the Eastern European area. Thus, we review the studies that examine the spillovers from FDI in Eastern European Countries using firm-level data in the framework of micro-analyses. In the framework of related literature indicated above, most of the studies have focused on whether the existence of spillovers from FDI or not. It seems that most of them have not found positive spillovers from FDI in Eastern European Countries. These studies refer to the inadequacies in the absorption capacity of the local companies related to not receiving the expected positive contributions from the FDI. In other words, empirical results mostly show that the degree to which domestic firms may benefit from spillovers from FDI depends on the absorptive capacity of domestic firms (Konings, 2001; Tytell and Yudaeva, 2006; Nicolini and Resmini, 2006; Gersl et al. 2007, Damijan et al. 2013; Estrin and Uvalic, 2016; Karahan 2016).

On the other hand, when the related literature is reviewed, it is also seen that some studies have made more detailed analyses to determine which type of spillovers effect has occurred rather than the presence of the spillover effect. Spillovers from FDI operate via two channels of transmission mechanism as horizontal spillovers and vertical spillovers. Horizontal spillovers from FDI occur through contacts between foreign subsidiaries and their local competitor in the same sectors. Vertical spillovers from FDI taking place through contacts between foreign affiliates and local firms in upstream (supplier) and downstream (customer) sectors, which are referred to as backward spillovers and downward spillovers, respectively. Looking at the studies trying to determine the form of spillovers, it seems that technological diffusion from FDI operates in the form of vertical spillovers rather than horizontal spillovers much more. As can be seen below, many studies related to Eastern European countries using firm-level data at country and multi-country levels have confirmed the existence of powerful vertical spillover effects from FDI (Schoors and Tol, 2002; Javorcik, 2004; Marcin, 2008; Ayyagari and Kosova, 2010; Jude, 2012).

Concerning country-level studies in Eastern European Countries, Schoors and Tol (2002) analyse the influences of FDI on labour productivity of domestic firms in Hungary. Empirical results indicate the presence of forward linkage spillovers. Besides, foreign firms have a positive spillover effect on labour productivity of local firms within sectors,

which confirms the positive horizontal spillover effects. However, the forward linkage spillovers are much more important compared to positive horizontal spillover effects. Empirical findings also indicated that absorption and openness play a significant role in the process of spillovers from FDI. Javorcik (2004) focuses on the inter-industry and intra-industry spillovers from FDI based on firm-level data between 1993 and 2000 from Lithuania. The results of the study failed to find positive intra-industry spillovers from FDI.

On the other hand, the results are consistent with the presence of productivity spillovers taking place through backward linkages. This suggests that productivity spillovers arise from the contacts between foreign affiliates and their domestic suppliers. However, no evidence of forward spillovers is found which means there are no spillovers stemming from multinational presence in sectors buying intermediate inputs. Marcin (2008) examines horizontal and vertical spillovers by exploiting firm-level panel data spanning the data between1996 and 2003 related to the Polish corporate sector. Main findings indicated that local firms benefit from a foreign presence in the same industry and in downstream industries. The absorptive capacity of domestic firms is highly relevant to the size of spillovers. Therefore, there are reasons to support policies strengthening the absorptive capacity of domestic firms. Policy-makers should focus on not only attracting foreign investors but also enhancing the absorptive capacity of domestic companies. Stancik (2009) analysis the spill over effects from FDI by focusing on the sales growth rate of domestic firms in the Czech Republic. Using firm-level data from 1995-2005, the empirical study indicates the negative backward spillover effects since the sales growth rates of domestic firms mostly decrease in the presence of foreign companies downstream. Regarding horizontal spillover effects, they are statistically weaker and much smaller in magnitude. Positive backward spillovers are present, which indicates that domestic firm in the upstream sector increases their sales. The overall impact of FDI on the sales of Czech domestic companies is mostly negative. That means Czech domestic companies are not profiting from the presence of foreign investors.

Ayyagari and Kosova (2010) analyse the spillover effects from FDI focusing on the domestic firm entry in the Czech Republic during 1994-2000. They find evidence of vertical entry spillovers in the form of both backward and downward spillovers in the industries. FDI in downstream industries initiates entry in upstream sectors, as well as FDI in upstream industries, initiates entry in downstream sectors. The findings also indicate the existence of positive horizontal spillovers from FDI in the industries. A larger foreign presence in the industry stimulates the entry of domestic firms within the same industry. Besides, benefits from FDI entry spillovers via horizontal channels are mainly driven by FDI from members of the **EU**. However, empirical results show that the volume of vertical spillover effects is higher than horizontal spillovers in the industries. Jude (2012) empirically estimates the magnitude of technological spillovers from FDI using a firm-level dataset of the Romanian economy for the period 1999-2007. He used time-varying Input-Output tables in order to compute spillover effects. Econometric results show that local suppliers benefit from positive backward spillovers, which confirm the productivity gains in upstream sectors. However, local clients are negatively affected by forward spillovers, which indicate the losses in downstream sectors. Thus, from a policymaker's point of view, policies aiming to encourage the entry of new foreign firms to downstream sectors in order to minimize the negative forward spillovers. Fatima (2016) analyses the productivity spillovers from foreign direct investment (FDI) using Turkish firm-level data for the period 2003–2010. Thus, the empirical model focused to determine the technology transfer capacity of the Turkish economy based on FDI-induced spillovers via the channels of horizontal and vertical linkages. The empirical results show that the presence of FDI decreases the productivity of local competitors, which indicates negative horizontal spillovers. On the other hand, vertical linkages exert a positive impact on the local productivity levels, which confirms the positive backward and forward spillovers. Positive vertical spillovers call policies for strengthening of supplier–buyer relationship between local and multinationals. Ciani and Imbruno (2017) examine the spillover effects of FDI in Bulgaria focusing on the export performance of Bulgarian manufacturing firms. Using firm-level data for the period 2004-2006, they find positive forward spillover on export performance. Conversely, empirical results show negative backward and horizontal spillover on export performance of Bulgarian manufacturing firms. Foreign presence hurts both local competitors and suppliers in upstream sectors. Therefore, empirical findings suggest that policymakers in Bulgaria design policies oriented to attract FDI in downstream sectors to generate much more positive effects from FDI in the economy.

Looking at the multi-country level studies in Eastern European Countries, it seems that many studies investigate the presence of the spillover effect rather than how it occurs. In addition, when investigating the spillover effect in multi-country studies, it is seen that there is no distinction between the manufacturing sector and the manufacturing sector. The results obtained generally show that the spillover effects from FDI were either not at all or were realized in a weak way. Konings (2001) investigate empirically the effects of FDI on the productivity of domestic firms in Bulgaria, Romania, and Poland by using firm-level panel data. Estimation results of the fixed effects model using instrumental variables in the general methods of moment technique show no evidence of positive horizontal spillovers to domestic firms but negative horizontal spillovers to domestic firms in Bulgaria and Romania. Thus, empirical results suggest a negative competition effect dominates positive technology effects in Bulgaria and Romania. This means that, although productivity in the economy increases in the long run, inefficient firms will lose their market share in the short run due to foreign competition. Tytell and Yudaeva (2006) examine the spillovers from FDI by using firm-level data for manufacturing firms in four countries of Eastern Europe including Russia, Ukraine, Poland, and Romania. They found that not all FDI has automatically positive spillover effects on domestic firms. Spillovers exit positively only in the cases of export-oriented FDI. Empirical results also demonstrated that benefits from FDI are likely to materialize once a relatively large stock of foreign capital is accumulated. Besides, spillovers occur predominantly in the more educated and the less corrupt regions that show the significance of the absorptive capacity of domestic firms in reaping the benefits of FDI. Nicolini and Resmini (2006) examined the productivity effects

DOI: 10.25103/ijbesar.143.02

generated by FDI on domestic firms in Bulgaria, Romania, and Poland. Panel data from firm level in three transition countries are analysed by using random-effects models. Empirical findings indicated that only more productive domestic firms could reap the benefits from FDI. Thus, it is clearly indicated the importance of the absorptive capacity as a determinant of productivity spillovers. Besides, findings also show that the level of the technological level of foreign firms also affects the degree of benefits from spillovers for local firms. Spillovers emanating from high-tech foreign are so much high compared to those generated by low-tech foreign firms.

Gersl et al (2007) focus on the analysis of productivity spillovers from FDI in CEE countries. Using firm-level data on manufacturing industries for the period 2000-2005, they examine the link between the productivity of the local firms and foreign presence in the same sector and in sectors linked via the production chain. Empirical results do not show significant horizontal and vertical spillovers in all countries. Moreover, the degree of spillover effect varies depending on other conditions and characteristics on the industry and national level. Damijan et al (2013) analyse the spillovers through FDI on a unique firm-level dataset of ten Eastern European Countries- Bulgaria, the Czech Republic, Croatia, Estonia, Latvia, Lithuania, Poland, Romania, Slovenia, and Ukraine. Empirical results show that local firm heterogeneity is essential in the occurrence of positive spillover effects of FDI in the host country. The heterogeneity of firms in terms of absorptive capacity, size and technology levels affect the benefits from FDI. Thus, findings indicated that spillovers through FDI on a set of ten transition countries do not exist automatically. Firm heterogeneity acts a significant role when determining the spillovers from FDI on domestic firm performance. Estrin and Uvalic (2016) explored the impact of foreign direct investment on the economies of the Western Balkans covering Albania, Bosnia and Herzegovina, Croatia, Macedonia, and Serbia. In order to determine the horizontal spillovers regression analysis has been performed on data from the manufacturing sector for the period 2002-2012. Empirical findings indicated that FDI has had no horizontal effects on key measures of performance of the manufacturing industry in Western Balkan countries. Thus, they concluded that the main constraints arising from institutional and economic factors possibly limited the potential benefits of FDI in Western Balkan.

3. Data and Methodology

In this section, we empirically analyse spillovers from FDI on domestic companies in Eastern European countries, both within industries (horizontal) and across industries (vertical). Accordingly, after given the knowledge about the data set and methodology, econometric results will be explained.

3.1 Data Set

In order to analyze the potential spillover effects of foreign direct investments (FDI) on productivity, we utilize annual data over the period of 2008-2018 in 10 Eastern European Countries including Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia. Annual industry-level data for manufacturing and services sectors classified according to NACE Revision 2 codes have been sourced from Eurostat.

Table 1 displays the list of variables and a brief explanation including data sources.

Table 1: List of Variables

Variables	Description	Source
1.Gross value added (lnY)	Natural log of gross value added (million Euro), 2008-2018	EUROSTAT National Accounts
2.Capital input (lnK)	Natural log of total fixed assets (million Euro), 2008-2018	EUROSTAT National Accounts
3.Labor input (lnL)	Natural log of total employment (thousand), 2008-2018	EUROSTAT National Accounts
4.Horizontal spillovers (lnhorzm, lnhorzs)*	Natural log of share of foreign enterprises in industries, 2008-2018	EUROSTAT Structural Business Statistics
5.Backward spillovers (lnbackm, lnbacks)**	Natural log of weighted share of output supplied to other sectors, 2008-2018	EUROSTAT, ESA Supply, Use, Input Output Table
6.Forward spillovers (lnforwm, lnforws)***	Natural log of weighted share of output supplied by other sectors, 2008-2018	EUROSTAT, ESA Supply, Use, Input Output Table

Note: * lnhorzm, and lnhorzs show the horizontal spillovers in manufacturing and services sectors respectively.
** lnbackm and lnbacks show the backward spillovers in manufacturing and services sectors respectively.
*** lnforwm and lnforws show the forward spillovers in manufacturing and services sectors respectively.

In order to capture potential horizontal spillover effects of FDI, we need statistics regarding the total number of foreign enterprises. For this purpose, we compiled the data on the total number of enterprises including the foreign enterprises (inward foreign affiliate) from the Structural Business Statistics (SBS) of Eurostat. A foreign affiliate is defined as an enterprise resident in a country that is under the control of an institutional unit not resident in the same country, and control is defined as foreign affiliates' chain of control. FDI reflects this control and lasting interest

implying that a long-term relationship exists between the investor and enterprise. Such an interest is formally deemed to exist when a direct investor owns 10% or more of the voting power on the board of directors or equivalent.

Vertical spillovers that arise from inward FDI have been identified by utilizing the industry-level data from Eurostat's ESA Supply, Use, and Input-Output Table on an annual basis which is calculated by ESA 2010 Methodology. Supply and use tables are helpful tools to show the production process for a particular product and industry that are classified by NACE Revision 2 codes. We use to supply data at basic prices for each country on the industry level to determine the foreign share of output within and across sectors to identify backward and forward linkages associated with foreign capital.

In the Cobb-Douglas production-function frame, to analyse the effect of inward FDI on total factor productivity, we also use proxies for capital and labour used as input in the production process. In this context, as a proxy for physical capital input, we use gross fixed capital formation for each sector covering the fixed assets of the firm in terms of current prices in Euro and deflated by GDP deflator. For labour input, we get total employment in each sector and both variables collected in the National Accounts database of Eurostat.

3.2 Model Specification

The impact of potential spillover effects associated with FDI flows on productivity growth has been examined by constructing the baseline specification of which Gersl et al. (2007) and Stancik (2009) introduced by assuming the following conventional Cobb-Douglas type production function:

$$Y_{ijt} = A_{jt}\, f\,(K_{ijt}, L_{ijt}) \tag{1}$$

where Y_{ijt} is the value added, A_{jt} is the technology parameter associated with the FDI, K_{ijt} and L_{ijt} is the physical capital and labor input in corresponding sector j at time t. By totally differentiating both sides of Equation 1, the following expression is yield.

$$\Delta Y_{ijt} = \Delta A_{jt} / A_{jt} + \beta_1 \Delta K_{ijt} + \beta_2 \Delta L_{ijt} \tag{2}$$

$\Delta A_{jt} / A_{jt}$ is the productivity growth rate associated with the horizontal and vertical spillovers caused by inward FDI while β_1 and β_2 are the respective elasticity parameters of capital and labor inputs. Productivity growth rate is affected by FDI and components of potential spillovers caused by FDI are horizontal, backward and forward linkages expressed by the following equation form.

$$\Delta Ajt / Ajt = \beta_0 + \beta_3\, horz_{jt} + \beta_4\, back_{jt} + \beta_5\, forw_{jt} + \varepsilon_{jt} \tag{3}$$

In Equation 3, $horz_{jt}$, $back_{jt}$ and $forw_{jt}$ represent horizontal, backward and forward spillovers while ε_{jt} shows disturbance term that represents the potential effects of productivity shocks within or across industries. Analogues to the approach that is developed by Gersl et al. (2007), we identify the variable for horizontal spillovers that is associated with the presence of foreign enterprises via diffusion of technology in sector j at time in the following form:

$$horz_{jt} = \sum_{i=1}^{n} FF_{jt} \;/\; \sum_{i=1}^{k} AF_{jt} \tag{4}$$

where FF_{jt} represents the number of foreign enterprises while AF_{jt} represents the total number firms in sector j at time t.

Secondly, domestic companies within the sector rather than that foreign enterprise may have direct contact with that foreign enterprise as they provide or supply necessary inputs for the production. Hypothetically, foreign enterprises are regarded as technologically efficient companies and require efficient use of inputs may enforce domestic companies to produce inefficient manner, and indigenizing the new technologies within the production process is considered as vertical spillovers of FDI (Javorcik 2004; Stancik 2009). In this context, vertical spillovers are considered as backward and forward linkages of FDI and represented by the weighted share of output supplied by all sectors to sector j at time t and weighted share of output supplied by sector j to all sectors at time t respectively and constructed in the following forms:

$$back_{kjt} = \sum_{k:k\neq j} \alpha_{jkt}\; horz_{jt} \tag{5}$$

$$forw_{jkt} = \sum_{k:k\neq j} \alpha_{kjt}\; horz_{jt} \tag{6}$$

where α_{jkt} is the share of output supplied by sector j to other sectors while α_{kjt} represents the share of output supplied by all sectors to sector j at time t.

Having considered these facts, we estimate the following log-linear production in Cobb-Douglas sense at industry-level in the following form:

$$\ln Y_{ijt} = \beta_0 + \beta_1 \ln K_{ijt} + \beta_2 \ln L_{ijt} + \beta_3 \ln horz_{ijt} + \beta_4 \ln back_{ijt} + \beta_5 \ln forw_{ijt} + \sigma_{ij} + \varphi_{jt} + \varepsilon_{ijt} \tag{7}$$

where dependent variable $\ln Y_{ijt}$ is the natural logarithm of gross value added whereas $\ln K_{ijt}$ and $\ln L_{ijt}$ represent the natural logarithms of gross fixed capital formation and total employment respectively. Spillover variables are represented by $\ln horz_{ijt}$, $\ln back_{ijt}$, $\ln forw_{ijt}$ namely horizontal spillovers, backward spillovers and forward spillovers in each sector (j). In addition, σ_{ij} and φ_{jt} denote the country-specific and time-specific effects whereas ε_{ijt} denotes the conventional error term. To this end, we will conduct the standard panel data models, namely the fixed effect (FE) and random effect (RE) estimators. Regarding the conformity of random effect estimator over fixed effect estimator, the Hausman test is also performed.

To make comparisons and test the robustness of the findings, Equation 6 will be considered in a dynamic panel fashion and estimated by using the Generalized Methods of Moments (GMM) technique that is pioneered by Arellano and Bond (1991). Estimation of Equation 7 by the standard panel data models might subject to have some drawbacks. The main drawback is connected with Equation 6 stems from the emergence of technological spillovers with lags. On

DOI: 10.25103/ijbesar.143.02

the other hand, estimation of Equation 7 by standard panel data models might cause endogeneity bias and produce inconsistent estimates. As Konings (2001) states that, this would be the case if productivity shocks may have an effect on the input factors employed by the firms in the industry. The other reason is productivity shocks may have an effect on spillovers that would lead to the endogeneity of the spillovers. Thus, in order to circumvent the endogeneity issue, the GMM estimator introduces the instrumental variables. Another advantage of the GMM estimator is the inclusion of the lagged dependent variable ($\ln Y_{ijt}$ in our case) as an independent variable. Hence, the dynamic characteristics of the specification emerge by the introduction of the one-period lagged dependent variable that is not estimated by the standard panel data estimators efficiently. In this context, Equation 7 is rewritten to be estimated by the GMM estimator by the inclusion of the one-period lag of the dependent variable in the following form:

$$\ln Y_{ijt} = \beta_0 + \beta_1 \ln Y_{ijt-1} + \beta_2 \ln K_{ijt} + \beta_3 \ln L_{ijt} + \beta_4 \ln horz_{ijt} + \beta_5 \ln back_{ijt} + \beta_6 \ln forw_{ijt} + \varepsilon_{ijt} \quad (8)$$

where $\ln Y_{ijt-1}$ is the one period lag of the dependent variable. The remainder of the variables in Equation 8 is the same with Equation 7 as outlined above. Both equations will be estimated by each sector to reveal whether the spillover effects are valid or not for 10 selected Eastern European Countries.

4. Estimation Results

Through the baseline model specification, which is driven in Equation 7, we embark upon our empirical treatment regarding the investigation of spillover effects by performing conventional linear panel data models namely the fixed effect (FE) and random effect (RE). Table 2 reports the results of estimating baseline specification in Equation 7. It seems that the signs and significance of the coefficients are consistent with each other regardless of the estimation methods namely the fixed effect (FE) and random effect (RE). However, the results of the Hausman Test indicate that estimations that are carried out by random effect (RE) estimator are not appropriate. Hence, the fixed effect (FE) estimator should be considered since it produces results that are more reliable.

According to the findings of fixed effect (FE), there are no horizontal spillovers caused by inward FDI in the manufacturing and services sectors since the coefficients for horizontal spillovers are statistically insignificant. Similarly, the coefficients of forward spillovers are insignificant in the manufacturing and services sectors. Thus, results do not report any significant relationship between foreign presence and productivity growth of downstream industries in each sector. However, the results highlight the presence of backward spillovers in the manufacturing and services sectors. In other words, the results strikingly indicate that positive backward spillovers prevail in manufacturing and services sectors by the inward FDI flows. The coefficient of backward spillovers in the manufacturing sector indicates that a 1% increase in foreign presence within upstream sectors yields a 0.164 % productivity increase for domestic firms while it accounts for 0.135 % of productivity increases in the services sector.

On the other hand, factor productivity is captured by the introduction of the capital and labor input which are represented by the natural logarithms of gross fixed capital formation (lnKit) and total employment (lnLit) in each sector. Both coefficients are positive and statistically significant to the extent that the rise in both inputs reveals the productivity gains in each sector. However, the coefficients of labor input are relatively larger than capital input in not only services but also the manufacturing sector. The possible reason for the relatively dominant effect of labor input on production might stem from the presence of labor-intensive technologies in the production process of Eastern European Countries. Within the presence of relatively scarce capital input makes labor more productive by the increments to the overall capital stock of these countries.

Table 2: Standard Panel Data Estimation Results

Dependent Variable: ln Y_{it}	**Manufacturing**		**Services**	
	FE	RE	FE	RE
Constant	1.831 (1.000)***	2.885 (0.426)*	-1.398 (2.600)	3.275 (0.718)*
lnK	0.357 (0.048)*	0.384 (0.045)*	0.094 (0.040)**	0.186 (0.053)*
lnL	0.867 (0.187)*	0.639 (0.089)*	0.613 (0.0876)*	0.824 (0.098)*
lnhorzm	-0.001 (0.009)	-0.007 (0.010)		
lnbackm	0.164 (0.063)**	0.127 (0.043)**		
lnforwm	0.005 (0.007)	0.003 (0.007)		
lnhorzs			-0.004 (0.004)	-0.002 (0.002)
lnbacks			0.135 (0.053)**	0.072 (0.013)*
lnforws			0.094 (0.104)	0.052 (0.044)
Model Diagnostics				
# of obs.	110	110	110	110
Wald statistics		349.63 [0.000]*		130.33 [0.000]*
F-statistics	33.88 [0.000]*		10.70 [0.000]*	
Hausman test		27.91 [0.000]*		10.43 [0.033]**
R-squared	0.92	0.93	0.88	0.92

Notes: *, ** and *** denote the significance levels at 1 %, 5% and 10 % respectively. Robust standard errors are shown in parenthesis whereas p-values of diagnostics are shown in brackets.

For the robustness of the empirical findings reported by the fixed effect (FE) method and possible methodological drawbacks as outlined in the previous section, we employ a dynamic panel data estimator in the framework of the GMM technique and the relevant results are reported in Table 3.

The results of the GMM estimator are in line with the fixed effect (FE) method that is reported in Table 2. There are no horizontal spillovers in both sectors associated with the presence of foreign firms since the coefficients of horizontal spillovers are statistically insignificant. The results also indicate that there are no forward linkages in both sectors as the coefficients of forward spillovers are statistically insignificant. Thus, domestic firms in downstream industries of each sector do not benefit from the increased efficiency of the foreign owned companies. On the other hand, we obtain positive backward linkages for both sectors, as the coefficients of backward spillover effects are positive and statistically significant. In this case, domestic firms experience productivity gains by supplying inputs to foreign firms. Findings show that 1% increase in foreign presence accounts for the increase in productivity by 0.091 and 0.047 in the manufacturing and services sectors, respectively.

In addition, the results show that the signs of capital (lnKit) and labor (lnLit) inputs are positive and statistically significant through the expectations. The coefficients of labor input are relatively larger than capital input, which indicates the presence of labor-intensive technologies in the production process of Eastern European Countries.

Finally, the below segment of Table 3 reports the diagnostics regarding the GMM estimation methods. Arellano and Bond autocorrelation test results show that there is no second-order autocorrelation within the residuals of the first order-lagged dependent variable. Sargan test examines the over-identification of the instruments and results reveal that the null hypothesis regarding the over-identification of instruments is rejected.

Table 3: GMM Estimation Results

Dependent Variable: ln Y	**Manufacturing**	**Services**
Constant	- 0.877 (1.061)	2.027 (0.805)**
ln Y_{t-1}	0.700 (0.113)*	0.875 (0.043)*
lnK	0.044 (0.041)***	0.010 (0.005)***
lnL	0.078 (0.011)*	0.017 (0.005)*
lnhorzm	0.009 (0.009)	
lnbackm	0.091 (0.030)*	
lnforwm	0.043 (0.046)	
lnhorzs		- 0.001 (0.009)
lnbacks		0.047 (0.013)*
lnforws		0.021 (0.029)
Model Diagnostics		
# of obs.	90	90
Wald X^2	1058.80 [0.000]	4468.98 [0.000]
Arellano-Bond test for AR(2)	-1.59 [0.110]	-1.46 [0.144]
Sargan test (x^2)	47.55 [0.223]	28.47 [0.869]

Notes: *, ** and *** denote the significance levels at 1 %, 5% and 10 % respectively. Robust standard errors are shown in parenthesis whereas p-values of diagnostics are shown in brackets.

Overall, our findings regarding the presence of positive backward spillovers versus the absence of horizontal and forward spillovers are consistent with the results of most empirical studies dealing with Eastern European Countries. The absence of horizontal spillovers attests to the findings revealed by Konings (2001), Tytell and Yudaeva (2006), Nicolini and Resmini (2006), Damijan et al. (2013), and Estrin and Uvalic (2016). On the other hand, the presence of positive backward spillovers is indicated by most of the empirical studies that deal with Eastern European countries (Schoors and Tol, 2002; Javorcik, 2004; Stancik, 2009; Aygari and Kosova, 2010; Fatima, 2016; Gersl et al. 2007). However, our study is one of the first to examine how spillovers from FDI affect domestic firms in two different sectors namely manufacturing and services. Thus, this study contributes to related literature by indicating that the form of spillovers from FDI do not differ between the manufacturing and service sectors in Eastern European Countries.

5. Conclusion

FDI inflows have an important potential for technology transfer and therefore productivity increase in the production process of host countries. For this reason, Eastern European countries have made great efforts to attract foreign capital to their countries in the past period and have made significant progress in this way. Therefore, a lot of research has been performed in the literature on Eastern European Countries in order to determine the role of FDI in technology transfer. However, when the relevant literature is reviewed, it is seen that the focus is on whether there are spreads related to FDI spillovers. However, studies focusing on what kind of diffusion occurs through which channels are still quite limited. Moreover, in most of the existing studies, it is seen that there is no distinction between manufacturing and service sectors while investigating the effect of technological diffusion provided by the presence of foreign investments. Unlike many other studies in the literature, we examined the operating channels of the spillover effect of foreign investments in Eastern European countries in manufacturing and service sectors separately.

DOI: 10.25103/ijbesar.143.02

In order to analyse the channels of spillover effects from FDI in manufacturing and service sectors, annual data over the period of 2008-2018 in 10 Eastern European Countries have been used. Panel Data Estimation Results based on the fixed effect (FE) estimator show that there are no horizontal and forward spillovers caused by inward FDI in manufacturing and services sectors. The coefficients for horizontal and forward spillovers are statistically insignificant. Nevertheless, the results indicate that positive backward spillovers prevail in both sectors by the inward FDI flows. For the robustness of the empirical findings reported by the fixed effect (FE) method, we employed dynamic panel data (GMM) estimator. The results of the GMM estimator confirm the findings of the fixed effect (FE) method that there are no horizontal and forward spillovers in both sectors. Dynamic panel data estimator also indicates the existence of positive backward spillovers for both sectors since the coefficients of backward spillover effects are positive and statistically significant. Empirical findings also indicate that the contribution of labor input to the production process is relatively larger than capital input, which attests to the presence of labor-intensive technologies in Eastern European Countries.

Our findings regarding the presence of positive backward spillovers versus the absence of horizontal and downstream spreads are consistent with the results of most empirical studies dealing with Eastern European Countries. However, unlike other studies, the existence of backward spreads was separately determined for both manufacturing and service sectors. Thus, our study has revealed that the backward spillovers, which are widely proven in the literature focusing on Eastern European Countries, do not differ between the manufacturing and service sectors. Accordingly, this study contributes to understanding whether the presence of spillover effects differs between manufacturing and service sectors. However, more comprehensive studies are needed to determine which factors other than sectoral differences affect spillover. In this context, the research can be expanded by seeking answers to questions such as whether the spillovers are affected by the distance between the host and the home country and the technological sophistication of the affiliate. On the other hand, our study results attesting only backward spillovers enhance the general view that the technology spillover effect of foreign investment in Eastern European Countries is not strong. Therefore, the findings show that in addition to attracting foreign investments to the country, a comprehensive policy design process is needed for the realization of the technology transfer expected from foreign investments. There is a greater need to design policies to increase the absorption capacity of domestic firms in both sectors of Eastern European Countries. In this context, given that both manufacturing and services sectors are labour-intensive, it seems that policies to improve human capital are much more effective in enhancing firms' absorption capacity. Besides, policy makers may be advised to strengthen the network between local suppliers and foreign buyers. Policies to encourage research and development investments by local firms can also be implemented. In addition, in order to reduce the negative horizontal spillover, regulations can be made against the exclusion effect of foreign firms on local firms.

References

Arellano M & Bond S (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *Review of Economic Studies*, 58 (2), 277-297.

Ayyagari, M. & Kosova, R. (2010). Does FDI Facilitate Domestic Entry? Evidence from the Czech Republic. *Review of International Economics*, 18 (1), 14-29.

Ciani, A. & Imbruno, M. (2017). Microeconomic Mechanisms Behind Export Spillovers from FDI: Evidence from Bulgaria. *Review of World Ecoomics*, 153, 703-734.

Damijan, J. P., Rojec, M., Majcen, B., & Knell, M. (2013). Impact of Firm Heterogeneity on Direct and Spillover Effects of FDI: Micro-Evidence from Ten Transition Countries. *Journal of Comparative Economics*, No: 41, 895-922.

Estrin, S. & Uvalic, M. (2016). Foreign Direct Investment in the Western Balkans: What Role Has It Played During Transition. *Comparative Economic Studies*, 58, 455-483.

Fatima, S. T. (2016). Productivity Spillovers from Foreign Direct Investment: Evidence from Turkish Micro-Level Data. *The Journal of International Tared & Economic Development*, 25 (3), 291-324.

Gersl, A., Rubene, I. & Zumer, T. (2007). Foreign Direct Investment and Productivity Spillovers: Updated Evidence from Central and Eastern Europe. *Czech National Bank Working Paper Series*, No: 8.

Grossman, G. M. & Helpman, E. (1991). Quality Ladders in the Theory of Growth. 4. *Review of Economic Studies*, 58, 43-61.

Javorcik, B. S. (2004). Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Bacward Linkages. *The American Review*, 94 (3), 605-627.

Jude, C. (2012). Horizontal and Vertical Technology Spillovers from FDI in Aastern Europe. Halshs – 00828022.

Karahan, Ö. (2016). "Technology Spillover from Foreign Direct Investment in Turkey," International Journal of Business and Economic Sciences Applied Research (IJBESAR), 9(3), 7-12.

Konings, J. (2001). The Effects of Foreign Direct Investment on Domestic Frms: Evidence from Firm-Level Panel Data in Emerging Economies.*Economics of Transition*, 9 (3), 619-633.

Lucas, R. E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Ecınomics*, 22, 3-42.

Marcin, K. (2008). How Does FDI Inflow Affect Productivity of Domestic Firms? The Role of Horizontal and Vertical Spillovers, Absorptive Capacity and Competition. *The Journal of International Trade & Economic Development.* 17 (1), 155-173.

Nicolini, M. & Resmini, L. (2006). *The Impact of MNEs on Domestic Firms in CEECs: A Micro-Econometric Approach*, Mimeo, ISLA, Bocconi University, Milan.

Romer, P. (1986). Increasing returns and Long Run Growth. *Journal of Political Economy*, 94, 1002-1037.

Romer, P. (1990). Endogenous Technical Change. *Journal of Political Economy*, 98, 71-1102.

Schoors, K. & Tol, B. (2002). Foreign Direct Investment Spillovers within and between Sectors: Evidence from Hungarian Data.

Ghent University Working Paper, No: 2002/157.
Stancik, J. (2009). FDI Spillovers in the Czech Republic: Takeovers vs. Greenfields. *European Union Economic and Financial Affairs Economic Papers*, No: 369.
Tytell, I. & Yudaeva, K. (2006). The Role of FDI in eastern Europe and New Independent States: New Channels for the Spillover Effect. *Centro Studi Luca D'Agliano Development Studies Working Papers*, No: 217.

DOI: 10.25103/ijbesar.143.02

International Journal of
Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

Was the Great Depression of 1929 Harsher than the Greek Depression?

[1]Pantelis Sklias, [2]Spyros A. Roukanas, [3†]Georgios Galatsidas

[1]Professor, Neapolis University Pafos, 2, Danaes Avenue, Pafos 8042, Cyprus
[2]Assistant Professor, Department of International and European Studies, University of Piraeus126 Gr. Lampraki Str., Piraeus, 18534, Greece
[3]Visiting Lecturer, Department of Financial and Management Engineering, University of the Aegean, Chios.

ARTICLE INFO

Article History

Received 2 July 2021
Accepted 17 November 2021

JEL Classifications
F00, E30, E60

Keywords: International Political Economy; Economic crisis effects; Economic recession; Public debt crisis; Fiscal crises; Effects of the crisis on the Greek economy.

ABSTRACT

Purpose:
This paper is an analysis based on the comparison of the Greek Depression with the Great Depression of 1929 in the US.
Design/methodology/approach:
This analysis does neither focus on the pre-crisis period, nor on the manifestation of the crisis or the structural problems and economic policies that rendered the Greek economy vulnerable when the financial turmoil broke out. An entire decade has passed since the onset of the crisis, and various policies have been implemented, with explicitly stated goals and specific results. A clear distinction is made between these two periods, which appear to be relatively independent. The causes of the crisis itself are different than the causes that turned the crisis into a prolonged depression with irreversible consequences for the economy and the society.
Finding:
The comparison of the two crises on the basis of their effects on the real economy demonstrates that the Greek crisis had harsher consequences than the US crisis, taking into account its impact on key macroeconomic aggregates such as the income loss, the duration of the depression, the unemployment, the stock market index.
Research limitations/implications:
This paper takes into account that Greece is a member state of Eurozone, on the other hand U.S.A had an autonomous monetary policy during the Great Depression.
Originality/value:
The stubborn implementation of the "bailout" programme for the Greek economy not only has failed to produce the expected results as regards the debt and the deficits, but has also had devastating effects on the real economy. In addition, we ought to focus on the lack of national planning and a carefully planned actual and sustainable development of the real economy and, by extension, economic growth.

1. Introduction

The depression caused by the stock market crash of 1929 is considered to be the worst economic crisis ever to hit the capitalist system in economic history. The main features of that crisis, which justify this description, are its economic and social consequences, duration, intensity, and global reach. The above facts gave rise to the name "Great" Depression. Since then, although the occurrence of economic crises has not been eliminated, this phenomenon has indisputably been contained and, most importantly, its negative economic effects have been limited (debt, deficits, negative GDP growth, unemployment).

†Corresponding Author: Georgios Galatsidas

Email: g_galatsidas@yahoo.gr

DOI: 10.25103/ijbesar.143.03

The manifestation of the Greek fiscal crisis of 2009-2010 (an endogenous crisis of the capitalist system) and the resulting depression also attract the scientific interest of economists worldwide, owing to its duration, and socioeconomic consequences for Greece. As regards the consequences of the Greek depression, Krugman has claimed that it "has devastated Greece just about as much as defeat in total war devastated imperial German" (Krugman, 2015).

In fact, the stubborn implementation of the "bailout" programme for the Greek economy not only has failed to produce the expected results as regards the debt and the deficits, but has also had devastating effects on the real economy, along with its catastrophic social consequences, as they were crystallised after the manifestation of the crisis and during its management. In this context, the question that often preoccupies the academic community is whether Greece is experiencing a new, harsher 1929 in terms of the effects of its fiscal crisis on the economy and, by extension, on society at large.

Under this prism, the purpose of this paper is the comparative evaluation of the consequences of the Great Depression of 1929 in the US and the Greek fiscal crisis on the real economy and the macroeconomic aggregates (e.g. GDP, debt, deficits, unemployment) of the corresponding countries. The ultimate goal is to highlight the problem faced by the Greek economy. This paper takes into account that Greece is a member state of Eurozone, on the other hand U.S.A had an autonomous monetary policy during the Great Depression.

The thesis of this paper is that the fiscal crisis of the Greek economy has had much more painful and stronger, in terms of intensity and duration, effects on the Greek economy, as compared to the corresponding effects on the US economy following the 1929 Crash. As soon as the Greek economy was hit by the crisis, in fact, the IMF, the EU, and the Greek governments made efforts to deal, as they claim, with the root of the problem, as regards the deficit and debt. Despite these efforts, the problem was amplified (as regards the debt) and, most ominously, the bailout measures caused irreversible damage to the real economy and, in particular, to the productive base.

The questions that we will try to answer in this analysis include: Is Greece experiencing a harsher 1929? Do the prolonged duration of the crisis and its consequences raise concerns about the effectiveness of the "bailout" plans? Should the bailout plans for the Greek economy, along with across-the-board expenditure cuts designed to stabilise budget deficits, also set strategic priorities for a new growth model for Greece?

The paper comprises three parts. The first part consists of a theoretical overview and a critical evaluation of economic crisis theories, and more specifically: a) Financial crises, which are divided into banking and stock market crises; b) public debt crises. The second part discusses the Great Depression of 1929 in the US and the recent Greek fiscal crisis, mostly focusing on exploring their effects on the economy of each country. The third part consists of a comparative evaluation of the effects of the crises on GDP, unemployment, and the time it takes for the economy to recover. The paper is completed with the conclusions and the answer to the resulting research questions.

2. Theoretical Approach

2.1 Definition of business cycles - economic crises – recessions

In order to facilitate our study, it is useful to define the concepts of business cycles and economic crises. Evidently, total output and productivity do not follow a steady course, albeit grow fast during certain time periods, while decreasing during others. The concept of the business cycle aims at highlighting the various phases of economic growth the economic system goes through (boom-bust-slowdown-depression-stagnation-recovery).

The business cycle, as defined by Wesley Mitchell, comprises four phases, two during the economic expansion period and another two during the contraction period. Starting from the trough of the cycle –stagnation–, we can see a fast improvement that is called recovery. This is followed by an additional expansion that is called prosperity. This phase, in turn, gives its place to a downward trend that results from the occurrence of a crisis. Finally, the crisis is turned into contraction, which is called depression (Howard, 1991:7-11). The term "depression" describes a deep and prolonged downturn of economic activity and a contraction of GDP (negative growth).

Economic crisis theories highlight the factors that interrupt the ascending phase of the business cycle and, in particular, analyse the parameters that lead to the emergence of the crisis during a specific time period. The onset of the crisis finds the economy at the peak of the business cycle. Then, the economy enters the depression phase, as a result of the crisis (Knoop, 2004:27).

In order to facilitate our study, we will attempt, in advance, to classify economic crises based on their causes. So, in terms of context, economic crises are divided into the following main categories: 1) conjunctural and growth crises; 2) inflation crises; 3) structural crises and commodity market bubbles (2008 property market bubble, 17th century "tulip mania"); 4) public debt crises (Greece being a recent case); 5) exchange rate crises (the cases of Russia and South East Asia); 6) financial crises, which are divided into a) banking crises (e.g. the recent 2007/8 financial crisis of in the US) and b) stock market crises. However, crises are quite often of a mixed nature, combining features of more than one category (Kotios and Pavlidis, 2012: 53). Irrespective, though, of the cause of the crisis, the occurrence of the phenomenon has, in all cases, consequences on the real economy, the macroeconomic aggregates, and the people (society), with varying degrees of intensity.

Understanding crises, the cycle, and the cyclical behaviour of the economy is indispensable for exploring the effects of crises on the economy and suggesting policies for dealing with them, as well as for evaluating the policies that are actually implemented. This analysis shall not emphasise on the study of the phenomenon of crises, albeit on the outcomes and magnitude of the depression brought on the economy by both the emergence of the crisis, and the subsequent policies for dealing with it.

DOI: 10.25103/ijbesar.143.03

2.2 Sovereign debt crises and their effects on the business cycle

The term "sovereign debt" denotes the sum of the government's financial obligations, which result from the conclusion of loan agreements either by itself, or by agencies under its control. Public loan agreements are usually concluded with the issuance of bonds (transferable securities) (Kotios and Pavlidis, 2012:53). Sovereign debt problems emerge in the case of countries that, with the creditors consent, have borrowed way beyond their means, thus leading to over-indebtedness. Over-indebtedness may lead to the non-sustainability of public debt and, consequently, to a sovereign debt crisis (Woodward, 1992: 23).

A sovereign debt crisis includes the partial, or total, inability to repay debts (Kotios and Pavlidis, 2011:56), the default of the borrower's loan obligations, and the restructuring of the borrower's debts on less favourable, as compared with the original, terms for the lender (Smith, 1776/1999; Reinhart and Roggof, 2010: 6). However, over-indebtedness does not automatically and inescapably lead to sovereign default, and the situation may be reversible (Kotios and Pavlidis, 2011: 56).

2.3 The dynamics of sovereign debt

The size of a country's sovereign debt is expressed as a percentage of GDP and is affected by the factors of the following equation:

$$Dt - dt\text{-}1 = pdt - ndfst + (rt-gt)/(1+gt)dt\text{-}1 \quad (1)$$

Source: Pinto and Prasad, 2009: 182

Where dt is the debt to GDP ratio at the end of a time period, pd is the primary deficit to GDP ratio, rt is the borrowing rate, gt is the real growth rate, and ndfs is the non-debt financing sources to GDP ratio. According to the above function, any changes in the debt to GDP ratio are explained by the primary deficit, the real interest rate, and the real growth rate. There are also other factors, including privatisations as a non-debt financing source, that can play a key role (albeit only as regards the reduction of the debt-to-GDP ratio). The above factors, either individually or combined, can affect the level of debt as a percentage of GDP, being potential causes of over-indebtedness and sovereign debt crisis (Table 1).

Table 1. The determinants of sovereign debt levels

1. Fiscal Deficit = primary deficit + interest payments
2. Nominal debt change = primary deficit + interest payments –(sovereign rights + privatisation)
3. Interest payments = nominal interest rate* nominal debt
4. The faster the economy grows, the lower the debt to GDP ratio remains.
5. If part of the debt is denominated in dollars, then a nominal revaluation (or devaluation) will increase (reduce) the debt level in local currency,
6. Moreover, the debt increases when the government is bailing out banks.

Source: Pinto and Prasad, 2009: 185

2.4 Budget deficits and government borrowing

The debt is linked to budget deficits via government revenue and expenditure. The fiscal deficit is determined by: 1) the primary deficit (pd) of an economy's government budget (central government revenue minus expenditure); and 2) the loans' servicing costs (determined by the size of a country's total debt and borrowing rate) (Pantelakis, 1995: 25; Krugman, 2008). Economies that show fiscal deficits resort to borrowing in order to cover them. Therefore, the accumulation of primary deficits over time is one of the main reasons behind a ballooning public debt. Moreover, interest payments increase the deficit for the current year and, consequently, total indebtedness (Kazakos et. al., 2016: 51).

Based on the above, sovereign debt stabilisation is achieved through the reduction of the fiscal deficit to manageable levels, as well as with the pursuit of strong growth rates. Indeed, as debt is not examined as an absolute figure, but as a percentage of GDP (debt/GDP ratio), any increase in GDP reduces the debt to GDP ratio.

DOI: 10.25103/ijbesar.143.03

The emphasis on the analysis of debt crises is due to the fact that they directly lead to the alteration of a country's business cycle, by disrupting its relations with its lenders, as well as to their consequences on its economy and society (Cohn, 2009: 261-164).

2.5 Financial crises and their effects on the economy

The term "financial crisis" denotes the sudden and brief deterioration of all, or a set of, financial indicators, such as short-term bank rates, security prices, savings, investment etc. The key features of such crises include bank runs and stock market panics, bank failures and, in general, the failure of a country's financial system. Financial crises are divided into: a) banking crises, and b) stock market crises, although the distinction is not always clear, given the evident interactions between the two types of crises. Moreover, combinations of the two types of financial crisis are a common occurrence (Kotios and Pavlidis, 2012).

2.6 Banking crises

The term "banking crises" denotes cases in which banking systems have been beset by: a) raids on banking institution liabilities, for example, bank runs; b) problems with a bank's assets, when there are large drops in the prices of its securities (bubble burst) or increases in non-performing loans (Table 2) (Spartiotis and Stournaras, 2010).

Table 2. Events that define the beginning of a banking crisis

Onset of the banking crisis	Increasing banking liabilities	Decreasing banking assets	
Events	Bank runs	Increase in non-performing loans	Reduction of security and investment prices (bubble burst)

Source: Authors' data

In most banking crises we encounter common causes, which can be divided into two categories: 1) those related to the macroeconomic environment; 2) those related to the structure and operation of the banking system itself. In fact, factors from both the above categories come into play in, and affect the outcome of, all financial crises (Spartiotis and Stournaras, 2010)

As regards the first category, we can say that periods of exogenous macroeconomic instability affect both the borrowers' financial strength and debt repayment capability, with repercussions on bank assets (Kotios and Pavlidis, 2012:97-99). The next paragraphs discuss the exogenous factors that disrupt the external economic environment of the banking system, causing instability.

Sudden shifts in a central bank's monetary and interest rate policy may cause many banks to incur losses, as they have extended a large part of their loans at fixed rates and are forced to borrow at higher costs (Kotios and Pavlidis, 2012:97-99). Moreover, exchange rate crises and exchange rate decreases can also cause bank failures (Pinto and Prasad, 2009). Also, sovereign debt crises in, and the unilateral default of, certain countries can have negative repercussions and disastrous effects on banks holding portfolios that include securities issued by these countries (Pauly, 2005:177-200).

That said, the most usual causes of a banking crisis are internal, and are related to the banks' own speculative operations. The extension of loans, in disregard of quantitative restrictions and qualitative borrower selection criteria, exposes credit institutions to external economic events, as part of their lending portfolio consists of bad loans, and therefore credit institutions are faced with potential defaults by insolvent clients (Agglieta, 2009). The above process may be also triggered by the extremely low interest rates set by the central bank and the growth of money supply in the economy, while we should not overlook the inadequacy of state regulation (Pinto and Prasad, 2009).

The effects of banking crises on the business cycle

The effects of a banking crisis are not limited to the bank itself, i.e. its shareholders and personnel, but also cause problems in the real economy. The real economy is facing refinancing difficulties, investment projects are postponed due to the lack of funding, and business-to-business transactions are obstructed, thus hindering the conduct and growth of commerce on a wider scale. The slowdown of economic activity triggers a vicious spiral of recession and financial difficulty, aggravating banking sector problems (Reinhart and Rogoff, 2009b).

Bank failures are the harbinger of a sovereign debt crisis, since the danger of a financial system collapse makes it necessary for the government to bail out the banking system, in order to save the economy. This way, therefore, private debt becomes public, giving rise to the threat of a sovereign debt crisis. However, this government policy also creates the certainty that banks will be bailed out, thus giving rise to "moral hazard", which leads to the preservation of the banks' reckless lending policies (Kotios and Pavlidis, 2012).

2.7. Stock market crises

The term "stock market crisis" denotes a sudden and steep drop of equity prices across a wide range of stock market securities, which leads to a lower price level (Kindleberger, 1978). This harsh adjustment requires a prior strong and unjustified upwards move of equity prices to levels much higher than their actual worth, as a result of increased speculative demand for stock. Therefore, a stock market crisis is the outcome and an integral part of a stock market bubble, which is the antechamber to the crisis itself (Flood and Hodrick, 1990; Diba and Grossman, 1988). Thus, it is

DOI: 10.25103/ijbesar.143.03

deemed useful to discuss the concept of asset price bubbles, as an integral part of financial crises. Moreover, our analysis of financial crises is based on Minsky's 5 stages of financial instability: Displacement, Boom, Euphoria, Profit-taking, Panic.

2.8 Stock market bubbles and the emergence of financial crises

There are various interpretations of the causes of a stock market bubble. A first explanation focuses on an initial increase in security prices (returns), based on actual economic events (i.e., an initial displacement in the economy, which is transmitted to the stock market). This initial upswing in security prices might be caused by exogenous factors and major economic events, such as: a) the discovery and invention of new products, new production methods, and new industries; b) the growth of global demand for a specific asset (prompted by a rise in incomes, also resulting from increased demand for raw materials due to intense production activity, and changes in consumer preferences) (Kotios and Pavlidis, 2012:43-45; Brown, 2011; Kapstein, 1994:58-80).

Whatever the cause of the initial displacement may be, if this is diffused across the economy, it will change the overall economic outlook. Euphoria is also transferred to the stock market, causing an initial and fair, on the basis of actual facts, increase in stock prices (initial displacement) (Minsky, 1982). However, the initial displacement is not enough for the phenomenon to evolve into a bubble. There are also certain additional factors that thrive on the basis of the initial displacement in the economy and the stock market, and, consequently, have an additional and catalytic effect on the completion of the stock market bubble. These factors include: speculation; investor expectations; imitation - herd behaviour; liquidity. Indeed, speculation motivates many consumers to invest in the securities market, in order to benefit from the observed rise in the price of an asset, increasing demand for securities, and sustaining a vicious spiral of security demand and price increases (Kindleberger, 1978:40; Minsky 1982). At the same time, investor expectations regarding the continuation of the rise of stock market prices, enhance and consolidate speculative tendencies among investors, thus having a catalytic effect on the intensification of demand for stock (Walh, 2009).

Imitation and the concept of herd behaviour, also reinforce this trend. Indeed, non-institutional investors, observing other stock market professionals and experts realise profits from speculative deals, also tend to act in the same way, thus spreading the phenomenon of speculative demand (Keynes, 2001:183-184).

Another key parameter that sustains strong demand for securities is the existence of liquidity (monetary policy, in conjunction with the banking system), which enables the transformation of speculative tendencies into action. The credit system enables a part of the population who do not possess adequate funds, to partake in the sale and purchase of securities. Thus, based on all the above, the initial rise in stock prices (displacement) can hatch and grow into a bubble (Kotios and Pavlidis, 2012). The direct consequence, in all the above cases, is the diffusion, of the practice of stock market investment across a large part of the population and, consequently, the excessive growth of demand for securities. Therefore, increased demand for securities leads to further price increases, thus reproducing and intensifying a vicious spiral of price and demand increases, and leading, via this process, to the creation of an asset price bubble (Kindleberger, 1978:40; Minsky, 1982)

Inescapably, the rise of stock market prices is interrupted by various endogenous and/or exogenous factors, leading to a violent adjustment in stock values, which also marks the onset of a stock market crisis (Alexakis and Xanthakis, 2008). Exogenous factors are related to adjustments in the economic environment, which cause an overall reduction of demand for securities.

The endogenous factors that are related to the bursting of the bubble include the concept of herd mentality, which drives investors en masse away from any investments and contributes to the weakening of the bubble. However, the public does not possess any expertise and fills in the gaps in their knowledge by imitating the experts. This factor does not help consolidate the conviction that stability will last, and fuels a disinvestment and asset price reduction mechanism, which leads to the "bursting of the stock market bubble" (Knoop, 2008:78).

The bursting of the bubble may also be caused by massive sales by institutional investors, as part of their speculative activity. More specifically, experts can predict possible changes in the conventional basis of stock evaluation, slightly before the general public. This way they precipitate certain events, by causing them to occur in a more intense way than if they had smoothly evolved. In addition, it has been often observed that experts artificially cause such situations, in order to benefit through their earlier withdrawal (Keynes, 2001:183-184). A banking crisis may also interrupt an asset price bubble, since it reduces the liquidity available for funding speculative demand for the asset. It is also possible that the two factors may interact (Flood and Garber, 1984b).

2.9 The effects of stock market crises on the business cycle

A stock market crisis may autonomously trigger the business cycle and lead to depression. To begin with, the bursting of the stock market bubble and the drop in stock prices affect the portfolios of businesses, reduce their wealth thus leading to losses, and lead to the contraction of their investment activity (Kotios and Pavlidis, 2012).

Moreover, the bursting of a stock market bubble quite often, albeit not always, affects the financial sector and its investment-financing function, since it increases the number of business that fail or face financial hardship and, by extension, their ability to repay their loans. It also reduces the net value of bank securities, as well as the value of the stock market products held by banks, for either collateral or investment purposes. Therefore, there is a close and interactive relationship between asset price bubbles, and stock market and banking crises (Kotios and Pavlidis, 2012)

In summary, the theoretical review of economic crises and, in particular, sovereign debt crises aims at providing us with the interpretative tools required for analysing the economic crises in the US and Greece, in order to study their effects on the economy.

DOI: 10.25103/ijbesar.143.03

3. The stock market crash of 1929 in the U.S. and the great depression

The Great Depression that befell the US as a result of the financial crisis of 1929-30 is among the harshest of the past hundred years, given its impact on the economy and the society. It is indeed telling that, even today, there is vibrant interest in the study of that phenomenon, since it is a milestone in the evolution of economics and a yardstick for all economic crises that have occurred until this date (Bernanke, 2000). This section will deal with the consequences of the 1929 crisis on the real economy of the US, after a brief discussion of its type, features, and causes.

3.1 Causes of the 1929 financial crisis in the US

Any effort to analyse the depression in the US economy in 1929 requires a study of both the causes of the financial crisis of 1929, and the macroeconomic situation prevailing in the US during the 1920s, before the onset of the financial crisis.

The 1920s saw significant economic growth. Indeed, there has been constant GDP and, therefore, constant GDP per capita growth since 1921, as shown in Figure 1, reflecting economic prosperity and the prevalence of strong demand across the economy.

This was accompanied by price stability, as shown in Figure 2 with the use of the Consumer Price Index (CPI, shows the price mobility of consumer staples purchased during a period of time) and the Wholesale Price Index (WPI, shows the cost of purchases for businesses, wholesale price).

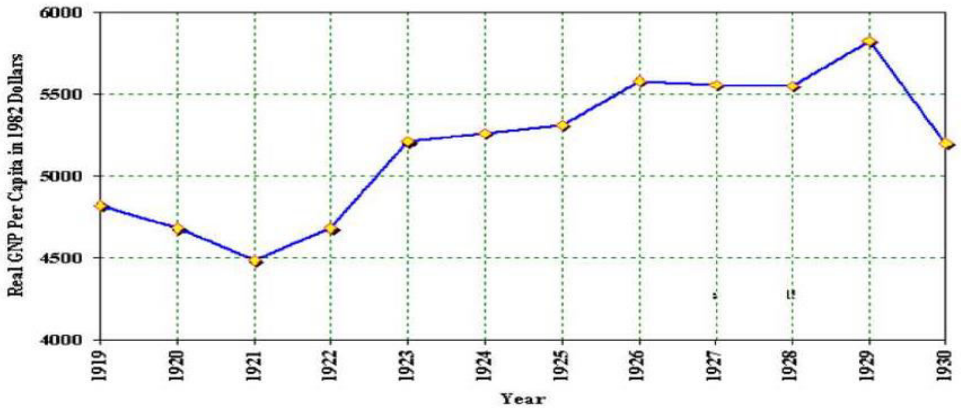


Figure 1. Per capita Gross National Product, US, 1919-1930

Source: Smiley, 2007

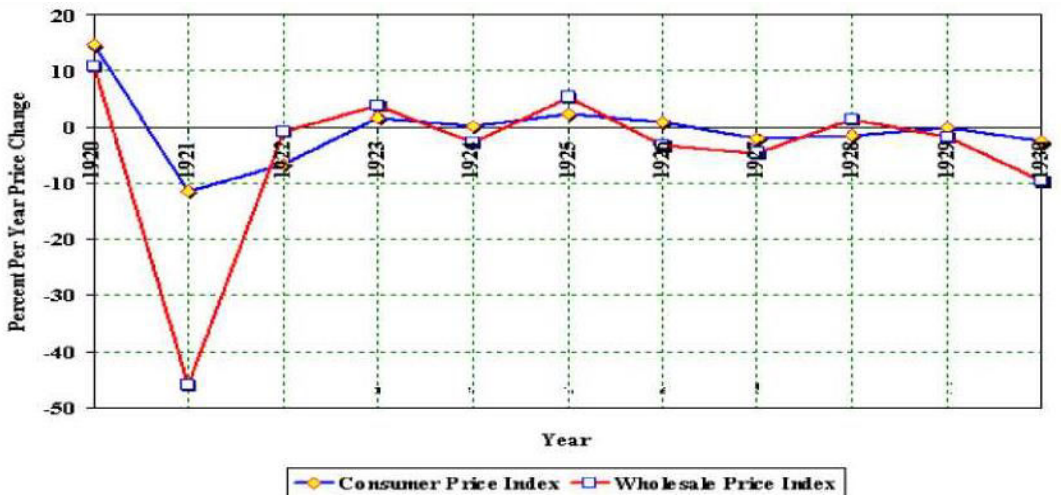


Figure 2. Price changes, US, 1920-1930

Source: Smile, 2007

Economic growth was the result of the industrial boom of that time. Indeed, the Industrial Production Index of the US Federal Reserve (Fed), which averaged at 67 (against a base of 100) during 1923-1925, rose to 110 in July 1928, and to 126 in June 1929. Strong industrial growth was, among other things, the outcome of the discovery of

DOI: 10.25103/ijbesar.143.03

new products, and the creation of new industries (such as automobiles, electrical appliances, the radio etc.) In 1926, automobile production stood at 4,301,000, and in 1929 it had increased by almost a million units, to 5,358,000, a number that compares favourably with the 5,700,000 new automobiles produced in 1953, a year of abundance (Galbraith, 2000: 23).

Moreover, the adoption of new, innovative production methods, in conjunction with the use of electricity, caused labour and capital productivity to rise, with beneficial effects on business profits. The construction sector also continued to grow, given the incessant increase in demand for the construction of roads and commercial buildings, thus precipitating economic growth (Crafts and Fearon, 2013). It is worth noting that monetary expansion in the US, which was realised through the low interest rates set by the Fed, helped boost economic activity (Kotios and Pavlidis, 2012).

In addition, the change of consumption patterns, because of the growth of per capita GDP and liquidity, further facilitated mass consumption, with positive effects on demand, thus giving rise to a virtuous circle of industrial output, per capita income, and economic growth. The conditions of euphoria in the real economy was transmitted to the stock market, leading to an initial upswing in stock prices, based on actual business profits and the overall economic progress (Reinhart and Rogoff, 2009a).

The combination of high liquidity and promising prospects in the new growing industries, allowed euphoria to take root, leading to the entry of new speculative investors in the stock market, attracted by the rise in stock prices (initial displacement) and the expectations for further growth. According to Galbraith, a representative index for gauging the magnitude of stock market speculation was the volume of trading on margin, which stood at 3,480,780,000 at the end of 1927, 4 billion in June, 5 billion in November, and close to 6 billion at the end of the year. This is how demand for stock and stock market transactions skyrocketed. During the year, a total of 920,550,032 shares changed hands in the New York Stock Exchange. Figure 3 shows the growth of stock and security sales during the 1920s. At the same time, the Dow Jones Industrial Average jumped from 100 points in 1926 to 381 points in September 1929 (its peak). The stock price bubble was a given fact (Galbraith, 2000).

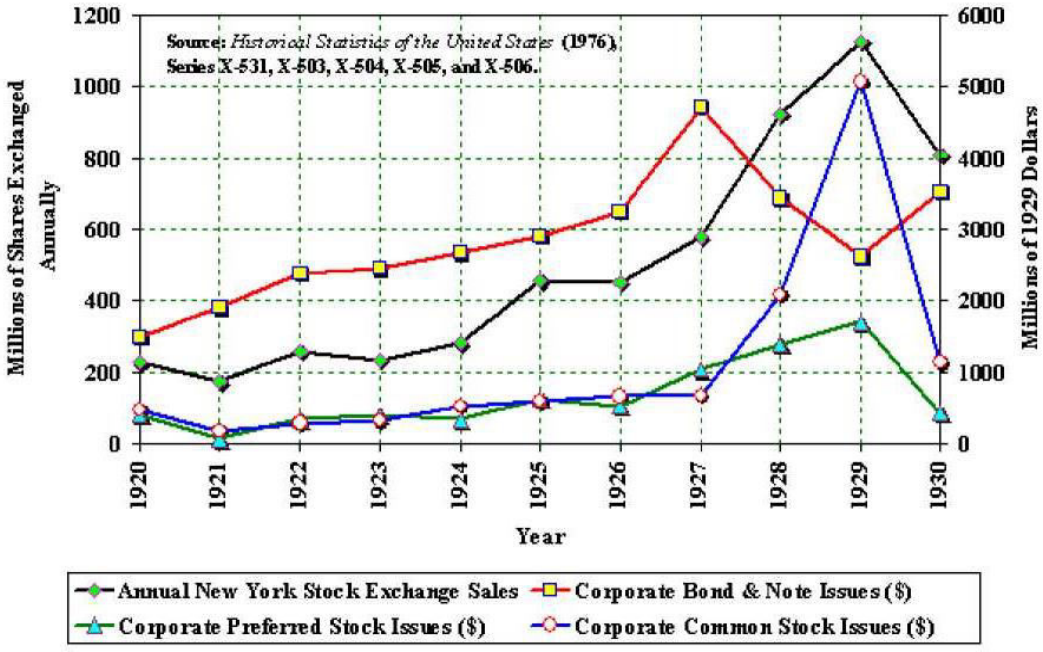


Figure 3. NYSE: Stock and securities sales, 1920-1930

Source: Smiley, 2007

Nevertheless, the rise of stock prices was interrupted when the stock market bubble burst in October 1929. Investor sentiment was reversed, stock prices fluctuated wildly, and panic took hold, urging investors to massive sell-off of shares. Daily stock trading volumes fell to 12.9-16 million shares, with their value almost reduced to zero (Galbraith, 2000).

3.2 The consequences of the stock market crash - the Great Depression

Bernanke recognises the correlation between the financial crisis and macroeconomic activity, as he points to the existence of a close relationship between the stages of the financial crisis (most importantly, bank failures) and the changes in output volumes, demonstrating the causal relationship between economic depression and financial crisis (Bernanke, 2000).

Indeed, the initial drop in stock prices caused losses for the portfolios of both businesses and private investors, thus reducing their ability to repay their loans. In fact, the non-performing loan to GDP ratio rose from 9% to 20% (Reinhart and Rogoff, 2009a).

DOI: 10.25103/ijbesar.143.03

Moreover, the collapse of share prices generated losses for banking portfolios, either because of the securities held by banks as collateral for the extension of loans, or resulting from their own trading in the stock market. The loss of depositor confidence towards the banking system led to four consecutive bank runs. It is worth noting that 744 banks failed in the first 10 months of 1930. By the end of 1933, the number of banks still in operation was slightly above half of the corresponding figure for 1929 As a result of the banking crisis, the provision of credit to the private sector shrank by 50% during the Depression (Galbraith, 2000) (Figure 4, bank loan fluctuations, 1918-1938).

Figure 4. Bank loan fluctuations, 1918-1938

Source: Pettinger, 2012

This financial turmoil was transmitted to the real economy, causing the Great Depression. The initial losses sustained by businesses as a result of their financial activities, combined with the drop in liquidity as a result of the banking crisis, led to the contraction of both business activity and production, causing additional losses and the closure of many businesses, which gave rise to a wave of layoffs. The income loss caused by the drop in share prices reduced consumer expenditure from 16.2 billion US dollars in 1929 to 0.3 billion in 1933. As a result, there was a reduction in total effective demand, which led to a further reduction of total output and, inevitably, to the rise of unemployment. From August 1929 to March 1933 total output fell by 52%, prices fell by 52%, and real incomes fell by 35%. Corporate profits, which in 1929 accounted for 10% of US GDP, turned negative in 1931-2, while private sector investment fell by 87% (Crafts and Fearon, 2013).

The state of the economy is made clear by the study of the evolution of key macroeconomic aggregates, such as: GDP, unemployment, and inflation. In the first year of the crisis, US GDP fell by 8.5%, while in 1932 its contraction rate stood at 12.9%; negative growth persisted for the next 4 years, with the economy having lost 20% of GDP, while positive growth rates were seen only in the fifth year, which signalled the end of the depression (Galbraith, 2000) (Figures 5 and 6). The decrease in output and, in general, in economic activity led to high unemployment, which peaked in 1932 above 25% (unemployment fell markedly from the 6th year onwards) (Figure 7). Another feature of the depression was deflation (Figure 8).

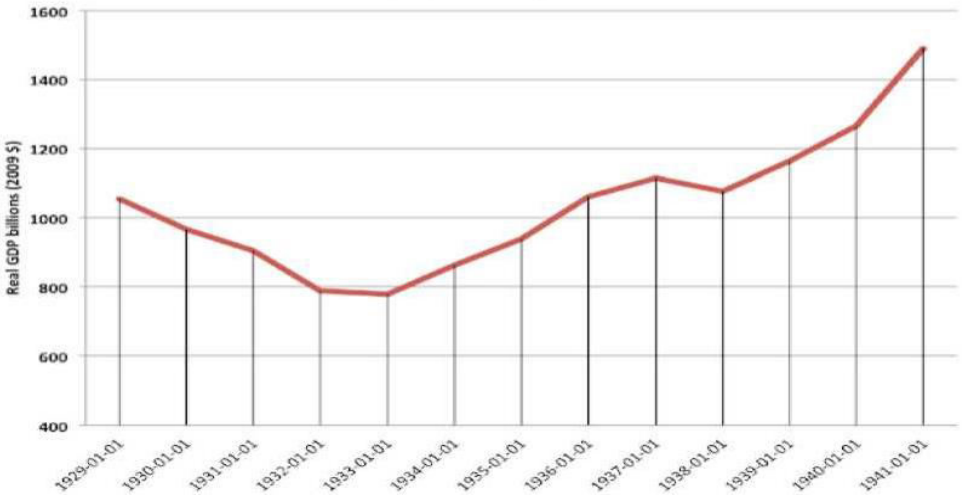


Figure 5. US GDP, 1930-1942

Source: Pettinger, 2012

DOI: 10.25103/ijbesar.143.03

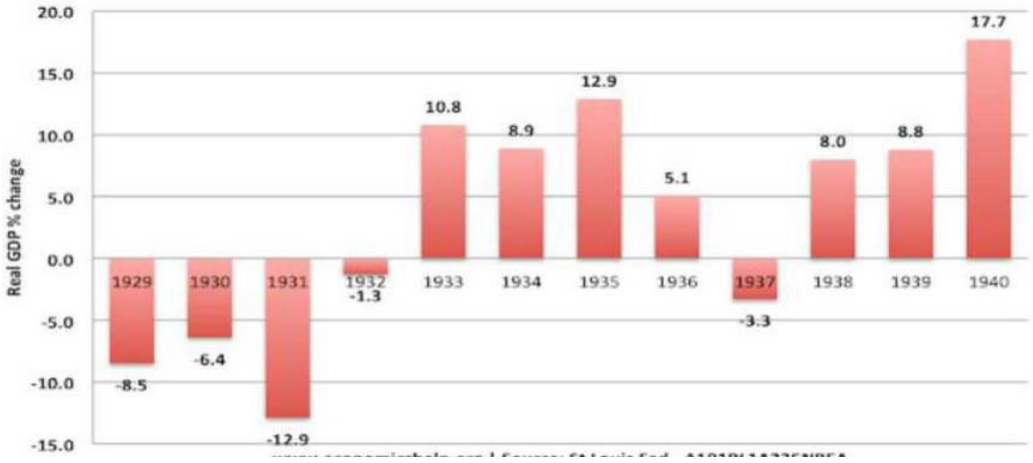


Figure 6. Annual % Change of US GDP

Source: Pettinger, 2012

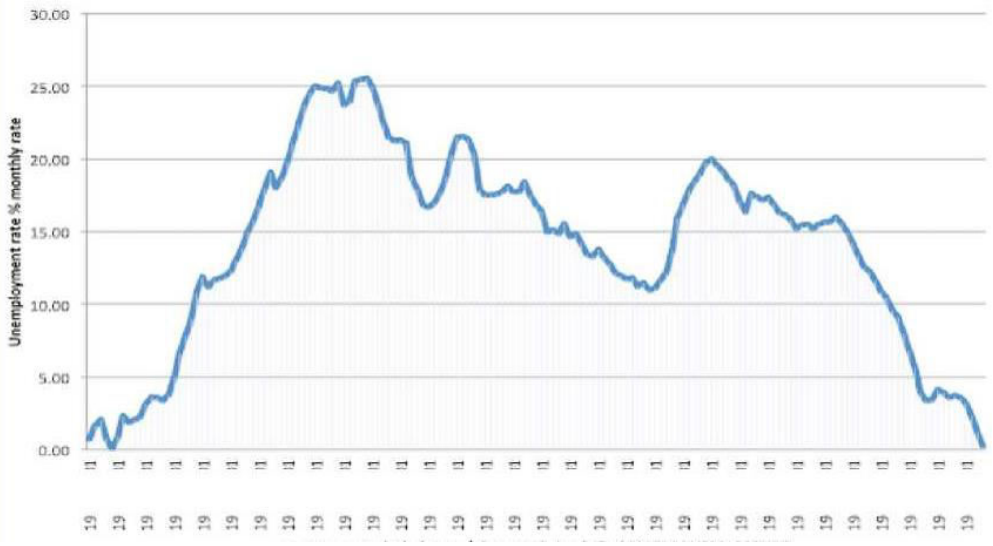


Figure 7. Unemployment fluctuation in the US during the Great Depression

Source: Pettinger, 2012

Figure 8: Consumer Price Index, 1922-1942

Source: Pettinger, 2012

DOI: 10.25103/ijbesar.143.03

4. The Greek Fiscal Crisis and Depression

The main argument of this paper is that Greece's fiscal position over time is characterised by high expenditure and the continuous accumulation of fiscal deficits, without any serious attempt to rationalise and control the multiplier effect of government spending. The direct consequence was a ballooning public debt. Moreover, non-productive spending facilitates the prevalence of an economic growth model that is based on domestic consumption, instead of innovative and extrovert entrepreneurship. This, however, does not only lay the groundwork for over-indebtedness because of the accumulation of deficits in the state budget, but, at the same time, the non-sustainability of a growth that is based on non-productive deficits with low multiplier effects, does not create favourable conditions for the repayment of loans.

4.1 Macroeconomic aggregates of the Greek economy over time

The intertemporal analysis of the Greek economy's macroeconomic data, as regards the evolution of primary deficits, public debt, government spending, as well as the qualitative characteristics of realised economic growth, reveals certain parameters of the Greek fiscal crisis. It is a fact that from 1975 to 1979 the Greek economy sustained adequate growth rates, against conditions of fiscal stability. That said, in 1979 and during the next decade there is a marginal increase in GDP (Table 3).

Research on the Eurostat database shows that, up to 1980, the annual fiscal deficit to GDP ratio remained stable and under control, at manageable levels of no more than 3% of GDP, whereas from 1981 onwards it increased and remained persistently high (with the exception of the run-up to eurozone entry and the achievement of the Maastricht criteria[1]: deficit at no more than 3% of GDP and debt at no more of 60% of GDP) (Table 3). However, despite the reduction of interest expenses (owing to the convergence of European interest rates) and despite Greece's almost certain accession to the EMU, primary spending started again to increase, leading to the rise of the public debt to GDP ratio (Karavitis, 2008). Thus, after the country's accession to the EMU and until the onset of the crisis, the deficit was once again strongly on the rise.

The existence of a deficit in the Greek economy means that the general government's primary spending increases faster than its total revenues.[2] Sophia Dimeli demonstrates that expenses equaled revenues up to the 1970s. In 1980, public spending stood at 25% of GDP and, since then, it has been continuously rising, reaching 47% of GDP, with a less than proportionate increase in revenues (Dimeli, 2010: 74). These persistent fiscal deficits were used for covering consumer spending, even during periods of growth (Alogoskoufis, 2013). Indeed, even in the 1990s, when Greece showed surpluses, these did not result from a reduction of public spending through the rationalisation of resources, but from the growth of public revenues (Argitis, 2012).

Table 3. Growth-development and fiscal deficit, 1975-2010

Year	Growth-development		Fiscal deficit	
	A) GDP at constant 2005 prices (€ bn)	B) Y-o-y Change (%)	C) Annual deficit at constant prices (€ bn)(%)	D) Annual deficit to GDP ratio
1975	95.7	6.4	-0.6	-2.9
1976	102.2	6.9	-0.4	-1.6
1977	105.2	2.9	-0.8	-2.5
1978	112.8	7.2	-1.0	-2.9
1979	116.6	3.3	-0.9	-2.4
1980	117.3	0.7	-1.0	-2.6
1981	115.5	-1.6	-4.0	-19.0
1982	114.2	-1.1	-3.6	-6.8
1983	113.0	-1.1	-4.0	-7.5
1984	115.2	2.0	-4.8	-8.3
1985	118.1	2.5	-6.9	-11.6
1986	118.8	0.5	-5.1	-9.4
1987	116.1	-2.3	-4.9	-9.1
1988	121.0	4.3	-6.4	-10.4
1989	125.6	3.8	-8.4	-12.2

[1] Makrydakis *et. al.* (1999), studying data on the Greek economy between 1958-1995, conclude that the Greek fiscal deficit was not manageable. Whereas Katrakilidis and Tabakis (2006) maintain that in 1956-2000 the Greek fiscal deficit was slightly manageable.

[2] This paper will only deal with the expenditure side of the Greek economy, without questioning the contribution of the efficient management of the revenue side.

DOI: 10.25103/ijbesar.143.03

1990	125.6	0.0	-10.4	-14.2
1991	129.5	3.1	-8.1	-9.9
1992	130.4	0.7	9.4	-11.0
1993	128.4	-1.6	-10.7	-12.0
1994	130.9	2.0	-7.8	-8.3
1995	133.7	2.1	-9.1	-9.1
1996	136.8	2.4	-7.3	-6.7
1997	141.8	3.6	-7.3	-5.9
1998	146.6	3.4	-4.7	-3.9
1999	151.6	3.4	-4.1	-3.1
2000	158.4	4.5	-5.2	-3.8
2001	165.0	4.2	-6.5	-4.5
2002	170.7	3.4	-7.6	-4.9
2003	180.8	5.9	-9.9	-5.8
2004	188.7	4.4	-13.8	-7.5
2005	193.0	2.3	-10.9	-5.6
2006	203.7	5.5	-12.6	-6.0
2007	210.9	3.5	-15.1	-6.8
2008	210.4	-0.2	-23.1	-9.9
2009	203.8	-3.1	-36.1	-15.6
2010	193.8	-4.9	-24.0	-10

Source: European Commission, 2013.

The non-rationalisation of public resources contributes to the maintenance of high expenditure and, consequently, deficits. Indeed, the research by Hauptmeier et. al. (2006) examines fiscal adjustment, the reduction, and the rationalisation of expenditure in different countries in the last three decades. In Greece, the reform and primary spending reduction effort made during the 2000s led to the reduction of the expenditure to GDP ratio by 0.4% (given the reduction of the country's borrowing costs following its entry in the EMU), while in countries that undertook ambitious reforms and started from more or less the same starting point (as regards the size of public spending) this reduction ranged from 9.7 to 23.3% (cited in Rapanos, 2008: 167-169). Actually, the rationalisation and containment of expenses are, to a great extent, achieved through the proper implementation of the government budget as an economic policy instrument.

Papadimitriou and Hadjigiannakis argue that in the last three decades the budgets of most ministries show major deviations in terms of realisation. It is indeed telling that, according to the research, realised expenses systematically exceed budgeted ones. This is evidence of the overall wasteful management of public finances, as no due process was adhered to regarding the study of the opportunity cost of each expenditure undertaken by the ministries, or the evaluation of the feasibility of each study in terms of its multiplier effect on economic growth, thus ignoring the need to better utilise available resources (Papadimitriou and Hadjigiannakis, 2010). As a direct consequence, the Greek economy was very wasteful, leading to the emergence of counter-productive deficits.

A continuously growing primary deficit is fed by government borrowing and, consequently, is added to the sovereign debt over time (Rapanos, 2008). In 1975, Greece's sovereign debt stood at 18.2% of GDP, much lower than the 60% suggested by the Maastricht treaty as manageable and safe for the economy. In the next decade, Greek debt started its gradual and steady increase, reaching almost 100% of GDP in the early 1990s and remaining around there until the onset of the crisis (Table 4). However, the unfavourable development of fiscal aggregates (debt and deficit) was accompanied by strong GDP growth, thus affecting the makeup and features of both the GDP, and the economic growth rate.

DOI: 10.25103/ijbesar.143.03

Table 4. Public debt to GDP ratio and changes thereof, 1975-2010

Year	Public Debt			
	A) As a percentage of GDP (%)	B) Y-o-y percentage change (%)	C) Absolute figure (at constant prices, € bn)	D) Y-o-y change as a percentage (%)
1975	18.2	-	3.9	-
1976	17.7	-2.7	4.6	17.9
1977	17.9	1.1	5.2	13.0
1978	23.2	29.6	7.2	38.5
1979	22.5	-2.2	7.9	9.7
1980	22.5	-0.9	8.5	7.6
1981	26.7	18.7	11.9	40
1982	30.2	13.1	3.4	28.6
1983	34.6	14.6	17.6	15.0
1984	41.3	19.4	23.4	33.0
1985	48.3	16.9	23.2	-0.9
1986	50.2	3.9	25.4	9.5
1987	56.4	12.4	29.1	14.6
1988	61.6	9.2	36.8	26.5
1989	64.8	5.2	42.2	14.7
1990	71.7	10.6	49.5	17.3
1991	74.0	3.2	57.5	16.2
1992	79.1	6.9	64.2	11.7
1993	99.2	25.4	84.9	32.2
1994	97.2	-2.0	88.7	4.5
1995	97.9	0.7	95.0	7.1
1996	100.3	2.5	107.7	13.4
1997	97.5	-2.8	114.9	6.7
1998	95.4	-2.2	115.7	0.7
1999	94.9	-0.5	122.3	5.7
2000	104.4	10.0	141.0	15.3
2001	104.7	0.3	151.9	7.7
2002	102.6	-2.0	159.2	4.8
2003	98.3	-4.2	168.0	5.5
2004	99.8	1.5	183.2	9.0
2005	101.2	1.4	195.4	6.7
2006	107.5	6.2	224.2	14.7
2007	107.2	-0.3	15.1	6.7
2008	112.9	5.3	263.3	10.0
2009	129.7	14.9	299.7	13.8
2010	148.3	14.3	329.5	9.9

Source: European Commission, 2013.

Indeed, Greek GDP during the period of the economic crisis (2000-2009) consists of 73% private consumption (the largest percentage in EU-27), against a eurozone average of 58.8% (Figure 9). The high percentage of consumption in the makeup of Greek GDP also resulted from the incessant annual increase of private and public consumption during the twenty-years that preceded the outbreak of the economic crisis (Tables 5 and 6). The point is to explore the contribution of various factors of the Greek Economy (investment, consumption, and external sector) to its growth.

DOI: 10.25103/ijbesar.143.03

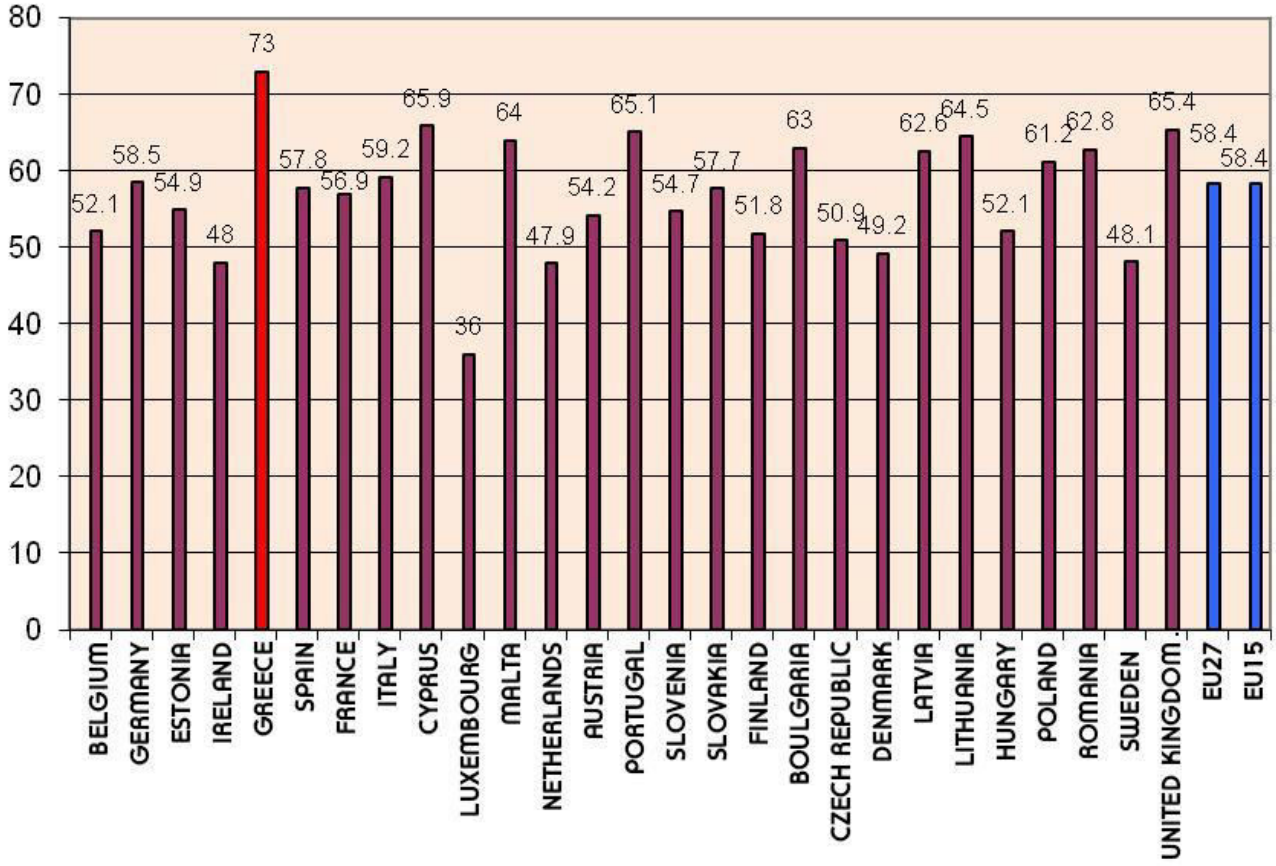


Figure 9. Private consumption to GDP ratio in EU countries, 2000-2009

Source: Anastasatos, 2009: 5

Table 5. Average annual percentage change of private consumption in Greece

Private consumption (Average percentage y-o-y change)							
Years	1992-1996	1997-2001	2002-2006	2007	2008	2009	2010
% annual change	1.8	3.1	4.3	3.2	-2.2	-4.5	

Source: *European Economy Forecast Spring 2011*, in Kotios and Pavlidis, 2012: 208-209

.

Table 6. Average annual percentage change of public consumption in Greece

Public consumption (Average percentage y-o-y change)							
Years	1992-1996	1997-2001	2002-2006	2007	2008	2009	2010
% annual change	1.0	4.3	3.9	8.2	1.5	10.3	-6.5

Source: *European Economy Forecast Spring 2011*, in Kotios and Pavlidis, 2012: 208-9

4.2 The contribution of various sectors to GDP growth

In 2000-2008, the Greek economy experienced a period of uninterrupted strong economic growth, at an average annual rate of almost 3.4% (Table 3), against an EU-16 average of 2.1%. That said, the economy was growing faster than its long-term potential output growth rate suggested (Anastasatos, 2009: 4), as we will try to demonstrate here.

We will examine the contribution of the three variables of the GDP formula (GDP = C + I + G + NX), which are: consumption, investment, and net exports, to the economy's growth. When studying the contribution of private

DOI: 10.25103/ijbesar.143.03

consumption to the growth of Greek GDP, we can see that it stood at 65.5%, against a eurozone average of 52.7% (Anastasatos, 2009: 4). This sustains a vicious spiral of growth and consumption.

As a direct consequence of increased private consumption, savings suffered a steep fall of -12% of GDP. In 1975, savings had reached their peak, exceeding 25% of GDP, and started to decrease since then, without any interruption until the advent of the crisis. During Greece's EMU membership, savings in Greece remained at consistently negative rates, whereas the eurozone average stood at 5% of GDP (EEAG 2011: 107). From 1989 onwards, this drop in the savings rate of the Greek economy is wholly attributed to the decrease in private savings from 27% in 1988 to 11% in 2008, thus leading to a scarcity of investment capital (Kotios and Pavlidis, 2011).

Total investment accounted for 23.4% of economic growth, as compared to an average of 21.2% in the eurozone. However, almost 1/3 of these investments concerned home construction (Anastasatos, 2009), as a result of the economy's specialisation in non-tradable goods (Christodoulakis, 2009), which crowds out the participation of productive and sustainable investments to the growth of the Greek economy, with obvious effects on supply, the composition of its productive fabric (Christodoulakis, 2009), and its international competitiveness, finally imposing a burden on the trade balance, as we will see from the examination of the economy's external sector.

The contribution of the external sector to Greece's economic progress prior to the crisis had been feeble. Indeed, exports of goods and services accounted for 30.8% of economic growth, against a eurozone average of 87.5%, highlighting the problem of limited openness, which is also a consequence of Greece's productive specialisation and reduced international competitiveness. Moreover, imports absorbed resources equivalent to 35.4% of economic growth, more-than-offsetting the positive contribution of exports. In other words, the external sector of the economy is a impediment to economic growth, as it deprives it of resources (Anastasatos, 2009).

Competitiveness, productivity, and per capita GDP in the Greek Economy

The economic growth experienced by Greece prior to the crisis did not match the competitiveness of its economy or the productivity of labour. Both figures are key determinants of the sustainability of economic growth.

The difference between per capita GDP and labour productivity in the Greek economy is both the outcome, and the cause, of the growth model that prevailed in Greece. Indeed, between 2000 and 2009, gross per capita income in Greece rose by 32%, as compared to 11% in France, 16% in Germany, 2% in Italy, and 10% in Portugal. In addition, "for the first time since 1981, Greece's living standard, measured in terms of private consumption, exceeded the EU-15 average, rising from 98.5% to 107.9% of the average for the 15-member European Union in 2008." (Sidiropoulos, 2016: 245).

That said, the productivity of one hour of labour increased by 26% in Greece during 2000-2009, as compared to 20% in France, 18% in Germany and Portugal, and 3% in Italy. Thus, we can conclude that the growth of productivity (labour compensation) in Greece was not sufficient to justify such a large rise in incomes (Sidiropoulos, 2016: 245-246).

The excessive and imbalanced rise in incomes resulted in price increases of 37% during the decade, as compared to 18% in Germany, 20% in France, 26% in Italy, and 29% in Portugal, which adversely affected the competitiveness of Greek products and the trade balance, as mentioned above (Sidiropoulos, 2016: 245-246).

The study of the mismatch between the economy's competitiveness and per capita GDP for 2011, presented in Table 7, can lead to important conclusions. In terms of income, Greece was ranked 31st in the world, whereas in terms of competitiveness it was ranked 90th. In order to understand the magnitude of this mismatch, we can just say that in terms of per capital GDP Italy was ranked 29th in the world, while in terms of competitiveness it was ranked 41st. Spain was ranked 27th and 37th respectively; these are discrepancies that are not encountered in developed countries.

This fact corroborates the fact that Greece was living beyond its means (Naftemboriki, 2017). That said, the productive specialisation of the economy, as well as the elevation of consumption to a key determinant of growth, are to a great extent related to the way the banking system operates and the economy is financed.

Table 7. Country rankings in terms of competitiveness and per Capita GDP, 2011

Country	Competitiveness	Per capita GDP	Change in place
Greece	90	31	59
Italy	41	29	12
Spain	37	27	10
Germany	7	19	-12
Portugal	45	39	6
Belgium	15	18	-3
Bulgaria	73	68	5
Albania	78	95	-17

DOI: 10.25103/ijbesar.143.03

Source: Processing of IMF data

4.3 The role of the banking system in the formation of the growth model of the Greek economy

The way Greek banks operate feeds back into the consumption-based growth model of the Greek economy and undermined its macroeconomic stability. Indeed, in 1990-2000 the Greek banking system operated under strict regulations, and under conditions of high stability, while the loans to deposits ratio stood at 0.40 in 1993 and rose to almost 0.56 in 2001.[3] Nonetheless, the Greek banking system, adjusted to the requirements of international competition and forced to better utilise its resources, embarked on a new period of operation during 2000-2008 (Drimpetas and Kalogeridis, 2016).

Indeed, the loans to deposits ratio rose from 0.64 at the beginning of the decade to 1.17 in 2010; this led to the reduction of safety margins and left commercial banks vulnerable to economic downturns.[4] During the same period, the sector increased its assets by 133%. Deposit growth stood at 50.62% and was disproportionate to the increase in loans, which stood at 176.25%, thus pointing to the responsibility of the central bank as the supervisor of commercial banks. However, the loans were not designed to reform the productive fabric of the Greek economy (Drimpetas and Kalogeridis, 2016), as is the case with successful growth models, such as that of South Korea (Kohli, 2004). Based on the data presented in Table 8 we observe exactly the opposite, as the number of total loans extended to the three industries in which Greece enjoys a comparative advantage, i.e. agriculture (€1.5 billion), tourism (€7.3 billion) and shipping (€14.2 billion) stands at €23 billion, whereas consumer loans exceed €32 billion (Papadogiannis, 2012).

By comparing the data and examining the ratio of consumer loans to loans extended to manufacturing and construction, we can see that consumer loans exceeded loans to manufacturing by 45% and loans to construction by 215% (Papadogiannis, 2012).

It is worth noting that consumer lending accounted for 14% of total loans, while mortgage lending accounted for a further 32%. Therefore, 46% of total loans were extended for consumption, as well as for housing (Papadogiannis, 2012), which is considered to be an in-between good, covering both consumer and investment purposes (Orleans, 2010: 23), albeit as an investment good it does not contribute to sustainable growth. Responsibility for the above structure of lending does not only lie with commercial banks, but also with the Bank of Greece and the political leadership that failed to properly oversee the banking system.

Table 8. The structure of bank lending to various sectors of the Greek Economy until September 2012

Loan amounts as per September 2012	Amounts in € million
BUSINESSES	**110320.00**
1. Agriculture	1503.00
2. Industry	22011.00
2.1 Mining and quarrying.	672.00
2.2. Manufacturing	21338.00
3. Commerce	22641.00
4. Tourism	7326.00
5. Shipping	14190.00
6. Construction	10146.00
8. Storage and transport, excluding shipping5944.00 7. Electricity, gas, water supply	1135.00
9. Other	18523.00
9.1. Information and communication	2885.00
9.2. Real estate management	4720.00
9.3. Professional and other activities	2873.00
9.4. Other sectors	8046.00
10. Insurance companies and other financial institutions	6902.00
FREELANCE PROFESSIONALS, FARMERS AND SOLE PROPRIETORSHIPS	**13957.00**
RETAIL CLIENS AND PRIVATE NON-PROFIT INSTITUTIONS	**107541**
1. Housing	75098.00

[3] This meant that, for every euro of deposits, banks extended total loans of 0.56 euros. It is well-known that the amount of loans extended by banks depends on the amount of deposits kept with them.

[4] Although the Greek economic crisis was not caused by the banking system, the fiscal crisis and the resulting depression dealt a huge blow to the stability of the banks, which had failed to create margins of safety. That said, the need to bail out banks through recapitalisation exercises increased public debt.

DOI: 10.25103/ijbesar.143.03

2. Consumer	30634.00
3. Other	1809.00
Total Loans	231818.00

Source: Papadogiannis, 2012

In conclusion, the study of the data shows that the growth model prevailing in the Greek economy was based on the ability to fuel consumption with loans channelled to counterproductive spending. This was compounded by the fact that sustainable and export-oriented productive investment –which utilises the country's competitive advantages, increases the added value of the primary sector's output and, at the same time, lays the groundwork for the specialisation of the economy's productive base in advanced sectors– did not play the leading role.

Effects of the crisis on the Greek economy

This section will discuss the development of GDP, the public debt, the budget deficit, public investment, the trade balance, inflation, and unemployment in the Greek economy for the period 2007-2017 (Table 9). In 2007 and 2008, and after many years of accelerating growth rates, Greek economic growth faced a slowdown, as a result of the outbreak of the global financial crisis. After the onset of the Greek fiscal crisis in 2009 and 2010, and the resulting austerity policy and income cuts, the economy's GDP fell by a further 9.1% in 2011, 7.3% in 2012 and 3.2% in 2013 (at constant 2010 prices). In 2014, the Greek economy returned to positive growth rates of 0.7%, while in 2015-2016 Greek GDP fell by a marginal 0.2-0.3%. In 2017, there was hesitant growth of 1.4%. Overall, the Greek economy has lost more than 30% of its income.

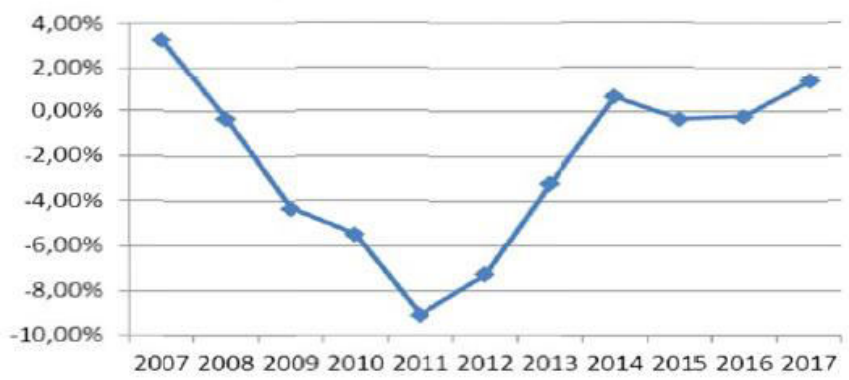


Figure 10. Evolution of GDP, 2007-2010

Source: Processing of ELSTAT data

Since the advent of the crisis, and for five years, the public deficit to GDP ratio does not show any signs of actual reduction, whereas there has been a significant contraction since 2015. Inflation tended to fall since the beginning of the crisis, and this is very logical and consistent with market conditions. Up to 2015 it decreased, whereas in the next couple of years it was back on the rise.

DOI: 10.25103/ijbesar.143.03

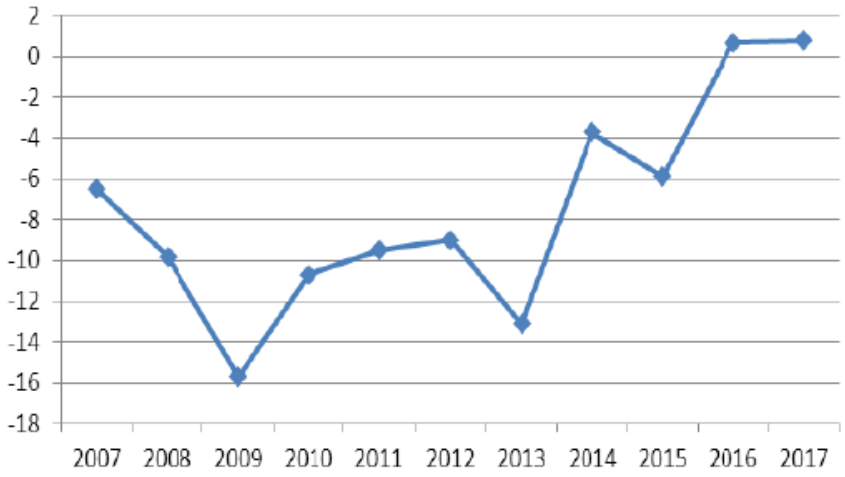


Figure 11. Public Deficit, 2007-2017

Source: Processing of ELSTAT data

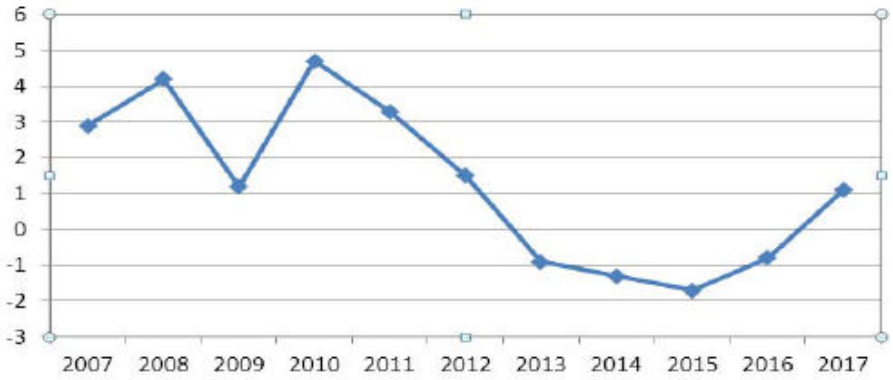


Figure 12. Inflation, 2007-2017

Source: Processing of ELSTAT data

Unemployment in Greece stood at relatively low rates of approximately 7.8% in 2008, almost on a par with the eurozone average. After the advent of the crisis and until 2015, unemployment started to grow, until it peaked at 26.5%, while in 2015 it fell slightly to 24.9%. This slow decrease continued in the next couple of years, so that in 2017, practically a decade after the onset of the crisis, unemployment still remained above 20% (21.5%). However, the total number of jobless individuals remains high, as it stood at 1027.00 thousand in 2017, as compared to 387.9 thousand in 2008 – in other words it trebled. The reduction in the absolute number of employed persons played a major role in the drop of the unemployment rate, as it fell from 4610.5 thousand in 2008 to 3752.7 in 2017 (Figures 13 and 14, and Table 10). Indeed, a KPMG study on the labour market and Greek migration showed that the total number of Greeks that left the country in 2008-2016 stands at almost 450,000. In their majority they are tertiary education graduates.

DOI: 10.25103/ijbesar.143.03

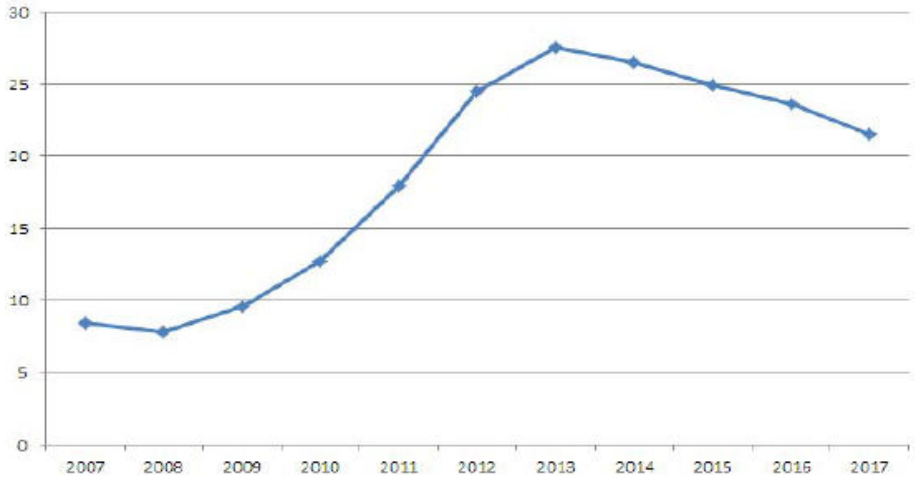


Figure 13. Unemployment, 2007-2017

Source: Processing of ELSTAT data

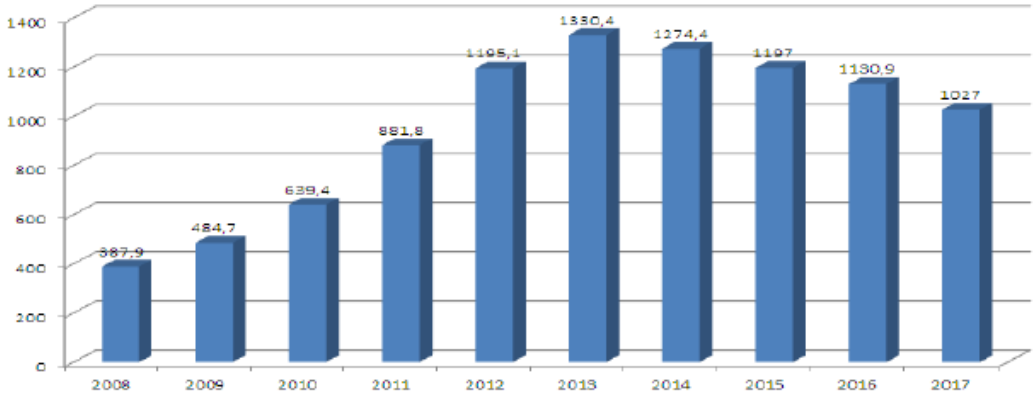


Figure 14. Unemployed individuals, 2008-2017

Source: Processing of data by the Population and

4.4 Labour Market Statistics Division of ELSTAT

The public investment sector shows remarkable stability during the decade. It started at 3.4% to 3.6% of GDP in 2008, showed a slight decrease up to 2012 (2.4%), only to rise up again to 3.8% in 2015. If, indeed, we take into account the fact that Greek GDP was declining throughout this period, we can conclude that no particular emphasis was placed on this sector, given that public investment includes community investments through NSRF programmes (Figure 15). Also, the trade balance remained in deficit, which, nonetheless fell from €42.5 billion in 2007 to almost half (€21.4 billion) in 2017. This is mainly due to the very large decrease in imports, itself the result of the steep drop in domestic purchasing power, without any actual improvement of the economy's exports (Figure 16).

DOI: 10.25103/ijbesar.143.03

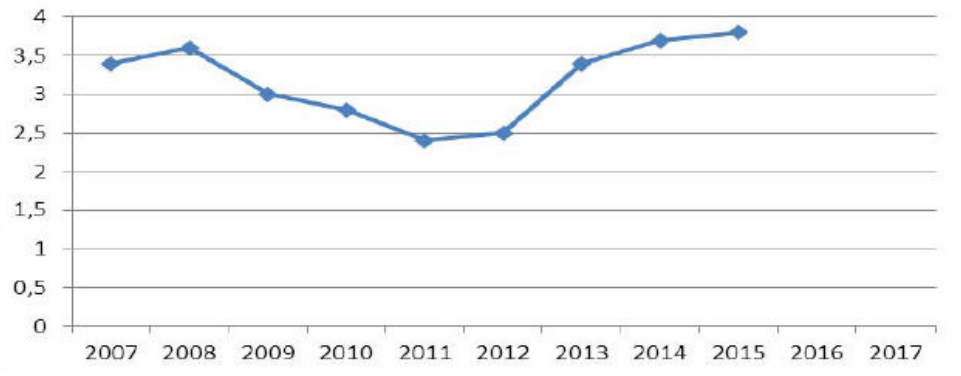


Figure 15. Public Investment, 2007-2017

Source: Processing of ELSTAT data

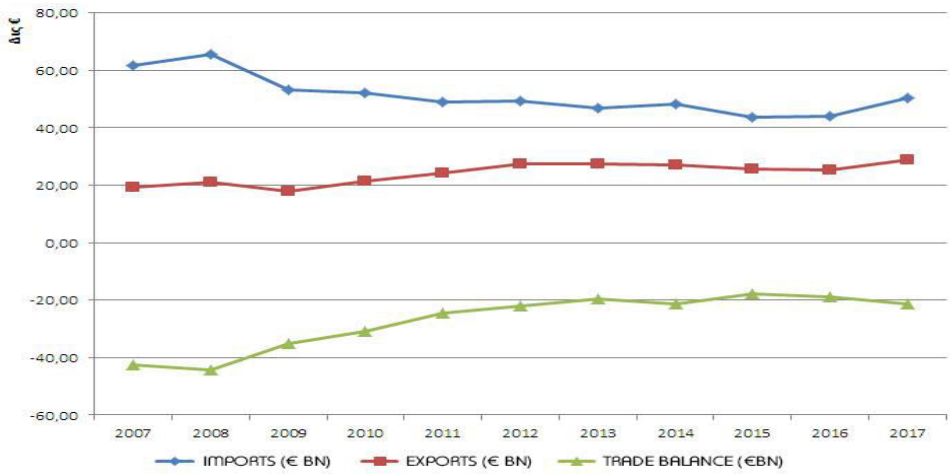


Figure 16. Imports- Exports – Trade Balance, 2007-2017

Source: Processing of ELSTAT data

Table 9. Evolution of key macroeconomic aggregates, 2007-2017

	Evolution of GDP (constant 2010 prices)	Budget deficit (% of GDP)	Average annual inflation	Public Investment (% of GDP)	Unemployment	Imports (€ million)	Exports (€ million)	Trade balance (€ million)
2007	3.3%	-6.5	2.9	3.4	8.4	61,857.3	19,313.4	-42,543.90
2008	-0.3%	-9.8	4.2	3.6	7.8	65,528.3	21,227.7	-44,300.60
2009	-4.3%	-15.7	1.2	3.0	9.6	53,135.1	18,015.1	-35,120.00
2010	-5.5% -10.7	4.7	2.8	12.7	52,147.5	21,299.4	-30,848.10	
2011	-9.1%	-9.5	3.3	2.4	17.9	48,891.5	24,377.3	-24,514.20
2012	-7.3%	-9	1.5	2.5	24.5	49,537.1	27,577.0	-21,960.10
2013	-3.2%	-13.1	-0.9	3.4	27.5	46,996.5	27,294.4	-19,702.10
2014	0.7%	-3.7	-1.3	3.7	26.5	48,327.1	27,118.4	-21,208.70
2015	-0.3%	-5.9	-1.7	3.8	24.9	43,602.1	25,824.9	-17,777.20

DOI: 10.25103/ijbesar.143.03

2016	-0.2%	+0.7	-0.8		23.6	44,187.4	25,463.5	-18,723.90
2017	1.4%	+0.8	1.1		21.5	50,273.0	28,843.1	-21,429.90

Source: Processing of ELSTAT data

Table 10. Population aged 15 and above, by employment status

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Employed	4610.5	4556	4398	4054.4	3695	3536.2	3536.2	3610.7	3673.6	3752.7
Unemployed	387.9	484.7	639.4	881.8	1195.1	1330.4	1274.4	1197	1130.9	1027
Non-economically active	4436.8	4390.4	4370.3	4436.7	4454.7	4466	4438.9	4438.9	4408.3	4397.2
Employment Rate[5]	48.9	48.3	46.7	43.3	39.5	37.7	38.1	39	39.9	40.9
Unemployment rate	7.8	9.6	12.7	17.9	24.4	27.5	26.5	24.9	23.5	21.5

Source: Population and Labour Market Statistics Division of ELSTAT

The economy's spiralling into prolonged depression and the worsening of macroeconomic aggregates have an impact on both the society and the people. However, studying the social consequences of the depression is beyond the scope of this analysis. We will only refer to the at-risk-of-poverty rate in Greece, as an indication of the social repercussions of the Greek economic crisis. Figure 17 shows the at-risk-of-poverty rate (calculated on the basis of the poverty line for the year 2005), which from 18.3% rose to 42% in 2014 and remained at these levels until 2016, pointing to the severity of the situation.

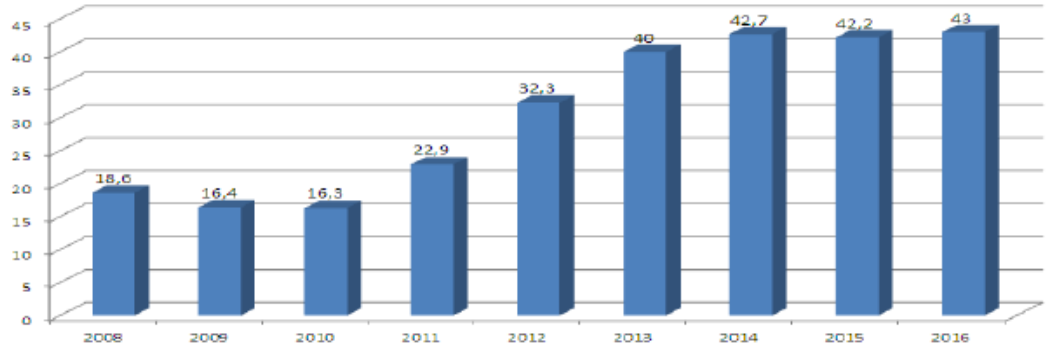


Figure 17. At-risk-of-poverty rate, based on the 2005 poverty line

Source: Processing of ELSTAT data

5. Comparison of Consequences for the Greek and US Economies

In fact, the magnitude of the effects of the Greek crisis on the real economy, as well as the duration of the depression, are comparable with the corresponding effects that were observed during the Great Depression of 1929 (Alderman et. al, 2017). This is corroborated by the comparison of key macroeconomic aggregates, which is presented below.

During the Great Depression the US economy suffered a cumulative GDP drop of 26%, whereas in the case of the Greek depression income contraction stood at almost 29.5% up to 2017 (Figure 18). As regards recovery times, the US economy started to recover after five years of incessant depression, while post-depression economic growth was strong at almost 10.8% (Figure 6). In Greece, the depression lasted for 7 years (Figure 18), while economic recovery is feeble, a fact that does not bode well for the sustainability of economic growth (Table 9).

[5] *The employment rate is the percentage of employed individuals over the total population*

DOI: 10.25103/ijbesar.143.03

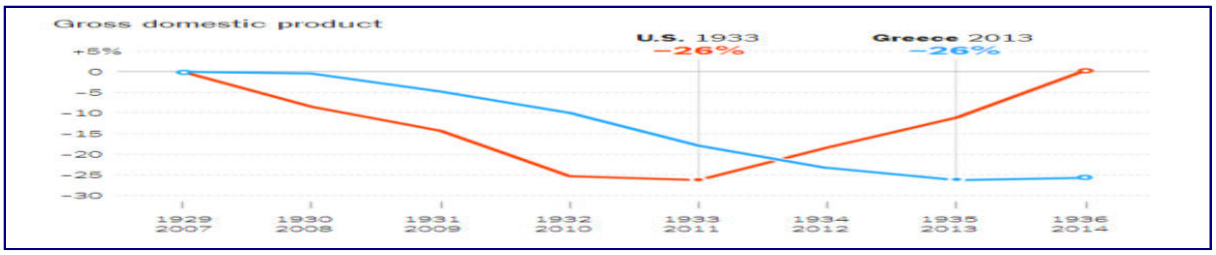


Figure 18. Percentage change of GDP since 1929 in the US and since 2007 in Greece.

Source: New York Times, U.S. Bureau of Economic Analysis; Eurostat; U.S. National Bureau of Economic Research; Bloomberg

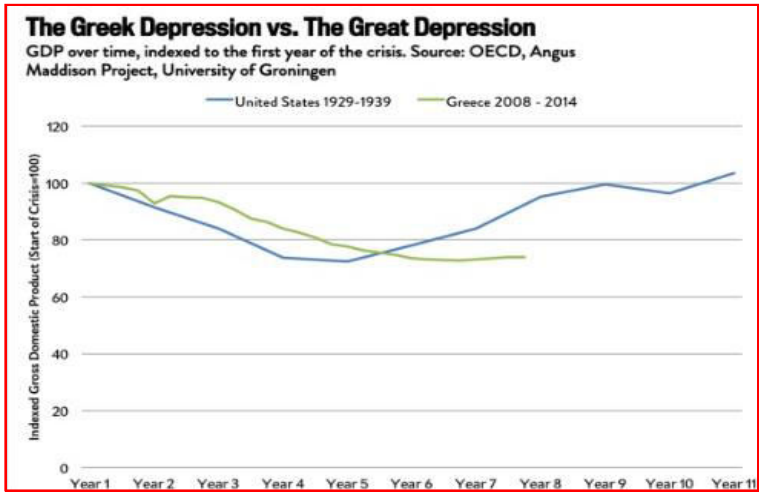
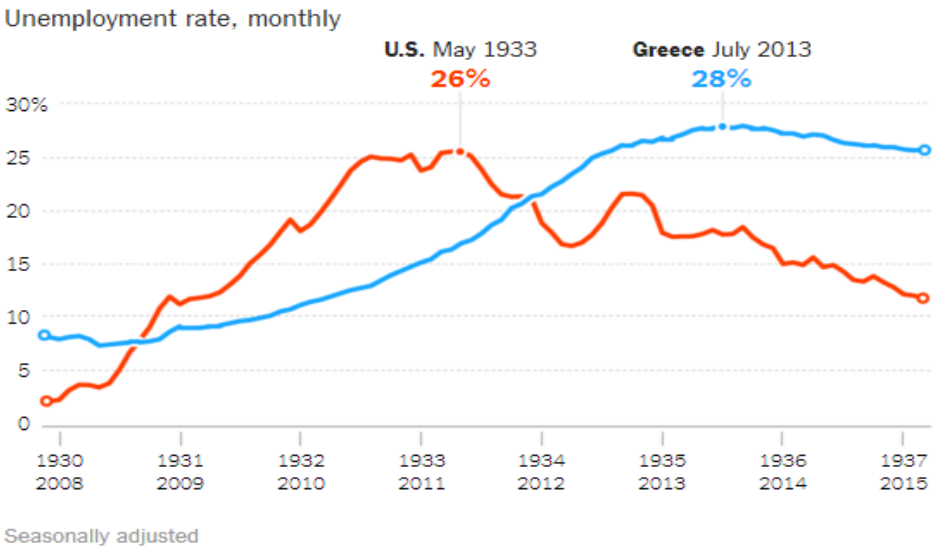


Figure 19. Comparison between the Greek and the Great Depression

Source: New York Times, U.S. Bureau of Economic Analysis; Eurostat; U.S. National Bureau of Economic Research; Bloomberg

Unemployment in the US had been rising for 3 consecutive years, reaching its peak in 1933 at 26% and improving significantly since then, as it fell by 10% in just one year, and in 4 years was almost back to its pre-crisis levels of approximately 12%. In Greece, unemployment kept rising for 6 years, reaching almost 28% at its peak, while its reduction is not significant and is, to a great extent, questionable, as discussed above (Figure 20 and Table 10). It is worth noting that up to this date unemployment in Greece remains the highest in Europe (Figure 21). The prolonged depression led to the contraction of the labour force in Greece, something that did not occur in the US (Figures 22 and 23).



DOI: 10.25103/ijbesar.143.03

Figure 20. Unemployment

Source: New York Times, U.S. Bureau of Economic Analysis; Eurostat; U.S. National Bureau of Economic Research; Bloomberg

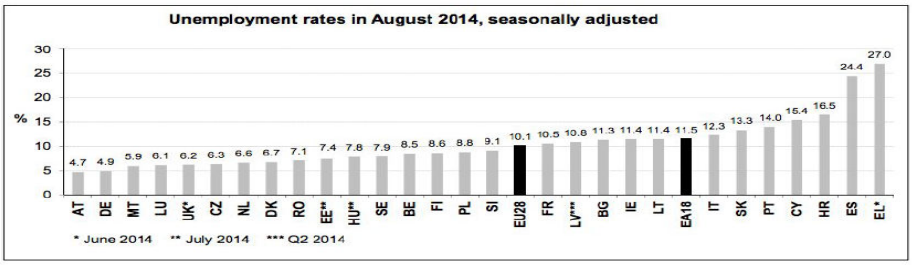


Figure 21. Unemployment per European country, August 2014

Source: Business Insider, Eurostat

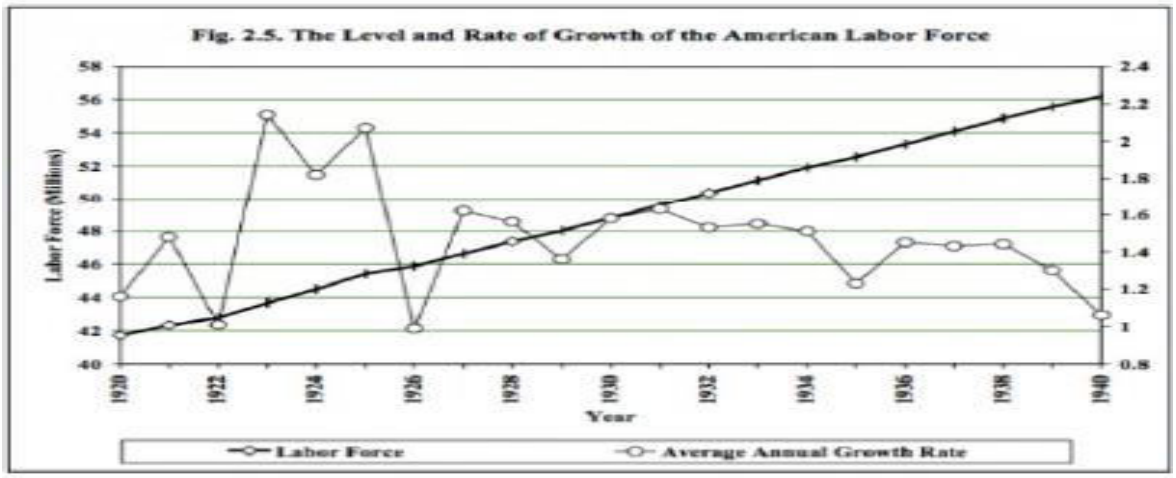


Figure 22. US Labour Force and Growth rate, 1920-1940

Source: Business Insider, The American Economy in the 20th Century, FRED

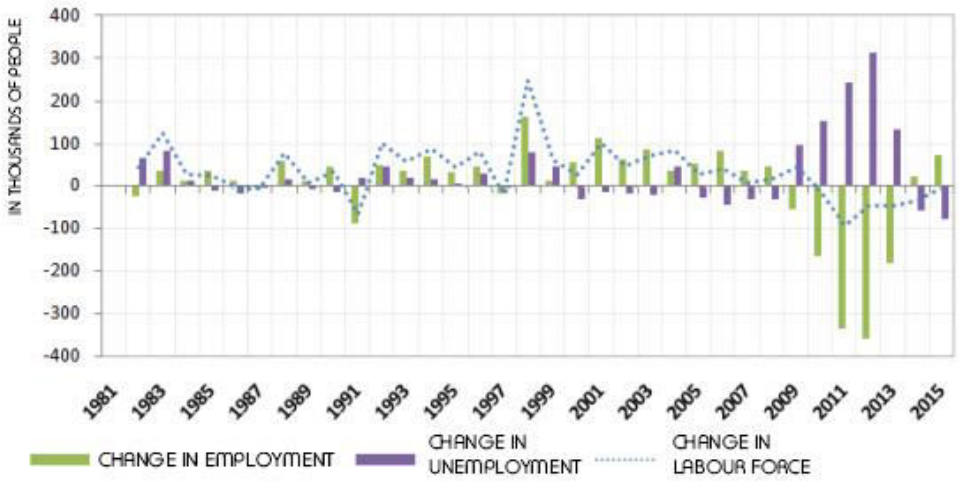


Figure 23. Greece: Changes in labour force, employment, and unemployment

Source: ELSTAT, Press release, February 2017

The Greek stock market fell more steeply than the US one, as the largest drop in the case of Greece reached 91% in June 2012, whereas in the US it reached 89%. In any case, our focus should be on the recovery of the stock market.

DOI: 10.25103/ijbesar.143.03

In the US, recovery was strong, immediately after the lowest point of the trough. In Greece, stability in the stock market has not yet been recovered, demonstrating that the country's reliability in the eyes of the investors remains precarious, a fact that does not give rise to prospects for the country's overall economic recovery (Figure 24).

Figure 24. Greek and US stock markets

Source: New York Times, U.S. Bureau of Economic Analysis; Eurostat; U.S. National Bureau of Economic Research; Bloomberg

6. Conclusions

The comparison of the two crises on the basis of their effects on the real economy demonstrates that the Greek crisis had harsher consequences than the US crisis, taking into account its impact on key macroeconomic aggregates susch as the income loss, the duration of the depression, the unemployment, the stock market index. Taking into account all the above macroeconomic fundamentals It is easy to conclude that the recent Greek depression that resulted from the fiscal crisis has been harsher than the Great Depression caused by the financial crisis of 1929 in the US.

Moreover, of particular importance is the feeble recovery of all economic aggregates in the case of the Greek economy as compared to the US economy, raising concerns about the ways the crisis was dealt and the overall management of the Greek economic crisis up to now. In addition, we ought to focus on the lack of national planning and a carefully planned actual and sustainable development of the real economy and, by extension, economic growth.

DOI: 10.25103/ijbesar.143.03

REFERENCES

Agglieta, M., 2009, The Economic Crisis (in Greek), Translation A. D. Papapgiannidis Athens, Polis.

Alderman, et. al., 2015. Is Greece Worse Off Than the U.S. During the Great Depression? Available at: https://www.nytimes.com/interactive/2015/07/09/business/international/is-greece-worse-off-than-the-us-during-the-great-depression.html (accessed November 25, 2017).

Alexakis, Ch. and Xanthakis, M., 2008, Behavioral Finance (in Greek), Athens, Stamoulis.

Alogoskoufis, G., 2013, Macroeconomics and Politics in the Accumulation of Greece's Debt: 1975-2009 (in Greek), Athens, Athens University of Economics and Business.

Anastasatos, T., 2009, "Towards a new Greek growth model: investment and extroversion" (in Greek), Eurobank Research, Economy and Markets.

Argitis, G., 2010, Bankruptcy and Economic Crisis (in Greek), Athens, Alexandria.

Bernanke, B., 1994, "The Macroeconomics of the Great Depression: A Comparative Approach", NBER, Working Paper No. 4814.

Bernanke, B., 2000, To understand the Great Depression is the Holy Grail of macroeconomics, Essays on the Great Depression, Princeton, Princeton University Press.

Crafts, N. and Fearon, P., 2013, The Great Depression of the 1930s: lessons for today, Oxford, Oxford University Press.

Dida, B. and Grossman H.I., 1988, "The theory of rational bubbles in stock prices", The Economic Journal, Vol. 98, (392), pp. 746-754.

Dimeli, S., 2010, Macroeconomic aggregates and growth rates of the Greek economy (in Greek), Athens, Athens University of Economics and Business.

Drimpetas, E. and Kalogeridis, N., 2016, "The Dynamics and Role of Greece's Banking system, 2000-2010", Roukanas, S. & Sklias, P., The Greek Political Economy, 2000-2015, Delft, Eburon, p.p. 66-95.

Economics Essays, 2012, "Causes of Great Depression", https://econ.economics help.org/2008/10/causes-of-great-depression.html (August 2018).

Economics of Everyday life (in Greek), https://www.dailyeconomics.gr/oikonomikoi-oroi/chrhmatopistwtikh-krish (November 2018).

EEAG, 2011, "The EEAG Report on the European Economy., A New Crisis Mechanism for the Euro Area", CESifo, pp.71-125.

European Commission, 2013, "Annual Macro-economic Database", http://eu.economy_finance/ameco//user/serie/SelectSerie.cfm (October 2017).

Flood, R. and Hodrick, R., 1990, "On testing for speculative bubbles", The Journal of Economic Perspective, 2, 85-101.

Flood, R.and Garber, P., 1984, Speculative bubbles, speculative attacks, and policy switching, USA, MIT Press.

Galbraight, J.K., 2000, The Great Crash of 1929 (in Greek), Athens, Livanis.

Howard, S., 1991, The business cycle. Growth and crisis under capitalism, New Jersey, Princeton University Press.

IMF, 2017, "Country Information", www.imf.org/external/country/index.htm, (October 2017).

IMF, 2017, "Data and Statistics", www.imf.org/external/external/data.htm., www.imf.org/external/external/ns/cs.aspx?id=28.htm, (October 2017).

Kapstein, E., 1994, Governing the global economy, international finance and the state, Massachusetts,Cambridge. USA, Harvard university press.

Karavitis, N., 2008, Public Debt and Deficit (in Greek), Athens, Dioniko publications.

Katrakilidis, C. and Tabakis, N., 2006, "Greek Budget Deficits, Structural Breaks and the Concept of Sustainability: New Econometric Evidence" Economics and Business Review, 3, pp. 263-278.

Kazakos, P. et. al., 2016, Greece's public debt (in Greek), Athens, Papazisis Publications.

Keynes, J. M., 2001, The General Theory of Employment Interest and Money (Greek translation by Th. Athanassiou), Athens, Papasizis Publications.

Kindleberger, C., 1978, Manias, Panics, and Crashes: A History of Financial Crises, New Jersey, Macmillan.

Knoop, T., 2008, Modern financial macroeconomics. Panics, crashes and crises, Oxford, Blackwell publishing.

Knoop, T., 2004, Recessions and Depressions. Understanding business cycles, London, Praeger.

Kohli, A., 2004, State-Directed Development: Political Power and Industrialization in the Global, Periphery Cambridge, Cambridge University Press.

Kotios, A. and Pavlidis, G., 2012, Systemic or Policy Crises? (in Greek), Athens, Rosili Publications.

Krugman, P., 2015, "Weimar and Greece, Continued", The New York Times, https://krugman.blogs.nytimes.com/2015/02/15/weimar-and-greece-continued, (February 2015).

Krugman, P., 2008, The Return of Depression Economics and the Crisis of 2008 (Greek translation by Ariadne Alavanou), Athens, Kastaniotis.

Lakasas, A., 2017. Brain-drain costs 15.3 billion (in Greek), Kathimerini newspaper, Available at: http://www.kathimerini.gr/946827/article/epikairothta/ellada/153-dis-to-kostos-toy-brain-drain. (accessed November 25, 2017).

Makrydakis, et. al., 1999, Forecasting: Methods and Applications, New York, Wiley.

Maraveyas N., 2009, "Ten years of EMU: convergence divergence and new policy priorities" The Hellenic Observatory LSE. Paper No 22.

Milward, B., 2000, "What is structural adjustment?", Mohan, G., Brown, E., Milward, B. and Zack-Williams A.B., Structural adjustment: theory, practice and impacts, London, Routledge.

Minsky, H., 1982, Can "It" Happen Again: Essays on instability and finance?, Journal of economic issues, 18.

Naftemboriki newspaper, 2017, "Per capita GDP inconsistent with Greek productivity" (in Greek). https://www.pressreader.com/greece/naftemporiki/20170329/281560880628764, (October 2017).

Orleans, A., 2010, "From euphoria to panic" (Greek translation by Babis Papadimitriou), Askenazy, P., Daniel, C.,

Nouvelles réflexions sur la crise financière, Athens, Polis publications.
Pantelakis, N., 1995, Public borrowing (in Greek), Athens, National Bank of Greece Cultural Foundation.
Papadimitriou, P. and Hadjigiannakis G., 2010, "The fiscal situation in Greece: In the end, it is all our blame" (in Greek), Minutes of the International conference on international Business, 2010 Thessaloniki, Greece.
Papadogiannis, G., 2012, "Greek banks extend loans for consumption and not production" (in Greek). http://www.kathimerini.gr/474143/article/oikonomia/ellhnikh-oikonomia/daneia-sthn-katanalwsh-kai-oxi-sthn-paragwgh-apo-tis-ellhnikes-trapezes, (July 2017).
Pauly, L., 2005, "The political economy of international financial crises", Ravenhill, S., Global political economy, N. York, Oxford University Press, p.p.225-245.
Pettinger, T., 2012, "Causes of Great Depression", https://econ.economicshelp.org/2008/10/causes-of-great-depression.html, (October 2018).
Pinto, B. and Prasad, M., 2009, "Lessons from market-access countries on public debt sustainability and growth", Braga, C. and Domeland, D., Debt relief and beyond: Lessons learned and challenges ahead, Washington, The World Bank, pp.181-201.
Rapanos, V., 2008, "Economic theory and fiscal policy: Fiscal institutions in Greece" (in Greek), Giannitsis, T., In search of a Greek growth model, Athens, Papazisis Publications, pp. 159-180.
Reinhart, C. and Rogoff, K., 2008, "This Time is Different: A Panoramic View of Eight Centuries of Financial Crises", NBER Working Paper No 13882.
Reinhart, C. and Rogoff, K., 2009, "The Aftermath of Financial Crises"., American Economic Review, 99, pp.466-472.
Reinhart, C.M. And Roggof, K.S., 2010, "From financial crash to debt crisis", NBER, Working Paper 15795.
Sidiropoulos, M., 2016, "Economic policy impetus to post-EMU Greece's economic growth",: Roukanas, S. and Sklias, P., The Greek Political Economy. Delft, Eburon, pp. 303-318.
Smiley, G., 2007, "The U.S. Economy in the 1920s.", https://eh.net/encyclopedia/the-u-s-economy-in-the-1920s/. (accessed October 5, 2018).
Smith, A., (1999/1776), Έρευνα για τη φύση και τα αίτια του πλούτου των εθνών, (Greek translation by Emmanouil Kalitsounakis), Athens, Papazisis Publications.
Spartiotis, D. and Stournaras, I., 2010, Fundamental Causes of the collapse of banks and financial markets, the experience of 2007-2008 (in Greek), Athens, Gutenberg.
Walh, P., 2009, "Food speculation – The main factor of the price bubble in 2008", Briefing Paper, www.weed-online.org, (July 2012).
Woodward, D., 1992, Debt and adjustment: an introduction, London, Pinter publishers.

DOI: 10.25103/ijbesar.143.04

International Journal of Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

Effects of Natural Resource exploitation on CEMAC Countries Development: The Human Capital Channel

Ghamsi Deffo Salomon Leroy †[1], Ajoumessi Houmpe Donal [1], Demgne Pouokam Véronique[1], Njoupouognigni Moussa Ledoux[2]

[1] Dschang School of Economics and Management, University of Dschang-Cameroon
[2] ENSET Douala, University of Douala-Cameroon

ARTICLE INFO

Article History

Received 26 June 2021
Accepted 17 November 2021

JEL Classifications
A10, C23, C51, O43

Keywords:
Natural Rent, Economic Development, Human Capital and Panel data.

ABSTRACT

Purpose:
The aim of this study is to determine the effect of the exploitation of natural resources on the development of CEMAC countries and to examine human capital as a transmission channel.

Design/methodology/approach:
In order to achieve our goal, we formulate a panel of 6 CEMAC countries over the period 2002-2018. This period of study is justified by the surge in the prices of natural resources in the market and also a fall of the prices of basic resources following two large exogenous shocks (subprime crisis and 2015 oil crisis). The estimation method use is the fixe effect, two stage least square and the Maximum likelihood with limited information.

Findings:
Of the estimation by the fixed-effect method show that natural resources abundance measured by: total rent, oil rent and forest rent has a negative effect on economic development. Likewise, human capital contributes to the transmission of these effects. The minimum education rate beyond which natural resources no longer have a negative effect on economic development, measured by the logarithm of GDP, is approximately 0.52, 0.51 and 0.48 respectively when we consider the total rent, the oil rent and the forest rent. This result is confirmed with the adoption of Maximum likelihood with limited information and the Two Stage Least Squared.

Research limitations/implications:
This study is limited in time and space. Moreover, the failure to take into account certain human capital or development variables.

Originality/value:
In the literature on the natural resources curse, the analysis of transmission channels in developing countries remains largely unexplored. The human capital component studied in this article is one of the first in the case of CEMAC countries. Also, we studied the effect of many resources, both renewable and non-renewable.

1. Introduction

Natural resources are essential for the monitoring of men and the economic development of nations. Several states of the world have used raw materials to increase their levels of development, and are currently using these same resources. In the 1960s, about 80% of developing country exports were raw materials, while today 80% of exported goods are industrial products (Gelb, 2010).

Until the end of the 1980s, economic orthodoxy considered the abundance of natural resources as an important vector of development, which made it possible to attract investors and increase export income (Carbonnier, 2007).

†Corresponding Author: GHAMSI DEFFO Salomon Leroy
Email: lavoidef@gmail.com

DOI: 10.25103/ijbesar.143.04

However, during the 1970s, the rise in the price of hydrocarbons had negative consequences on the world economy. There had been a decline in growth, a slowdown in industrial production, rising unemployment and worsening budget deficits. This fact was recognized as the first oil shock.

After the oil shock in 1973, a debate on the risk of depletion of natural resources arose in the economic literature at the end of the 1970s. An intergenerational allocation of resources held the attention of researchers. Hartwick (1977) discusses the idea of substitution of different forms of capital. For example, natural resources that have been completed depleted may be replaced by artificial capital (Noula and al., 2020).

The rise in oil prices at the end of the 1970s again plunged the world's economies into a chaotic situation, similar to that of 1973: it was the second oil shock of 1979.

A year later, the exploitation of natural resources, more precisely petroleum, was still considered a lever for economic development. After the shock of 1986 set up by the Organization of the Petroleum Exporting Countries (OPEC), researchers are interested in the role of natural resources in economic development. It was then that in 1993 the concept of the natural resource curse was introduced into the literature by Auty (1993). Indeed, he notes that States rich in natural resources are less developed than those poor in basic resources. The work of Sachs and Warner (1995) opened a wide debate on the relationship between the exploitation of natural resources and economic development. Indeed, show that most countries that have an economy dependent on natural resources have had slower economic growth.

In addition, natural resource-dependent economies are increasingly exposed to exogenous shocks. After the shocks of the 1970s which considerably affected the world economy, the CEMAC countries were particularly affected by the economic crises of 2008 and 2015.

About the 2008 financial crisis, the financial policy of the United States of America was the main cause of the outbreak of this economic depression which very quickly affected all of the world's economic circuits.

CEMAC countries have particularly suffered. The financial and economic crisis of 2008 affected the main levers of growth in African countries. The demand and prices of African raw materials have fallen; promises of increased official development assistance made by developed countries have not been fulfilled (Noula and al., 2020; AfDB, 2009).

The second crisis is that of 2015. Indeed, after having fluctuated for several years between 80 and 110 US dollars, the price of a barrel of crude oil began to fall in the second half of 2014. A slight rise was observed in the spring of 2015, passing thus at the US $ 60 per barrel, a rise mainly due to the seasonal increase in American demand (the "driving season"[1] from April to September), during which Americans massively use their vehicles to travel. Prices fell further at the end of the summer (Noula and al., 2020). WTI[2] (West Texas Intermediate) fell below the US $ 40 per barrel at the end of August 2015. It stood at the US $ 45 per barrel on September 9, 2015 (DGRIS, 2015; Noula and al., 2020).

This crisis also confirms the vulnerability of the CEMAC countries to external shocks and the economic turmoil of the countries of this economic and monetary community. The economic vulnerability of the countries of this community is seen through the growth of the GDP.

After the 2015 crisis, GDP growth remained very low, compared to that of some economic zones and that of the world (Noula and al., 2020).

Table 1: GDP growth of some economic zones and that of the world

	2014	2015	2016	2017
Monde	3.6	3.5	3.2	3.7
ASS	5.1	3.4	1.5	2.8
Zone franc	5.5	4.3	3.6	3.9
CEMAC	**4.6**	**1.9**	**- 0.23**	**0.03**
UEMAO	6.5	6.3	6.5	6.7
Comores	2.1	1.0	2.1	3.0

Source : Ghamsi et al. (2020)

[1] During the holiday period, there is an increase in the use of means of transport and consequently an increase in fuel consumption.

DOI: 10.25103/ijbesar.143.04

In 2014, before the outbreak of the crisis, the growth of CEMAC was 4.6, very close to the growth of economic zones like ASS and the franc zone. It was even superior to that of the world and Comoros. In 2015, the year the crisis started, CEMAC's GDP growth fell from 4.6 to 1.9, lower than that of the world, WAEMU and the Franc zone. In 2016, this growth continued to drop from 1.9 to -0.23, lower than that of all the economic zones mentioned in Table 2. The same is true for 2017, where we observed a slight increase in growth (from -0.23 to 0.03); but which was also the weakest among the aforementioned economic zones.

In addition, the CEMAC States are classified among the least developed on the planet. According to UNDP (2018) the most developed CEMAC country after the crisis in 2015 was Gabon with an HDI of 0.702, but the latter is only ranked 110th in the world. Gabon is followed by Congo with an HDI of 0.606 and is ranked 137th in the world. Two CEMAC countries namely Chad and CAR are among the top 5 least developed countries on the planet with development indicators of 0.404 and 0.367 respectively. These countries are ranked 186th and 188th in the world rankings (Noula and al., 2020).

In addition, the literacy rate of Central Africans aged 15 to 24 was less than 40% in 2015, or about 48% for men and 27.0% for women. This secondary school enrollment rate was only around 13% in 2012. Girls are clearly at a disadvantage compared to boys, as the secondary school enrollment rate for the latter was 17.93% in 2012, which is close to double that of girls, which 9.34% (UN, 2016) was.

This economic and social unrest in countries dependent on natural resources is known in the literature as the “resource curse”. The work of Sachs and Warner (1995, 1997) broadened the debates on the relationship between natural resources and economic development. Because, the latter explain the phenomenon of the curse of natural resources by the theory of the Dutch Syndrome, or the "booming sector". According to this theory, the exploitation of an important resource in a country results in the destabilization of the productive system (Gregory, 1976; Corden, 1984; Corden and Neary, 1982).

An important question in the economic literature is what the transmission channels of the natural resource curse are. First, the poor quality of institutions (Phillippot, 2009; Torvik, 2002; Mehlum et al., 2006; Aoun, 2008), institutions occupy an important place in economic analysis, and constitute the explanatory basis for several economic failures (Acemoglu et al., 2001).

According to Philippot (2009), the exploitation of natural resources leads to the sectoral distortion of the national economy; second, it negatively affects the quality of institutions. Likewise, Institutions create conditions conducive to the 'voracity effect', highlighted by Lane and Tornell (1999), which show that revenues from the exploitation of natural resources are diverted by an elite group towards less profitable projects.
Second, the volatility of commodity prices (Shaxson, 2005; Van der Ploeg and Ploelhekke, 2008; Avom and Carmignani, 2009).

Volatility leads to poor economic planning, leading to a budget deficit which pushes states into debt. Countries whose economies are based on the exploitation of natural resources tend to get into debt, because it presents guarantees of solvency in financial markets (Noula and al., 2020).

Third; a deficit in human capital indeed: human capital is an important determinant of economic development. It has been recognized as such on the theoretical and empirical level by the work of Romer (1986), Lucas (1988) and Mankiw et al. (1992). Indeed, Mankiw et al. (1992) shows that the introduction of human capital in the neoclassical model of Solow (1956), will give robust results (Gurgand 2002).

Likewise, human capital, more precisely education, stimulates growth and improves living conditions through several chains: firstly, by increasing the efficiency of the labor force, secondly by creating conditions of good governance and thirdly, by improving health care offerings (Ghamsi and Tadadjeu, 2020).

Moreover, According to Birdsall et al. (2001), Gylfason (2001), Stjins (2006), Coulibaly (2013), Kim and Lin (2017), Behbudi et al. (2010), Shao and Yang (2014), Manning (2004), the exploitation of natural resources negatively affects human capital.

Zallé (2018), suggest that countries must simultaneously step up their investments in human capital to turn the natural resource curse into a blessing.

Likewise, for Hua-Ping (2018) Governments should use revenues from natural resource exploitation to increase investment in education to improve human capital.

Human capital promotes workforce growth, innovation and creativity, encourages people to get involved in political life, to seek good governance through democracy. Human capital also facilitates the absorption of superior technologies from developed countries (Barro, 2001). Education positively affects health and helps reduce inequalities (Aghion et al. 1998).

Likewise, Ghamsi et al. (2019) Believe that the exploitation of mineral resources reduces the human capital of CEMAC countries. Indeed, their study reveals that the exploitation of mineral resources negatively affects education, reduces life expectancy and increases infant mortality.

The countries of the CEMAC zone have made considerable efforts in education over the past two decades; those despite the resurgence of conflicts that force populations to move. However, Gylfason (2001); Birsal et al (2001), Atangana (2019), found that, the problem of African countries rich in natural resources is the low rate of education; hence the controversy which raises the question of knowing: does education allow natural resources to boost or harm economic development of African countries? Specifically, this article is about verifying the level of education from which natural resources exploitation boosts economic growth.

DOI: 10.25103/ijbesar.143.04

Our objective is to determine on the one first the effect of the exploitation of natural resources on the economic development of the CEMAC countries; and second to analyze the contribution of human capital in the transmission of these effects. The remainder of this article is organized as follows: section 2 is devoted to the literature review, section 3 is reserved for the methodology and presentation of the results and section 4 is for the conclusion.

2. Natural resources and education: the teachings of literature

A big debate in the natural resource curse literature is the link between human capital and natural resource and the economic development of commodity-dependent countries (Gylfason, 2001; Coulibaly, 2013; Stjins, 2006; Kim and Lin, 2017; Behbudi and al., 2010; Ghamsi and al., 2020; Manning, 2004).

According to Shao and Yang (2014) countries exposed to the natural resource curse are those with low investments in human capital. They also show that the government, through the institutions it embodies, can improve the quality of education by developing a job offer for a skilled worker. Atangana (2019) seems to agree because according to him, governments of African countries must adopt good institutions to allow natural rents to participate in the accumulation of human capital.

In most countries of the world, the benefits of education are exhibited, but investment in the education sector is hampered by a lack of financial means in most countries (Ghamsi and al., 2019). However, the abundance of natural resources can increase investments in human capital in countries. In contrast, countries rich in natural resources are countries that invest very little in education, compared to other countries. Investing in human capital can create a virtuous circle. But, the governments of the countries rich in NR are pushing the whole population to move away from this virtuous circle. (Ghamsi and al., 2019; Birdsall et al., 2001).

Similarly, the study by Gylfason (2001) and Ghamsi and al. (2019), shows that education is the cause of poor economic performance in countries rich in natural resources. In his opening remarks, he recalled that countries endowed with natural resources had low long-term economic growth, compared to countries endowed with natural resources. This is the case of Nigeria which, after independence in 1960, and although rich in petroleum resources, has a per capita GNP not very different from that of countries poor in natural resources. Several other countries are in the same situation, notably Venezuela, Kuwait, Libya, Qatar, etc.
Gylfason (2001) and Ghamsi and al. (2019), shows that among the 65 countries rich in natural resources, four stood out for their domestic investment, their rate of investment and their rate of GNP growth. Among these countries we can cite Botswana, Indonesia, Malaysia and Thailand. The three Asian countries have achieved their success by diversifying and industrializing their economies. And Botswana, rich in diamonds, is in the same vein.

In his analysis, Gylfason envisions 4 channels of transmission of the natural resource curse: firstly, the theory of Dutch syndrome; a boom in the natural resources sector is accompanied by an increase in the exchange rate and subsequently, induces a decline in exports in the manufacturing sector. Secondly, the rent-seeking behavior. Thirdly, the quality of institutions and finally, education.

In contrast, Bravo-Ortega and De Gregorio (2005) highlight two main reasons explaining the negative effect of natural resources on growth and economic development. The quality of institutions. Institutions create conditions favorable to the "voracity effect" indeed, the "voracity effect": highlights the fact that in states endowed with bad institutions, the elite in power tends to err on the side of optimism by initiating gigantic projects, when it does not simply divert the rent for its account or in a purely clientelist logic (Carbonnier, 2007).

Second, the misallocation of resources between various activities having different effects on growth. For example, financial, human and material resources in a country can be allocated either in the extractive sector or in the production of human capital. The main results of their analysis show that growth in an economy is a weighted average of the growth of the natural resources sector and that of the industrial sector. Indeed they lead to the hypothesis according to which natural resources use a constant amount of human capital stock unlike the industrial sector which uses ever-increasing human capital and generates rapid economic growth. The exploitation of natural resources limits growth as long as the level of human capital is low. Zallé (2018), suggest that countries must simultaneously step up their investments in human capital and struggle to turn the curse of natural resources into a blessing; it is important to combine one form of capital with another. The transformation of natural capital into human capital can be a means of increasing total output if this conversion aims at more productive forms of capital (OECD, 2009).

Likewise, Behbubi et al. (2010) start from the observation that studies of the relationship between growth and abundant exploitation of NRs (Natural Resources), are mixed because some of the natural resources seem to be the engine of economic growth; but for them, it does not seem easy to achieve development by exploiting only these resources (Ghamsi and al., 2019). However, economic theory suggests that all other things being equal, natural resources increase the possibilities of a powerless economy, as well as economic growth, but the exploitation of natural resources has become rather a curse because, in the long run it harm on economic growth through several transmission channels (Ghamsi and al., 2019).

DOI: 10.25103/ijbesar.143.04

Coulibaly (2013) undertakes a study to examine the relationships between the abundance of NRs (Natural Resources), HC (Human capita), and income level in sub-Saharan Africa. Furthermore, he studies the long-term relationship between the abundance of NR, HC and income level in the Malian context.
The data used during their study are those of the WB ranging from 1980 to 2012. In Mali, natural resources have a positive effect on human capital in the long term; on the other hand, they harm long-term economic growth, if public expenditure on education is used as a measure of human capital (Ghamsi and al., 2019); and as an abundance of natural resources, the Sachs and Warner measure (export of primary products to GDP).
As for Kim and Lin (2017), they test whether dependence on NRs (Natural Resources) affects investment in human capital. Two indicators of this capital are studied; first, education, and second, health. The results show that dependence on natural resources increases education but decreases health; unlike the exploitation of non-agricultural natural resources which increases education and health.

Gregorio (2005) who focus their attention on institutions and human capital, Kurtz and Brooks (2011), introduce the role of globalization in addition to that of human capital.

According to Kurtz and Brooks (2011), an important question is attracting more and more researchers, that of knowing not why, or how, the exploitation of natural resources, in general, becomes a curse, but rather when the exploitation of said resources becomes. The researchers who took the first approach (namely why, and how), paid less attention to the role of globalization in general and more particularly to the integration in the analysis of the role of the market as a determining factor of the effect of the exploitation of natural resources on growth.

In some developing countries, the naturals resources negatively affect human capital. Indeed, the studies by Ghamsi et al. (2019) have shown that in CEMAC the exploitation of mineral resources (minerals and oil) reduces human capital because it is the source of conflicts of wars which destroys hospitals and schools, displacement of populations to refugee camps, thus abandoning the path to classes.

Note also that, Kurtz and Brooks (2011), also recall that human capital is not a gift from heaven that is granted to some countries and is not granted to others. Both human capital and natural resources must be maintained, oriented towards productive activities that contribute to growth and development. The positive or negative effect of the exploitation of natural resources on economic growth depends particularly on the accumulation of human capital in a society

3. Methodology and results of the analysis

Our study is carried out in the CEMAC zone. This economic zone has an area of approximately 30,195,595 km2. The CEMAC zone has six countries namely Cameroon, Congo, Gabon, Equatorial Guinea, Central African Republic (RCA) and Chad. The study takes place from 2002 to 2018. The Period during which we observed a surge in the prices of resources on the market, but also a fall in prices following the crises of 2008 (subprime crisis) and 2015 (oil crisis).

3.1. Model and Data

3.1.1. Theoretical model

Our basic model is inspired by Mankiw et al (1992) who relate output to natural resources. It is defined as follows:

$$Y(t)=K(t)^{\alpha}H(t)^{\beta}(HN(t))\,L(t)^{\theta}R(t))^{1-\alpha-\beta-\theta} \quad (1)$$

Where Y stand for production, H human capital, R natural resources, K physical capital stock, L number of workers and N population growth.
NH assumes that producers must spend part of the natural rent to increase their human capital.
Let us assume: y=Y/L, k=K/L and h=H/L and r = R/L respectively income, physical capital stock, human capital and rent per head.

$$k'(t) = s_k\, y(t) - (n-g-\delta)\, k(t) \quad (2)$$

$$h'(t)=s_h y(t)-(n-g-\delta)h(t)$$

sk savings, sh*n the growth rate of L, g the growth rate of natural rent, and δ the depreciation rate of physical capital.
It is also assumed that human capital depreciates at the same rate as physical capital $\alpha+\beta<1$ which induces a decreasing return to scale. On the other hand, resources are assumed to be exhaustible.
Let us now study the equilibrium of the model:
In the steady state,

$$k^{*}=\left(\frac{s_k^{1-\beta}s_h^{\beta}}{n+g+\delta}\right)^{1/1-\alpha-\beta-\theta}$$

$$h^{*}=\left(\frac{s_k^{1-\alpha}s_h^{\alpha}}{n+g+\delta}\right)^{1/1-\alpha-\beta-\theta}$$

DOI: 10.25103/ijbesar.143.04

Substituting equation (2) into the production function and considering the logarithm of per capita values, we have :

$$\ln\left(\frac{Y(t)}{L(t)}\right) = \ln NH + gt - \frac{\alpha+\beta+\theta}{1-\alpha-\beta-\theta}\ln(n+g+\delta) + \frac{\alpha}{1-\alpha-\beta-\theta}\ln(s_k) + \frac{\beta}{1-\alpha-\beta-\theta}\ln(s_h) + \frac{\theta}{1-\alpha-\beta-\theta}\ln(r) \quad (3)$$

3.2. Empirical model

To determine the effect of natural resource exploitation on the contribution of human capital to the development of CEMAC countries, we compiled secondary data from three databases: WDI from 2020, WGI from 2020, and the UNDP website.

To determine the effect of natural resource exploitation on the contribution of human capital to the development of CEMAC countries, we compiled secondary data from three databases: WDI from 2020, WGI from 2020, and the UNDP website.

The basic model is of the following form

$$LogGDP_{it} = a_0 + \alpha Rent_{it} + \lambda Rent * Eud_{it} + \beta Educ_{it} + \mu Z_{it} + v_i + u_t + \pounds_{it} \quad (1)$$

Log(GDP): the logarithm of GDP at purchasing power parity (PPP). GDP is the sum of the gross value added by all resident producers in the economy, plus taxes on products and fewer subsidies not included in the value of products. It is calculated without deducting the depreciation of neither manufactured assets, nor the depletion and degradation of natural resources. Data are in current US dollars (Ghamsi and al., 2019).

Rent: this is the measure of the abundance of natural resources. We will use three alternative measures of natural resource abundance; namely, the total resource rent, oil rent and forest rent. The total natural resource rent is the sum of oil rents, natural gas rents, coal rents, mining rents and forest rents.

Educ: this is the enrollment rate for education. It measures the proportion of a country's population that is in school or the proportion of the population that has attended primary, secondary or higher school (Ghamsi and al.,2019).

*Rent * educ*: (interaction): this is the linear combination between the variables natural rent and education. It will allow us to analyze the contribution of education in the transmission of the effects of natural rent on the economic development of the CEMAC countries.

Z represents the matrix of control variables it is made up of:

- *Economic openness (open):* Generally, openness is measured by the ratio of exports and imports to GDP.
- *Government expenditure (govt):* Government final consumption expenditure includes all general government current expenditure on purchases of goods and services (including compensation of employees). It also includes most national defense and security spending, but excludes government military spending that is part of government capital formation.

-*voice:* it reflects perceptions of the extent to which the citizens of a country can participate in the choice of their rulers as well as of freedom of expression, association and freedom of the media.

– *Employer (employee):* Employers are workers who, working for their own account or with one or more partners, hold the type of jobs defined as "independent jobs", that is to say jobs where the remuneration depends directly on the profits from the goods and services produced and as such, have continuously hired one or more people to work for them as employees -

invest: this is the investment made by the public authorities and the private sector. This variable includes land improvements, factories, machinery and equipment purchases, construction of roads, railways, schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Therefore simply modify the value of the constant a_0 according to the values of i and t.

Variable	*Abreviation*	*Source*
Natural rent	Rent	WDI (2018)
Employment	Employer	WDI (2018)
Investment	Invest	WDI (2018)
Gross domestic product	GDP	WDI (2018)
Voice and accountability	Voice	WGI (2018)
Education	Educ	UNDP (2018)
Government consumption	Govt	WDI (2018)

Source: Author's computation

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max

DOI: 10.25103/ijbesar.143.04

Rent	90	20.048	17.713	0	57.452
Govt	90	20.557	1.151	18.422	22.169
Employer	90	4.56	4.409	.12	13.027
voice	90	-.948	.85	-2	1.159
GDP	90	2.518e+10	1.824e+10	2.606e+09	8.460e+10
Educ	90	.42	.121	.198	.621
Open	90	.946	1.498	.043	7.218
Invest	90	26.902	15.103	6.405	114.725

Source: Author's using Statat 13

3.3. Results

Table 3 below shows the results of the regression of equation (1). The measure of natural resource abundance is the total rent of natural resources (total_rent).

The first column of this table presents the regression by the fixed effects method. In this column, the results show us that the natural rent negatively and significantly affects the logarithm of GDP at the 1% threshold. Any increase in the natural rent of 10% has the effect of reducing production by approximately 0.28%. This result confirms the theory of Dutch disease, the theory according to which the exploitation of an important natural resource results in a disarticulation of the national productive system which will also result in a decrease in production.

Table 3: Contribution of human capital in the transmission of natural rent effects to the economic development of CEMAC countries

	(FE)	(DMC)	(LIML)
VARIABLES	logGDP	logGDP	LogGDP
Total_rent	-0.0280***	-0.0640***	-0.0689***
	(0.00571)	(0.0172)	(0.0189)
interaction1	0.0524***	0.122***	0.132***
	(0.0126)	(0.0355)	(0.0391)
Education	1.010*	0.183	0.0220
	(0.535)	(0.861)	(0.920)
Trade	0.112	0.0804	0.0757
	(0.0732)	(0.0899)	(0.0940)
Employment	0.441***	0.455***	0.457***
	(0.0666)	(0.0801)	(0.0836)
GFCF	-0.00594***	-0.0107***	-0.0113***
	(0.00204)	(0.00321)	(0.00342)
G	-0.0168***	-0.0296***	-0.0304***
	(0.00518)	(0.00781)	(0.00821)
Voice	-0.537***	-0.693***	-0.700***
	(0.164)	(0.202)	(0.211)
Constant	21.81***		
	(0.269)		
Observations	102	90	90
R-squared	0.748	0.658	0.628
Number of country	6	6	6
Sargan(p-value)		0.179	0.187

Source: Author's using Statat 13

Note: Robust standard errors are reported in brackets. (***, **, *) indicate statistically significance at 1%,5% and 10%.

The results of this regression also show us that education has positive and significant effects at the 10% level on production. Any increase in the enrollment rate of 1 unit results in an increase in domestic production by about 1.01 units. This result is consistent with the theory of human capital. Indeed, the theoretical model of Mankiw et al. (1992) had shown that the introduction of human capital into Solow's neoclassical growth model (1956) made the model more robust.

To analyze the role of human capital in the transmission of the effects of the exploitation of natural resources on the economic development of CEMAC countries, we constructed the interaction1 variable (rent_total * education). This variable has a positive and significant effect at the 1% level on the logPIB. The effect on economic development of a marginal increase in natural rent can be written as follows.

DOI: 10.25103/ijbesar.143.04

$$\frac{dlogGDP}{drent\_total} = -0{,}0280 + 0{,}0524Education$$

At the optimum, this marginal production of the rent is zero, which implies that:

$$0{,}0524Education = 0{,}0280$$

$$Education = 0{,}5343$$

We, therefore, show that the negative effect of natural rent on economic development is weaker as the education of populations is high. For CEMAC countries that have a high level of education (above 0.5343), the natural resource curse does not apply. In other words, 0.5343 is considered to be the threshold for the enrollment rate in the CEMAC beyond which the curse is not possible.

Education allows the population to better participate in the management of income derived from the exploitation of natural resources. This management can be manifested either by directing the rent towards the productive sectors or by the choice of their representative in state institutions.

On the other hand, investment harms production. This is because the investment is oriented towards sectors exposed to international competition. However, according to Corden (1986), following the exploitation of NRs and the appearance of a large stock of monetary resources in the economic circuit, populations will choose to consume foreign products. This will result in reduced investments but also reduced production.

The number of independent employers contributes to economic development. Employers create added value and fight against unemployment.

Institutions measured by freedoms and responsibilities have negative effects on the logarithm of GDP. In other words, the manifestation of freedoms and responsibilities in CEMAC leads to a decline in economic development in CEMAC.

Government spending negatively affects economic development in CEMAC. Indeed, we observe in CEMAC a good part of the state budget is embezzled by officials and members of the government. This is by false invoicing, overbilling and the realization of fictitious projects.

The second column presents the estimation of equation (1) by the 2SLS. We take into account the criticism formulated by Van der Ploeg and Ploelhekke (2008) which states that the natural rent variable is as endogenous as the resource intensity variable (export / GDP) of Sachs and Warner (1995, 1997).

To correct the endogenous problem, it is imperative to use the assumed endogenous variable. The choice of endogenous variables such as employment in the agricultural sector and the rate of CO2 (carbon dioxide) emissions is explained by the need to over-identify the model.

The 2SLS regressions and the limited-information maximum likelihood confirm that of the fixed effects, with relatively equal coefficients. In the second column, the natural rent negatively and significantly affects production at the threshold of 1%. An increase of one unit of rent increases gross domestic production by about 0.06 units.

The positive effect of human capital on economic development is not robust as there is no significant relationship between education and log(GDP) in the second and third columns.

On the other hand, the interaction variable retains its sign and its significance. The threshold for the school attendance rate beyond which the natural rent no longer harm economic development is 0.5245 in the regression by the 2SLS method and 0.5219 by the limited-information maximum likelihood method (LIML).

Likewise, in the 2SLS and LIML regression employment has positive and significant effects on economic development as does the fixed effects regression, with roughly equal coefficients.

Similarly, we observe that the institutional variable capturing freedom and responsibility in the CEMAC (voice), State expenditure (Govt) and investment (invest) have negative and significant effects on the logarithm of GDP (logGDP) , confirming the regression by the fixed effects method.

In addition, the probabilities of the Sargan statistic are greater than 10%. We cannot reject the null hypothesis of the validity of the instruments.

3.4. Robustness

To test the robustness of our results, we used as a measure of the abundance of natural resources other types of resources, namely oil and forest rent.

3.4.1. *Effect of the oil rent on the economic development of CEMAC countries*

Table 4: Contribution of human capital in the transmission of oil rent effects to the economic development of CEMAC countries

VARIABLES	(FE) logGDP	(DMC) logGDP	(LIML) LogGDP
oil_rent	-0.0212***	-0.0659***	-0.0747***

DOI: 10.25103/ijbesar.143.04

	(0.00543)	(0.0207)	(0.0244)
interaction2	0.0394***	0.127***	0.145***
	(0.0122)	(0.0432)	(0.0508)
Education	1.517***	1.062	0.902
	(0.528)	(0.835)	(0.924)
Trade	0.103	0.0389	0.0272
	(0.0737)	(0.102)	(0.112)
Employment	0.416***	0.400***	0.397***
	(0.0691)	(0.0915)	(0.0996)
GFCF	-0.00559**	-0.0121***	-0.0132***
	(0.00212)	(0.00398)	(0.00450)
G	-0.0172***	-0.0343***	-0.0362***
	(0.00570)	(0.00987)	(0.0109)
Voice	-0.563***	-0.788***	-0.810***
	(0.171)	(0.237)	(0.259)
Constant	21.58***		
	(0.268)		
Observations	102	90	90
R-squared	0.727	0.552	0.470
Number of countries	6	6	6
Sargan(p-value)		0.162	0.179

Source**:** Author's using Statat 13

Note: Robust standard errors are reported in brackets. (***, **, *) indicate statistically significance at 1%, 5% and 10%.

In Table 4 above, the measure of natural resource abundance is oil rent. As in Table 3, the oil rent negatively affects economic development in CEMAC. Education has positive effects on log (GDP); but, this result is not robust.

To determine the role of human capital in the transmission of the effects of the exploitation of natural resources on economic development in CEMAC, we constructed the variable interaction2 (education * oil_rent). This variable has a positive effect on the logarithm of GDP in all of our regressions.

Similarly, education contributes positively to the transmission of the effects of the oil rent to economic development, the level of education contributing to the transmission of the effects is appreciably equal to that resulting from table N ° (0.538 by the method fixed effects, 0.5188 by 2SLS 0.5151 by LIML method).

3.4.2. Effect of forest rent on the economic development of CEMAC countries

Table 5 below shows the results of the regression, taking the forest rent as a measure of the abundance of natural resources.

Table 5: Contribution of human capital in the transmission of forest rent effects to the economic development of CEMAC countries

	(FE)	(DMC)	(LIML)
VARIABLES	logGDP	logGDP	LogGDP
Forest_Rent	-0.0970***	-0.799*	-0.917*
	(0.0327)	(0.432)	(0.534)
interaction3	0.158**	1.631*	1.875*
	(0.0723)	(0.902)	(1.116)
Education	1.314**	-6.748	-8.103
	(0.633)	(5.175)	(6.369)
Trade	0.0365	0.0739	0.0755
	(0.0773)	(0.196)	(0.225)
Employment	0.475***	0.572***	0.588**
	(0.0757)	(0.198)	(0.229)
GFCF	-0.00165	0.0109	0.0128
	(0.00227)	(0.00922)	(0.0111)

DOI: 10.25103/ijbesar.143.04

G	-0.00527	0.0299	0.0360
	(0.00476)	(0.0256)	(0.0311)
Voice	-0.404**	0.607	0.782
	(0.180)	(0.768)	(0.930)
Constant	21.60***		
	(0.324)		
Observations	102	90	90
R-squared	0.711	-0.539	-1.017
Number of countries	6	6	6
Sargan(p-value)		0.478	0.507

Source: Author's using Statat 13
Note: Robust standard errors are reported in brackets. (***, **, *) indicate statistically significance at 1%, 5% and 10%.

As with the above alternative measures of natural resources, forest rent has a negative and significant effect on the log gross domestic product. Likewise, education has a positive and significant as does the interaction3 variable (education * Forest_rent). But, the education rate is not robust; because it loses its significance by the regression with the 2SLS and the LIML. The education rate which contributes to the transmission of the negative effects of forest rent on economic development is 61.3% by my fixed-effects method, 48.98 by the 2SLS method and 48.90 by the LIML.
On the other hand, investment and government spending lose their signs and significance, unlike when we measure the abundance of natural resources by the total resource rent and the oil rent.
However, the variable capturing freedom and responsibility in CEMAC (voice) and employment (employee) retain their signs and remain significant.

4. Conclusion
On the one hand, it was a question of determining the effect of the abundance of natural resources on the economic development of the CEMAC countries; and on the other hand, to analyze the role of human capital in the transmission of these effects. Natural resources are essential for human survival. Several states have used their wealth in natural resources to increase their levels of development. This is the case with the United States of America, Great Britain and Canada, during the industrial revolution in the 18th and 19th centuries. However, recent studies show that the exploitation of natural resources can be seen as a double-edged sword because it provides important financial resources for economic development; but, it also weakens the economies of the countries that depend on it. The work of Sachs and Warner (1995, 1999, and 2001) has shown that the exploitation of natural resources reduces the growth of countries that are dependent on them. Otherwise, states dependent on the exploitation of natural resources are less developed than diverse states. Likewise, Gylfason (2001) shows that the exploitation of natural resources negatively affects human capital. Ghamsi et al. (2020) have shown that in CEMAC, mineral resources (minerals and oil) have negative effects on human capital. Likewise, this present study shows us that the abundance of NRs harm economic development. The Exploitation of natural resources limits growth as long as the level of human capital is low Bravo-Ortega and De Gregorio (2005). According to Zallé (2018), countries must simultaneously step up their investments in human capital to turn the natural resource curse into a blessing. Our study shows us that education contributes to the transmission of the negative effects of natural resources on economic development. In fact, for better management of natural resources a high level of education is needed. However, in CEMAC the enrollment rate is very low. Education enables the local population to participate actively in the management of resource income either through local processing of (agricultural and timber resources) or by appointing their representatives to various strata of the state. In most countries of the world, the benefits of education are exhibited, but investment in the education sector is hampered by the lack of financial means in most countries (Shao and Yang, 2014).
Four main recommendations:

- ✓ The creation of a special "human capital" fund. The financial resources allocated to this fund will come from part of the rent from the natural resources exploited. There would be additional funding for investments in human capital, which could be released at any time the need arises; to increase the supply of education.
- ✓ Strengthen the fight against child labor. Two measures can be adopted: first, sensitize parents to send their children to school. Then, supervise mining activities with the same objective.

DOI: 10.25103/ijbesar.143.04

- ✓ Governments will also be able to extend the duration of compulsory education. That said, make compulsory from primary to lower secondary education or compulsory education up to 18-20 years, depending on the demographic development of each country.
- ✓ The accessibility of education in urban and rural areas in the countries of the CEMAC zone remains very unequal. To this end, we recommend the public authorities to provide rural areas with infrastructure and to improve the teachers who work there.

References

Acemoglu D., Johnson S. & Robinson J. A. (2001), « The Colonial Origins of Comparative Development: An Empirical Investigation », The American Economic Review, Vol. 91, No 5, pp 1369-1401.

Aghion P. & Howitt P. (1998), « Endogenes Growth Theory », MIT Press, Cambridge (trad. française: théorie de la croissance endogène, Dunod, 2000.

Alexeev M. and Conrad R. (2009), "The elusive curse of oil" Review of Economics and Statistics, vol.91, n° 3, pp. 586-98.

Aoun M. C. (2008), « La rente pétrolière et le développement économique des pays exportateur », Université paris dauphine edocif. Sciences des Organisations CGEMP - Centre de Géopolitique de l'énergie et des Matières Premières.

Atangana O. H (2019), « Natural resource curse: A reality in Africa », Resources Policy, vol 63.

Auty R. (1993), « Sustaining Development in Mineral Economies: The Resource Curse Thesis», London: Routledge.

Avom D. & Carmignani F. (2009), "Is mother nature a curse for social development." Macroeconomic research group discussion paper 27.

BAD (2009), « Effet de la crise financière sur l'Afrique »

Behbudi D., Mamipour S. & Karam A. (2010), « Natural resource abundance, human capital and economic growth in the petroleum exporting countries », Journal of Economic Development vol 35, n°3.

Birdsall N., Pinckney T. & Sabot R. (2001), « Natural Resources, Human Capital, and Growth », in R. Auty, ed., Resource Abundance and Economic Growth, New York NY, Oxford University Press, pp 57-75.

Boyce J. R. and Herbert J. C. (2011) "Is a negative correlation between resource abundance and growth sufficient evidence that there is a resource curse? Resources Policy, vol. 36, n° 1, pp. 1-13.

Bravo-Ortega C. & De Gregorio J. (2005) « The Relative Richness of the Poor? Natural Resources, Human capital, and Economic Growth » World Bank Policy Research, Working Paper N° 3484.

Brunnschweiler C. & Bulte E. (2008), « The resource curse revisited and revised: a tale of paradoxes and red herings », Journal of Environmental Economics and Management, vol55, n° 3 pp 248-264.

Brunnschweiler C. (2008), « Cursing the Blessings? Natural Resource Abundance, Institutions, and Economic Growth » World Development Vol. 36, No. 3, pp 399-419.

Carbonnier G. (2007), "Comment conjurer la malédiction des ressources naturelles ? "Annuaire suisse de politique de développement vol 26, n°2

Carbonnier G. (2013), "La malédiction des ressources naturelles et ses antidotes " Revue internationale et stratégique vol 3, n° 91

Cavalcanti T.V.D.V., Mohaddes K. and Raissi M. (2011), "Growth, development and natural resources: new evidence using a heterogeneous panel analysis, Review Economy and Finance, vol. 51, n°4, pp.305-318.

Corden W. M. & Neary J. P. (1982), « Booming sector and Deindustrialization in a small economy », The Economic Journal vol 92(368), pp 825-848.

Corden W. M. (1984), « Booming sector and Dutch Disease Economics: Survey and Consolidation », Oxford Economic Papers 36(1), pp359-380.

Coulibaly I. (2013), « Long term economic impact of the natural resources and human capital on the growth rate », Research Papers. Paper 399.

Davis G. A. (1995), « Learning to love the Dutch disease: Evidence from the mineral economies », World Development, 23(10), pp1765–1779

DGRIS, (2015), « Impact de la baisse du prix du pétrole sur les pays producteurs d'Afrique équatoriale (Cameroun, Congo-Brazzaville, Gabon et Guinée équatoriale) », note n°23

Dione L. A. (2016), « Composition des dépenses publiques et impacts sur la croissance économique : analyses théoriques et empiriques sur des panels de pays développés, émergents et en voie de développement », Université de Bourgogne, Français.

Gelb Alan, (2010) "Diversification de l'économie des pays riches en ressources naturelles"Center for Global Development, Contribution préparée pour le séminaire de haut niveau du FMI Ressources naturelles, finance et développement, Alger, 4-5 novembre 2010

Ghamsi D. & Tadadjeu W. (2020), « exploitation des ressources minières et capital humain dans la CEMAC », IRADDAC Working Paper Series N° IWP-03/20

Ghamsi D., Tadadjeu W. & Mofow N. (2019), « Exploitation of Mineral Resources and Human Capital in CEMAC » journal of economics and Sustainable Development, vol 10, N° 24.

Gregory R. G. (1976), « Some implications of the growth mineral sector », Australian Journal of the Agricultural Economics » 67, pp 455-470.

Gurgand M. (2000), « Capital humain et croissance : la littérature empirique à un tournant ? », Économie publique/Public economics, Vol 2, n° 06.

Gylfason T. (2001), « Natural resources, education and development », European Economic Review 45, pp 847-859.

Hartwick J. M. (1977), « Intergenerational equity and the Investing of Rents from Exhaustible Resources », The American Economic Review (67), pp 972-974.

Hausmann R. & Rigobon R. (2003), « An alternative interpretation of the resource curse: theory and policy implications», In Davis J., Ossowski R., et Fedelino A. (eds), "Fiscal Policy Formulation and Implementation in Oil-Producing Countries", IMF, Washington.

DOI: 10.25103/ijbesar.143.04

Kim D.H. & Lin S.C. (2017), « Human Capital and Natural Resource Dependence », Structural Change and Economic Dynamics, vol1, n°2.
Koutassila P. (1998), « Le syndrome Hollandais : théorie et vérification empirique au Congo et au Cameroun », Documents de travail n°24, Centre d'économie du développement, Université Montesquieu-Bordeaux IV.
Kurtz M. & Brooks S. M. (2011), « conditioning "the resource curse" globalization human capital and growth in oil rich nation », comparative political studies vol 44, n°6 pp747-770.
Lane P. & Tornell A. (1999), « The Voracity Effect », American Economic Review, vol 89, pp 22- 46.
Lederman D. and Maloney W.F. (2007), "Natural resources: Neither curse nor destiny", *World Bank*- free PDF.
Lucas, R. E. (1988). « On the Mechanics of Economic Development », Journal of Monetary Economics vol 22(1) pp 3-42.
Mankiw N. G., Romer D. & Weil D. N. (1992), « A Contribution to the Empirics of Economic Growth », Quarterly Journal of Economics, vol. 107, May, pp 407-437.
Manning A. (2004), « Human Capital as a Transmission Mechanism of the Resource Curse », the Park Place Economist, Vol 7.
Mehlum H., Moene K. & Torvik R. (2006), « Institutions and the Resource Curse », The Economic Journal, vol 116, pp 1-20.
Nakoumde N. (2007), « Boom pétrolier et risque d'un syndrome hollandais au Tchad : une approche par la modélisation en équilibre général calculable » Sciences de l'Homme et Société, Université d'Auvergne.
Noula A., Ghamsi D. & Mofow (2020), « Exploitation of Mineral Resources and Economic Growth in CEMAC: The Role of Institutions » International Journal of Business and Economic Sciences Applied Research, vol 13, N° 2
Omgba L. D. (2010). « Trois essais sur l'économie politique de la rente pétrolière dans les Etats africains ». Université d'Auvergne - Clermont-Ferrand I.
ONU (2016), « profil pays: RCA »
Papyrakis E. & Gerlagh R. (2004), « The resource curse hypothesis and its transmission Channels », Journal of Comparative Economics vol 32 pp181–193
Philippot L. M. (2009), "Rente naturelle et institutions. Les Ressources Naturelles : Une " Malédiction Institutionnelle " halshs-00553629.
UNDP (2018), « indices et indicateurs de développement humain », mise à jour statistique 2018
Romer P. (1986), « Increasing Return and Long-Run Growth », Journal of Political Economy, vol 94, October, n°5, pp 1002-1037.
Sachs J. & Warner A. (1995), « Natural Resource Abundance and Economic Growth », in G. Meier and J. Rauch (eds.), Leading Issues in Economic Development, Oxford University Press, New York.
Sachs J. & Warner A. (1997), "Source of slow growth in African economies", journal of African economies, vol. 6 (3), pp 35-76.
Sachs J. & Warner A. (1999) « The big push, natural resource booms and growth », Journal of Development Economics, vol 59, pp 43 -76.
Sachs J. & Warner A. (2001), « Natural Resources and Economic Development The curse of natural resources », European Economic Review, vol 45 p827-838.
Shao S. & Yang L. (2014), « Natural resource dependence, human capital accumulation, and economic growth: A combined explanation for the resource curse and the resource blessing », Energy Policy 74, pp 632–642.
Shao S. & Yang L. (2014), « Natural resource dependence, human capital accumulation, and economic growth: A combined explanation for the resource curse and the resource blessing », Energy Policy 74, pp 632–642.
Shaxson N. (2005), « New approaches to volatility: dealing with the "resource curse" in sub-Saharan Africa », international affair vol 81(2), pp 311-324
Solow R. (1956), « A Contribution to the Theory of Economic Growth », Quarterly Journal of Economics, 70, pp 65-94.
Stijns J. P. (2006), « Natural resource abundance and human capital accumulation », World Development, Vol. 34, No. 6, p. 1060–1083,
Torvik R, (2002), « Natural resources, rent-seeking and welfare », Journal of Development Economics, vol 67, pp 455-470.
Torvik R, (2009), « Why do some resource-abundant countries succeed while others do not? », Oxford Review of Economic Policy, vol 25(2), pp 241-256.
Van der Ploeg F. & Ploelhekke S. (2008), « The volatility curse: revisiting the paradox of plenty », DNB working paper n° 206.
Van der Ploeg F. & Ploelhekke S. (2010), « The pungent smell of "red herrings": Subsoil assets, rents volatility and resource curse », Journal of Environmental Economics and Management, forthcoming.
WDI (2018), World Development Indicators, database of development in the word
WGI (2018), Worldwide Governance Indicators, database of governance
Zallé O. (2018), Natural resources and economic growth in Africa: the role of institutional quality and human capita », resources policy, vol (62).

DOI: 10.25103/ijbesar.143.04

International Journal of
Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

An Optimal Forecasting Method of Passenger Traffic in Greek Coastal Shipping

Ioannis Sitzimis[1]

[1] Department of Business Administration & Tourism, Hellenic Mediterranean University, Heraklion, Greece

ARTICLE INFO

Article History

Received 14 June 2021;
Accepted 26 November 2021

JEL Classifications
R40, R41, C53

Keywords:
Greek coastal shipping, passenger traffic, smoothing forecasting methods, decomposition forecasting methods, seasonal ARIMA models, measures of forecasting accuracy

ABSTRACT

Purpose:
The main goal of this study is to exact an optimal forecasting method by answering the research question: which is the best model for capturing short-term seasonal components of passenger traffic in Greek coastal shipping?

Design/methodology/approach:
There are not a lot of scientific efforts in forecasting passenger traffic in Greece. In order to fill this gap, we tried to find an optimal forecasting method, by comparing Box-Jenkins ARIMA, smoothing and decomposition methods. As Greek coastal shipping consists of several concentrated submarkets (lines) we remained in fourteen popular itineraries (including total passenger traffic). Taking into consideration the high seasonality and no stationarity that characterizes those routes we limited our analysis to Winter's triple exponential smoothing, to time series decomposition method, to simple seasonal model and to seasonal ARIMA models.

Findings:
The analysis results show that in fourteen popular coastal routes Winters' multiplicative method, simple seasonal model and decomposition multiplicative trend and seasonal model have the best integration to the time series data. No coastal line led to better results by seasonal Box-Jenkins ARIMA models.

Research limitations/implications:
The results should be treated with caution since COVID-19 pandemic does not allow safe conclusions for the forecasting period 2020-2022 in GCS. However, the forecasting results of the first quarter of 2020, when pandemic had not fully prevailed, gave encouraging results with little deviations between predicted and actual values.

Originality/value:
Greek coastal shipping is one of the biggest in Europe serving a large number of passengers and having a large part of the total shipping fleet. It plays an important role for Greek economy and society, as it connects the majority of inhabited islands to mainland. The finding of an optimal forecasting method of passenger traffic is very significant for both business and government policy. Decisions on the number of routes served by shipping companies, on ships by coastal line (number and size), on companies' pricing policy, on public service obligations, on state port infrastructure policy and on the amount of state funding for barren lines are typical examples.

Corresponding Author: Ioannis Sitzimis
Email: isitzimis@hmu.gr

DOI: 10.25103/ijbesar.143.05

1. Introduction

GCS is one of the biggest in Europe and performs an important role connecting mainland to Greek islands[1]. Its contribution to GDP is € 13.6 billion or 7.4% of total GDP (2019). It employs approximately 332,000 people and contributes to public revenues with approximately € 3 billion (IOBE, 2020). It carries over 35 million Greeks and foreigners annually (including ferry lines), with its fleet accounting for about 7% of the global passenger shipping fleet. It covers about 17% of total passenger shipping in Europe, with more coastal lines than other countries (due to the plethora of islands). The sector is characterized by high seasonality with almost half of the transport traffic taking place in the period June-August (IOBE, 2014).

In 2019, the listed shipping companies, employed 2,449 employees, launched 43 ships and served passenger traffic of 7,543,460 people. Respectively, they transported 1,041,574 cars and 555,241 trucks. They served about 36% of total passenger traffic[2] and 46% of total vehicle traffic. The average age of their fleet is high, with 60% being over 22 years old and 25% of the total being over 30 years old (XRTC, 2004-2020).

All the above show that GCS is of great importance for Greek economy and society. The volume of passenger traffic it serves is very high and its forecast is very significant for both business and government policy. Decisions on the number of routes served by shipping companies, on ships by coastal line (number and size), on companies' pricing policy, on public service obligations[3], on state port infrastructure policy and on the amount of state funding for barren lines[4] are typical examples. Indicatively, according to Official Government Gazette B,15/04/20,1426 (article 2), the state funding for the financial support of coastal companies, on barren lines, has a basic precondition. The reduction of average passenger traffic by 80% in relation to the previous year's data. Also, the indisputable existence of scale economies in GCS (because of high fixed costs), is related to economic necessity of achieving high occupancy rates (by using larger ships and reducing routes) (Sitzimis 2021a; 2021b). In any case, both the private and public sector need to know the future passenger traffic in GCS. Forecast is essential to decision making.

The main goal of this study is to exact an optimal forecasting method by answering the research question: which is the best model for capturing short-term seasonal components of passenger traffic in Greek coastal shipping? In particular, it aims to find an optimal forecasting method of passenger traffic in GCS by comparing Box-Jenkins ARIMA, smoothing and decomposition methods (Wardono, et al., 2016; Ahmad & Ahmad, 2013; Trull, et al., 2020). The first methods seem to be effective in predicting passenger traffic in transport and the other two have not been preferred for research (Aivazidou, 2015). The basic assumption in all three of the above methods is that the available observations will continue to behave in the future as in the past (Shim & Siegel, 2001).

In the period 2020-2021, due to covid-19 pandemic, this did not happen and there was a sharp drop in passenger traffic. This is why our forecast will start from 2020, ignoring this decrease so as not to create a problem in time series forecasting for the coming years (and especially for the year 2022 when the situation is expected to return to normalcy).

2. Related work

In relation to transport forecasting efforts in the transport sector, about 60% of publications concern forecasts for passenger transport (Aivazidou, 2015). These mainly concern air, road and urban transport. Similar scientific research on maritime passenger transport is absent from international literature. The main reason is that in a few countries coastal shipping is a means of transport. Remarkable is only the research of Ortuzar and Gonzalez (2002), on the coastal line between the Canary Islands and Tenerife.

In GCS, because it largely connects mainland to Greek islands, the research is more extensive. Attempts in this direction have been made by various authors, such as Psaraftis (1994) who made an attempt to systematically analyze possible scenarios for passenger demand after deregulation of the market. Spathi (2005), attempted to find the function of passenger demand using the dynamic model with the error correction model mechanism (Ramanathan, 2001). A similar study was carried out by Tsekeri (2008) who presented an aggregate analysis of substitution and complementary relationship among all available transport modes for domestic travel in Greece. He proposed a model based on consumer demand theory.

Simplistic efforts were made to forecast the financial statements and passenger traffic of coastal companies, with polynomial and hyperbolic functions having the best application (higher R squared) (Sitzimis, 2012). An important research took place in 2014 (IOBE), which used the regression method for the estimation of demand elasticity for coastal

---

[1] It connects about 115 inhabited islands to mainland in Greece.

[2] The remaining 64% for passengers and 54% for vehicles are serviced by smaller companies. In 2019, these companies launched 15 conventional and 21 high-speed vessels on all GCS routes.

[3] Although the market is liberalized and a simple declaration to the Ministry of Maritime Affairs and Insular Policy is required to enter and exit, there are also obligations for shipping companies such as obligatory period of ten-month shipping, prohibition of interruption and change of routes without approval, mandatory crew compositions of ships.

[4] According to Law 2923/2001, the State characterizes as "barren" those lines for which there is no expression of interest for their operation from coastal companies.

DOI: 10.25103/ijbesar.143.05

shipping services with respect to ticket prices and household disposable income. Various other forecasting approaches are performed by XRTC on annual basis (2004-2020).

However, according to Aivazidou (2015) the basic forecasting methods used for other passenger transport are mainly time series analysis models and less combined time series and regression analysis models or pure regression analysis models. In fact, the most widely used models are those based on the Box-Jenkins ARIMA methodology, while very few are based on methods of smoothing and time series decomposition. In other words, there is a gap in the relevant literature that we are going to fill with this research.

3. Passenger traffic analysis in GCS

Air, road and urban transport offer useful conclusions about passengers' demand forecasting to a transportation industry (Sitzimis, 2012; Sabry, et al., 2007; Tamber, et al., 2021; Dingari, et al., 2019). We could be based on them and reach to the congruent conclusions about GCS. However, market conditions differ between those industries. In GCS these assumptions cannot be unified and undivided (Goulielmos & Sambrakos, 2002). This market consists of several concentrated submarkets-coastal routes, which should be analysed individually (Sitzimis, 2012; Goulielmos & Sitzimis, 2014; Goulielmos & Sitzimis, 2012). There are many studies that make the mistake of dealing the market GCS as a total (Tsekeris, 2008). We preferred the assiduous review of the real conditions of GCS, by analysing it per coastal route.

Coastal lines in Greece are characterized by intense seasonality with the largest percentage of passenger traffic (about 45%) taking place in the third quarter of each year. The months from April to September accounting for about 70% of the total annual number of passengers (Sitzimis, 2012; XRTC, 2004-2020). This fact reflects the strong tourist demand for island destinations (IOBE, 2014). August, is the month with the greatest traffic, leaving behind July, September and June. The lowest traffic of passengers traveling within their national borders, mostly appears during February, January and November (XRTC, 2004-2020).

In order to analyse the passenger traffic in shipping itineraries of Greece, we remained in 13 itineraries, which represented the biggest average percentage of total passenger traffic (diagram 2). Those of Argosaronikos (A), Piraeus-Peloponnese (PP), Piraeus-Creta (PC), Piraeus-Creta-Dodecanese (PCD), Piraeus-Dodecanese (PD), Piraeus-West Cyclades (PWC), Piraeus-East Cyclades (PEC), Piraeus-Mykonos-Tinos-Samos (PMTS), Piraeus-Chios-Mytilene (PCM), Patra-Akarnania-Ionian islands (PAII), Rafina-Euboea-Andros-Tinos (REAT), Volos-North Sporades-Kymi (VNSK) and the rest (L).

The average number of passenger traffic on these lines, between 1970-2000, increased at an impressive rate. Overall, an average increase of 4.2% was observed (Sitzimis, 2012). This was due to: (a) the growth of tourism in insular Greece, (b) the increase in GDP per capita of island inhabitants, (c) the general increase of permanent population in Greece and (d) the greater dependence of islands from the mainland (due to the modern tendency for astyphilia) (Spathi, 2005). The lines with the highest traffic were "A", "PEC" and "PC", while the highest growth rate appeared in line "PEC" (7.2%), followed by lines "PC" (7.1%) and "PWC" (6.5%) (Sitzimis, 2012). It is obvious that "PWC" and "PEC" lines gathered the largest shipping traffic in GCS between 1970-2000. This was mainly due to the great growth of tourist arrivals that occurred in these islands after 1970.

Comparing the years 2001 to 2019 (table 1 and figure 1) it is obvious a very large increase of passenger traffic between the years 2001-2007 (35%), mainly due to liberalization of the market (lifting of cabotage privilege), partly in 2002 and fully in 2006 (Law 2932/01, EU regulation 789/04, Presidential Decree 124/06) (Sitzimis, 2012; Goulielmos & Sitzimis, 2014). Also, in this increase contributed both the Olympic Games in Athens (2004) and the increase of tourist flows to the country. Between 2006-2007 there is stabilization and a small percentage decrease. In the period 2008-2013, passenger transport is significantly reduced due to global financial crisis, with the percentage reduction reaching 25%. The decrease was caused by the descending course of income per capita of Greeks and by the overdraft of Greek households. After 2014 and until 2019 the market is recovering but continues to be at lower levels than it was before the crisis. Despite the sharp increase in tourist traffic[5], Greek coastal shipping does not benefit enough as most foreign tourist arrivals took place by air. Overall, for the years 2001-2019 the average increase was about 10% (table 1).

For 2020, the impact of Covid-19 pandemic was clear. Greek coastal shipping was subjected to a restriction on passengers' transportation from March to May 2020 followed by state ceilings for transported passengers thereafter. If we consider the big drop in tourism, the passenger reduction was significant (about 55%) (IOBE, 2020).

The most popular destination and the greatest average traffic (2001-2019) (Figure 2) is presented in shipping route "A" (having a part of 16.3% of passengers), followed by Piraeus-Cyclades ("PEC" and "PWC", having a part of 15,5% of passengers), "PC" (a part of 13,7%) and "REAT" with 12.9%. This is normal because they constitute very popular touristic destinations. Especially after the deregulation of the market took place «cream skimming». This means that most shipping companies preferred the most lucrative coastal markets, mainly in the summer months. At the same time left non

[5] In 2004 there were 13 million tourist arrivals, whereas in 2019 the number was 34 million.

DOI: 10.25103/ijbesar.143.05

profitable markets in winter (Sitzimis, 2012; 2021a; 2021b; Goulielmos & Sambrakos, 2002). Also, the high levels of traffic are interpreted by the fact that these itineraries are based on the part of demand with the least seasonality. So, the higher levels of occupancy rates and exploitation of ships are achieved.

4. Methodology

The main issue in this research was to predict passenger traffic on the main lines of Greek coastal shipping. To do this we had to choose between certain quantitative forecasting methods. Qualitative forecasting methods are based more on human judgment than on the analysis of existing data (Shim & Siegel, 2001). We had quarterly data on passenger traffic between the years 2004-2019, so we chose the quantitative methodology. In each case we processed our data with the statistical package SPSS 22. Exception took place for the calculation of time series decomposition where the Minitab 19 software was used. Also, the calculation of the augmented Dickey-Fuller test was done through EViews 11. The reason was that SPSS did not have these features clearly.

In order to make a prediction for our dependent variable we could use regression analysis (Petropoulos & Asimakopoulos, 2013). In this way we would recognize the quantitative and causal relationship between the variables involved in the interpretation of our problem. Unfortunately, this method is difficult to apply here as the independent variables that affect passenger traffic are not completely clear, it is difficult to find relevant statistic data and time series analysis models seem to be better applied in these cases (Sabry, et al., 2007; Wu, et al., 2013; Tsui, et al., 2014; Rashidi & Ranjitkar, 2015).

For these reasons we could rely on known smoothing methods or Box-Jenkins ARIMA models, taking into account only the existing observations and not the possible relationship with other variables (Ahmad & Ahmad, 2013; Munarsih & Saluza, 2019; Yonar, et al., 2020).

Starting with smoothing methods, they are easy to apply and have a low degree of computational difficulty. The basic logic is that we use time series data, that is, past observations of equal successive time periods. These time series are not affected by the small amount of available data and provide satisfactory forecasts in the short term (Petropoulos & Asimakopoulos, 2013). As is well known, when we do not have a trend and seasonality (stationary time series) for a short forecast range, the simple moving average and simple exponential smoothing models are best applied. Respectively, if there is a trend but not seasonality, for a long range of forecasts, the trend analysis or the exponential smoothing with adaptation to the trend (Holt's method) are suitable. For a smaller range the double exponential smoothing (Brown's method) or the double moving average method (double moving average or linear moving average) are preferable (Chalkos, 2020).

The passenger traffic data available at GCS were quarterly and therefore there were indications of seasonality and no stationarity. As shown in Figure 5 in all examined lines there is a strong increase in traffic in the 3rd quarter of the year, with a slightly decreasing or increasing trend over the years 2004-2019. This means that we could not use prediction techniques such as the above. Repeated seasonal fluctuations and quarterly available observations made the Winters model (Winter's triple exponential smoothing) (indicated when we have seasonality rather than a short-term forecast), the time series decomposition (suitable when we have a trend and seasonality for a long range of forecasts), the simple seasonal model (suitable when we do not have a trend, but only a stable seasonal result) and the seasonal ARIMA models suitable for our case (Chalkos, 2020; Petropoulos & Asimakopoulos, 2013).

Table 1: Total passenger traffic in GCS (for the 13 main itineraries) (2001-2019).

Year	Passengers	Average	% alteration
2001	13,852,000		
2002	13,124,000		
2003	14,905,000		
2004	17,306,000	16,422,862	34.79%
2005	18,257,159		
2006	18,844,396		
2007	18,671,482		
2008	18,068,255		
2009	17,442,121		
2010	16,587,040	15,729,890	-24.72%
2011	15,071,705		
2012	13,608,289		

DOI: 10.25103/ijbesar.143.05

2013	13,601,930		
2014	14,463,293		
2015	14,323,032		
2016	14,542,183	15,598,306	20.40%
2017	15,938,427		
2018	16,909,512		
2019	17,413,388		
Average (2001-2019)	**15,943,643**		**10.16%**

Source: Hellenic Statistical Authority (2000-2020). Our elaboration.

4.1. Measures of forecasting accuracy

The basic selection criterion we followed is which method best suited our data, that is, it led to the smallest values ofdiscrepancies between predicted ($\overline{Yt}$) and actual values (Yt) of the time series (forecast error). By studying the time behavior of forecast error values, we were able to arrive at both the evaluation of our forecasting methods and the choice between alternatives (Agiakloglou & Oikonomou, 2019; Karmaker, et al., 2017).

We used the following precision measures:

a) The mean absolute percentage error (MAPE), which expresses the percentage accuracy. Defined as:

$$MAPE = \frac{\Sigma\left|\frac{Yt - \overline{Y}t}{Yt}\right| x100}{n} \quad (1)$$

where n is the number of measurements.

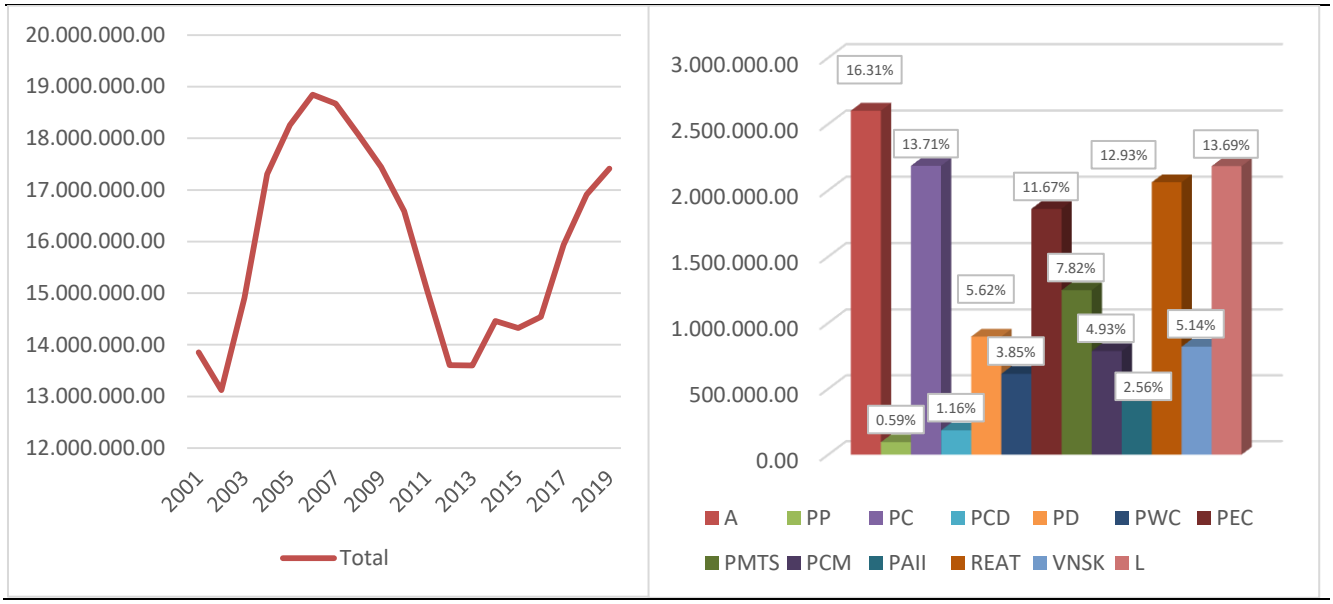
b) The mean squared deviation (MSD or MSE) calculated as:

$$MSD = \frac{\Sigma(Yt - \overline{Y}t)^2}{n} \quad (2)$$

Mean squared error expresses the mean value of the squared deviations and is considered statistically more reliable, so it is used more often. Because its interpretation is difficult to understand we mainly used the root mean squared error (RMSE) (Agiakloglou & Oikonomou, 2019).

Figure 1: Fluctuations of total passenger traffic in GCS (2001-2019)	**Figure 2: Average passenger traffic per route in GCS (2001-2019)**

DOI: 10.25103/ijbesar.143.05



Source: Hellenic Statistical Authority (2000-2020). Our elaboration.

c) The mean absolute error (MAE), which expresses a measure of the accuracy of the forecast against the actual values, maintaining the units of measurement of the original time series. It is set as:

$$MAE = \frac{\Sigma|Yi - Fi|}{n} \tag{3}$$

and its high values show bias of the method.

d) The Bayesian information criterion, developed by Schwarz (1978) (or BIC) selects the model that minimizes:

$$BIC = \ln \sigma^2 + \frac{\ln n}{n} r \tag{4}$$

where σ^2 is the sum of the squares of the residuals, n is the number of observations and r is the total number of parameters with the constant term.

For all forecasting accuracy measures we considered that the lower the price the better the model in terms of estimation (Chalkos, 2020). We also accepted that MAPE values below 10% describe an extremely accurate forecast, below 20% a relatively good forecast and below 30% a marginally accurate forecast (Dingari, et al., 2019).

4.2. Winter's triple exponential smoothing

Winter's triple exponential smoothing has three smoothing parameters. The parameter α for the smoothing of time series values (level), the parameter β for the smoothing of trend (slope) and the parameter γ for seasonality smoothing. These components are either additive or multiplicative. The multiplication model is selected when the seasonal pattern in the data depends on the size of the data. In other words, the size of the seasonal pattern increases as the series goes up and decreases as the series goes down. The additive one is selected when the seasonal pattern in the data does not depend on the size of the data. In other words, the size of the seasonal pattern does not change as the time series goes up or down (Hansun, et al., 2019; Dingari, et al., 2019).

The smoothing of the time series values in the additive model is done through the function:

$$A_t = a(Y_t - S_{t-L}) + (1 - a)(A_{t-1} + T_{t-1}) \tag{5}$$

whereas in the multiplicative through the function:

$$A_t = a\frac{Yt}{S_{t-L}} + (1 - a)(A_{t-1} + T_{t-1}) \tag{6}$$

where α is the smoothing constant ($0 \leq \alpha \leq 1$), At the smoothed values of time series, St is the seasonal factor of the period t and L is the periodicity of the seasonality.

In the additive model the smoothing of the trend follows the equation:

$$T_t = \beta(A_t + A_{t-1}) + (1 - \beta)T_{t-1} \tag{7}$$

DOI: 10.25103/ijbesar.143.05

where β is the trend smoothing constant (0≤β≤1) and Tt the smoothed values of trend. The equation in multiplicative model is transformed as:

$$T_t = \beta(A_t/A_{t-1}) + (1-\beta)T_{t-1} \quad (8)$$

The seasonality smoothing in additive model follows the equation:

$$S_t = \gamma[Y_t - A_t] + (1-\gamma)S_{t-L} \quad (9)$$

and in multiplicative the equation:

$$S_t = \gamma\frac{Yt}{A_t} + (1-\gamma)S_{t-L} \quad (10)$$

where γ is the smoothing constant of seasonality (0≤γ≤1).

The forecast is:

$$\bar{Y}_{t+h} = (A_t + hT_t)S_{t+h-L} \quad (11)$$

where h=1,2,3…L is the future periods of first year and

$$\bar{Y}_{t+h} = (A_t + hT_t)S_{t+h-2L} \quad (12)$$

where h=L+1,L+2,L+3…2L is the future periods of second year etc.

Initialization of the method according to Chatfield (2003) is required. For t=1,2,..,L-1 the values At are not determined, while for t=L the A_L is defined as:

$$A_L = \frac{Y_1 + Y_2 + \cdots + Y_L}{L} \quad (13)$$

For t=1,2,…,L-1 the values Tt are not determined, for t=L we set T_L=0 and for t=1,2,…,L the values of the seasonal coefficients St are calculated as:

$$S_t = \frac{Y_t}{A_L} \quad (14)$$

The optimal values of α, β and γ were calculated automatically by minimizing the RMSE criterion in SPSS and for all possible combinations of parameter values in the time series data (Chalkos, 2020; Dhali, et al., 2019; Ravinder, 2013; Tamber, et al., 2021).

4.3. Time series decomposition and Simple seasonal exponential smoothing

The objective of time series decomposition is to identify the mechanism by which time series values are formed. The decomposition method is used to separate a time series into the trend component, the seasonality component, the cyclical component and the irregular component to make predictions (Chalkos, 2020).

It is necessary to choose whether the seasonality works addictively or multiplicatively to the trend. If it works addictively, the model has the form:

$$Yt = Tt+St+Ct+It \quad (15)$$

where Yt is the real observation in time t, Tt is the trend, St is the seasonality, Ct is the circularity and It is the randomness. This model is more difficult for further computational analysis and assumes independence between the factors. This assumption applies to natural phenomena, but not to business or economic applications, where the trend also affects seasonal fluctuations (Agiakloglou & Oikonomou, 2019). In the case of the multiplicative model the above relation is transformed as:

$$Yt = Tt\cdot St\cdot Ct\cdot It \quad (16)$$

It works well when the fluctuations depend on the level of values, which is usually the case (Kyriakidis, 2018).

The simple seasonal exponential smoothing is suggested for series with no trend and a seasonal effect that is constant over time. It has two smoothing parameters, level (α) and season (δ). It is very similar to an ARIMA model with zero orders of autoregression, one order of differencing, one order of seasonal differencing, and orders 1, p, and p + 1 of moving average, where p is the number of periods in a seasonal interval (for quarterly data, p = 4) (IBM, 2021). The model equation is:

$$Y_t = \mu_t + S_{t,p} + a_t \quad (17)$$

and the smoothing equations are:

$$L_t = a(y_t - S_{t-P}) + (1-a)L_{t-1} \quad (18)$$

$$S_t = \delta(y_t - L_t) + (1-\delta)S_{t-P} \quad (19)$$

The h-stem-ahead equation is:

$$\bar{Y}_{t+h} = L_t + S_{t-P+h} \quad (20)$$

h=1.2…, where μ_t is the mean of the observed time series at period t, S_{t-P+h} is the seasonal component, p is the seasonality periodicity, h is the number of periods in forecasting and a_t is the forecast error at period t.

4.4. ARIMA: Auto-Regressive Integrated Moving Average

DOI: 10.25103/ijbesar.143.05

In relation to the Box-Jenkins ARIMA models, we would say again that in all coastal lines appear seasonal data that have a distinct pattern which is repeated every year (Figure 5). Our data are quarterly, so the length of the seasonal period is S = 4. This means that there are observations that are correlated both within the year and between different years. In these cases, seasonal ARIMA (SARIMA) models that contain non-seasonal and seasonal autoregressive and moving average terms are applied (Wardono, et al., 2016; Ma, et al., 2018; Sim, et al., 2019). In fact, in non-stationary series, a seasonal difference is usually used to completely determine the model. (Wardono, et al., 2016; Ma, et al., 2018; Sim, et al., 2019).

These models are denoted as ARIMA (p,d,q)(P,D,Q)s where: p are non-seasonal autoregressive terms, d are regular differences, q are non-seasonal moving average terms, P are seasonal autoregressive terms, D are seasonal differences, Q are the seasonal terms of moving average and s is seasonality. Indicatively a SARIMA model is written:

$$\Phi_\rho(\mathrm{B})\Phi_\rho(B^S)(1-B)^d(1-B^s)^D y_t = \theta_q(\mathrm{B})\Theta_Q(B^S)\varepsilon_t \qquad (21)$$

where ϕ and θ, are parameters of autoregressive (AR) and moving average (MA), while Φ and Θ, are parameters of seasonal autoregressive (SAR) and seasonal moving average (SMA) respectively. B is lag operator which defined as $B^K Y_t = Y_{T-K}$ (18) (Wang, et al., 2013; Suhartono, 2011).

In particular, to implement SARIMA modeling and forecasting in GCS we followed 4 basic steps (table 2). The first stage was the "recognition" of the model whenever we initially ascertained the existence or not of stationarity in the time series data. When the series were not stationary (in the sequence chart the values were not around zero) we applied the method of differences. In some cases, both first regular differences ($\Delta Yt = Yt-Yt-1$) and seasonal quarterly differences ($\Delta Yt = Yt-Yt-4$), that is of order S = 4, were needed. After the differences if the autocorrelation function of the time series were declining rapidly and were zero, we considered this to be a sign of stationarity. In order to determine whether the time series actually became stationary we applied the augmented Dickey-Fuller test, which had as null hypothesis that the data are not stationary (p-value <5% in order to reject the null hypothesis) (Hasudungan & Pulungan, 2021; Makatjane & Moroke, 2016). We used EViews software for this unit root test.

In the resulting stationary time series, through Minitab 19 we checked the importance of the time series autocorrelation coefficients per lag. We used the t-student distribution, with n-1 degrees of freedom, 95% confidence interval for one-tailed test and null hypothesis that the coefficients are not autocorrelated (Gujarati & Porter, 2018). The autocorrelation of the coefficients is desirable, so our goal was to accept the alternative hypothesis (that is approximately for values t <2). At the same time, we checked the autocorrelation for all Lags, where we used the Ljung - Box Q statistics through the chi-square distribution, with the same degrees of freedom as the lags, 95% confidence level, one-tailed test and null hypothesis that the data is random and without apparent trend (LBQ>chi-squared). That is, not all autocorrelation coefficients are statistically different from zero (Gujarati & Porter, 2018). The same test was performed through SPSS where the p-value <5% for the Box-Ljung statistic criterion was required.

The final identification of the appropriate model per coastal line was made by comparing the ACF and PACF calculated from the data with the theoretical ACF and PACF for the various ARIMA models. The general logic was that if the sample autocorrelations exponentially drop to zero and some are interrupted, the model will require autoregressive terms. If the sample autocorrelations are interrupted and some of them decrease the model will also require moving average terms (Kyriakidis, 2018). By counting the number of significant sample autocorrelations and the partial autocorrelations we determined the classes of MA and AR terms.

For instance, in itinerary "A" we got a regular and a seasonal difference, because through the sequence chart and the ACF diagram of the original series we found no stationarity in the data. After the differences, the autocorrelations of the time series decreased rapidly and were zero, which was a sign of stationarity for us. The Augmented Dickey-Fuller test statistic gave a p-value<5%, which means that the null hypothesis is rejected and indeed the time series was stationary. Because we wanted our data to have the desired autocorrelation, using the t-statistic for a significance level of 5%, one-tailed test, and n-1 degrees of freedom, we found that the autocorrelation coefficients were statistically different from zero. The same conclusions were emerged by the chi-squared statistic (zero hypothesis rejection), showing that the time series data as a whole were not random.

So, we decided to proceed with the modeling of the seasonal ARIMA model. We definitely had 1 nonseasonal difference (d) and 1 seasonal difference (D). In nonseasonal AR (p) we tested values 1 and 2 because we had lags which are significantly correlated and in seasonal AR (P) the value 1 as it is sufficient for most seasonal patterns (IBM, 2021). Considering that sample autocorrelation ceases after the 1st lag and partial autocorrelation decreases, we used values 1 and 2 as nonseasonal MA (q) and obtained value 1 as seasonal MA (Q) as it is sufficient for most seasonal patterns (IBM, 2021).

The second stage concerned the "assessment" of the model and specifically its parameters. Based on the previous analysis for line "A" we checked several models, keeping the differences constant. The model with the lowest RMSE, MAE, MAPE and normalized BIC was the SARIMA $(0,1,1)\ (1,1,0)_4$.

In the third stage and before using the models for prediction, we checked them for their "adequacy". Adequate is the model whose residuals are random and independent (Gujarati & Porter, 2018). Through Minitab 19 we relied on a chi-square test, based on Ljung-Box statistics with number of lags minus number of parameters degrees of freedom. If p-value>5% for all individual values (lags), the residual autocorrelations were considered to express consistent and random

DOI: 10.25103/ijbesar.143.05

errors (white noise). At the same we performed a comprehensive check of the adequacy of the model, through the chi-square test based on Ljung-Box statistics (SPSS). For line "A" it appeared that the errors had white noise behavior. Then, the statistical significance of the parameters of the selected model was checked. In line "A" because p-value<5% the coefficients were statistically significant and were maintained in the model. Finally, the interpretive power of the model was investigated through stationary R squared. Given the adequacy of the models, we adhered to the principle of parsimony and on every case, we chose the simplest model that provided an adequate description of the main characteristics of the data (Kyriakidis, 2018).

Table 2: Basic steps for SARIMA forecasting in GCS (2004-2019).

STEP 1: Model recognition		**STEP 2: Model estimation**	**STEP 3: Model adequacy**	**STEP 4: Model forecasting and feedback**
1. Are data stationary?	2. Now the data are stationary:	1. Which is the best fitted model per route?	1. Is the best fitted model statistically adequate?	1. Which are the quarterly forecasts of passenger traffic for years 2020-2022?
a. Check sequence chart	a. Are the autocorrelation coefficients statistically different from zero?	a. Check which model has the lowest result in MAPE, RMSE, MAE and normalized BIC	a. Check the residuals whether are random and independent.	a. We must forecast passenger traffic only for year 2022 cause COVID-19.
b. Check ACF, PACF diagrams	b. Are time series data as a whole random?		b. Check model interpretive power	b. Compare the predictive values to the actuals
c. If there is no stationarity take a normal or both a normal and a seasonal difference	c. Which are the possible values of SARIMA trend and seasonal components?			
d. Check again sequence chart				
e. Check again ACF, PACF diagrams				
f. Use augmented Dickey-Fuller test				

Source: (Researcher, 2020)

In the last stage and after determining the adequacy of the models, we made forecasts for the years 2020,2021,2022 per quarter and we compared the predictive values to the actuals.

5. Analysis and results

As we said, the quarterly data for most of the coastal lines show a marginally decreasing or increasing trend and a relatively stable seasonality (repeated) (Figure 1). Using SPSS statistical software, we calculated Winters 'additive and multiplicative model and the additive and multiplicative model of decomposition in every significant route of GCS. Also, we analysed SARIMA models and simple seasonal exponential smoothing models per route. Especially for decomposition method we calculated both trend and seasonality or only seasonality. So, the results concluded a linear trend and seasonal indices per quarter.

The time series on the coastal lines of Greece were examined for the first time, so we considered it expedient to find the optimal parameters for each method used. That is, those values that minimize the RMSE criterion (table 3). With SPSS finding the best values of α, β, γ is no longer the problem (Tamber, et al., 2021). An exception was the SARIMA method where the approach was done step by step, as described in the methodology. In this case too, however, the exported model was compared with the excellent one via SPSS (through SPSS modeler). In case of conflicting results our main selection criteria were RMSE and normalized BIC. Moreover, through the stationary R squared we performed the

DOI: 10.25103/ijbesar.143.05

interpretation power of the selected model and with the use of the Ljung - Box test we checked its adequacy. Then we made a forecast for the year 2022, which was our final goal, as under positive conditions there will be a return to normalcy (after COVID-19 pandemic).

Most forecasts gave us MAPE below 20%, so the best fitted methods describe relatively good forecasts. Particularly, our analysis revealed that surprisingly eight of fourteen itineraries (including total passenger traffic) integrated better to Winters 'multiplicative method (figure 6 and table 3). It proved the better model for the short - term quarterly seasonality as many researchers have shown (Makatjane & Moroke, 2016; Dingari, et al., 2019). Other itineraries fitted better to SS model and only in "PD" the best method was DMTS. No line led to better results through the SARIMA models. The choice of SS and WM methods shows that smoothing methods show satisfactory accuracy rates in relation to SARIMA models and in general in relation to more complex forecasting methods (Petropoulos & Asimakopoulos, 2013). This is because they are not affected by the peculiarities of the data patterns or by occasionally occurring extreme values.

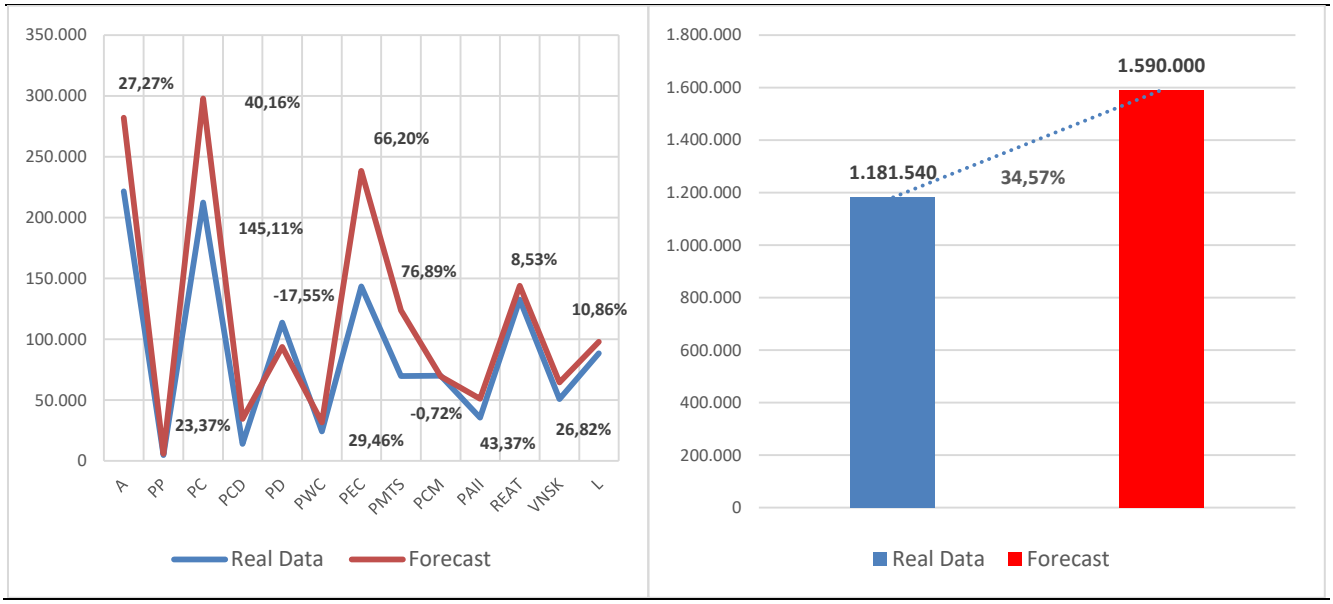
What we noticed is that in all lines selected by WM method the trend parameter β was almost zero, which means that the passenger traffic trend does not change over time. The slope of the trend line was constant during the observation period. In some lines the value of the parameter α (level) was quite large (eg "PAII") which shows that in this case more weight is given to the most recent observations and very little weight to the most remote ones (Agiakloglou & Oikonomou, 2019; Trull, et al., 2020). In lines where the value of α was lower, the smoothing of time series was more intense, with the respective forecasting models fluctuating around the initial level and being slow to follow large changes in the historical data. The high weighting parameter γ for seasonal components showed for the majority of itineraries that seasonal factor has great influence. This is reasonable because of the observed seasonality in GCS. An exception is "PC" line where the low value of γ indicates a stable seasonal effect (Vujko, et al., 2018). For all coastal lines the Ljung - Box statistical criterion showed that the errors had white noise behavior and the models were adequate. Also, in all lines the coefficient of determination R squared was relatively high, which shows the good interpretive power of the models.

The lines that SPSS showed SS as the best model, the conclusions vary. The rule is that the seasonal factor has a significant influence, except for "VNSK" line where there is a constant seasonal effect. The smoothing parameter of level differs per route, considering the importance of older or newer data. The resulting models, outside the "VNSK" line, are adequate and with relatively high data adaptability. "PD" line was the only one that gave DMTS as the best model. The -2287 slope of the linear trend equation shows an average decrease of 2287 passengers per quarter. The corresponding values of seasonal indices show that passenger traffic is increased in the second and third quarters and decreased in the first and fourth. However, the MAPE clarifies a marginally good forecast.

In conclusion, by comparing predictive values to the actuals, interesting results emerged. For the first quarter of 2020, when covid-19 pandemic had not fully prevailed, in eight to fourteen lines the percentage deviation was under 30% (figure 3 and 4) and the average deviation in all lines was 36.7% (including "T"). Indicatively, in "PDM" line was -0.72%, and in "T" (total passenger traffic) was 34.6% (figure 4). Also, in all lines the actual passenger traffic was inside the upper and low bound of the forecast. Considering firstly that the forecasting methods gave more positive results than the real ones, because of the long-term upward trend of tourist arrivals and secondly that the Greek government took the first restrictive decisions for passenger traffic in March of 2020 (a month of the first quarter), we have to do with a relatively good forecasting result.

Figure 3: Average deviation between real data and forecast on 13 coastal lines in GCS (1st quarter of 2020).	**Figure 4: Deviation between real data and forecast of tota traffic ("T") in GCS (1st quarter of 2020).**

DOI: 10.25103/ijbesar.143.05



Source: Researcher (2020)

6. Conclusions and discussion

GCS is one of the biggest in Europe and covers about 17% of total passenger shipping. It plays an important role for Greek economy and society. There are not a lot of scientific efforts in forecasting passenger traffic in Greece. In order to fill this gap, the main goal of this study was to find an optimal forecasting method, by comparing Box-Jenkins ARIMA, smoothing and decomposition methods. As GCS consists of several concentrated submarkets (lines) we remained in fourteen popular itineraries (including total passenger traffic). Taking into consideration the high seasonality and no stationarity that characterizes those routes we limited our analysis to Winter's triple exponential smoothing, the time series decomposition method, the simple seasonal model and the seasonal ARIMA models.

Even if we followed a careful step by step approach for SARIMA models ("recognition", "assessment", "adequacy", "forecasting and feedback") no coastal line led to better results by this method. In fact, eight of fourteen itineraries integrated better to WM, five of fourteen to SS and only one to DTMS. Especially for WM it emerged from the analysis that traffic trend did not change over time, in some lines the smoothing of the time series was more intense, and the seasonal factor had great influence. The suggested models were adequate with relatively high interpretative power. About SS method the smoothing parameter of level differed per route and seasonality was of great significance. The resulting models presented high data adaptability. In "PD" line, where DTMS model seemed the best one, the -2287 slope of the linear trend equation shew an average decrease of 2,287 passengers per quarter.

DOI: 10.25103/ijbesar.143.05

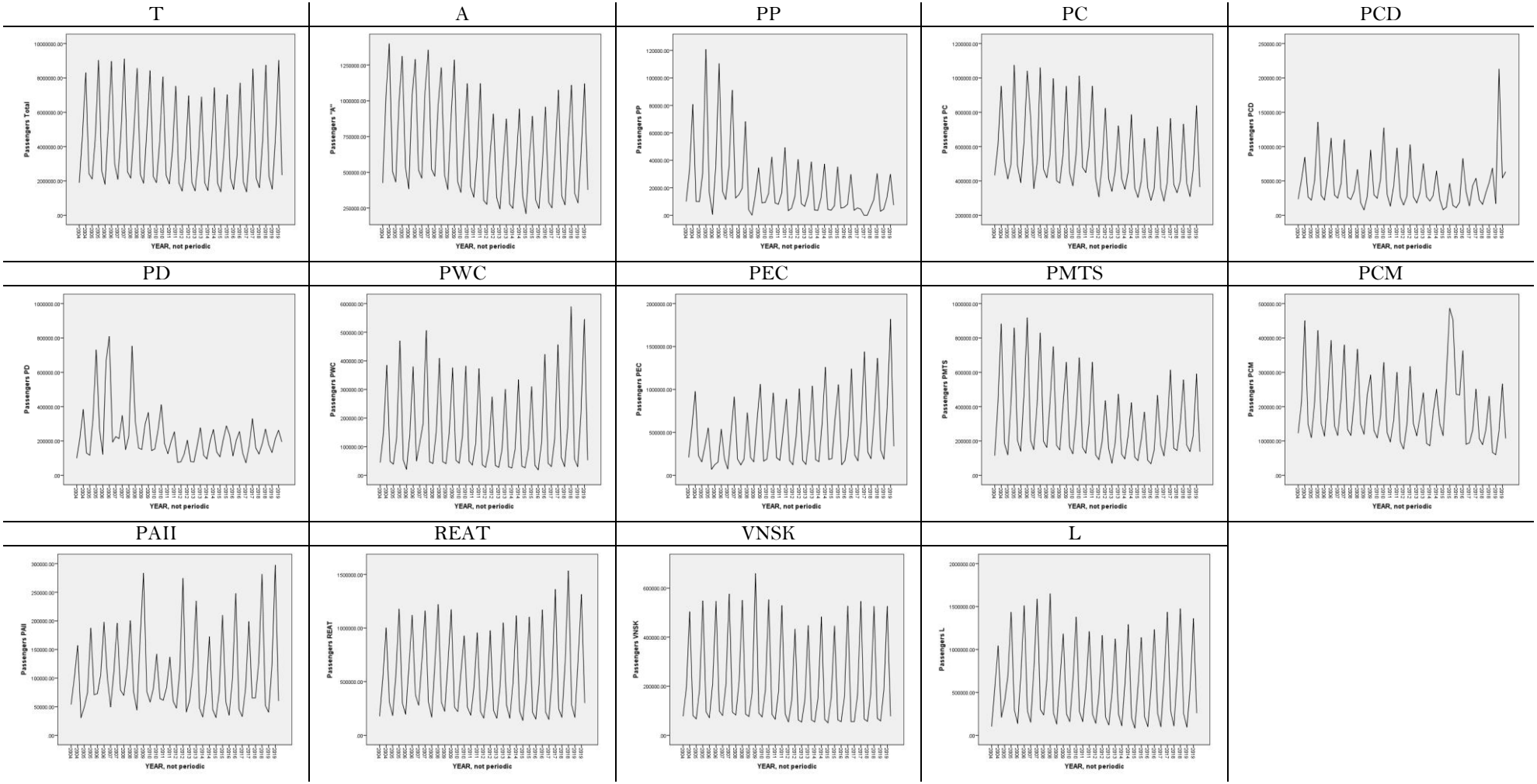


Figure 5: Sequence charts of passenger traffic of the main coastal itineraries in Greece (2004-2019) (data on quarterly basis).

DOI: 10.25103/ijbesar.143.05

Table 3: Best fitted forecasting methods for all lines in GCS (2004-2019).

ROUTE	BEST METHOD	OPTIMAL PARAMETERS OR FORECASTING EQUATIONS	Decision Criteria				Stationary R^2	Ljung-Box (sig)	Forecast (2022)			
			MAPE	MAE	RMSE	BIC			Q1	Q2	Q3	Q4
T	WM	α (level)=0.306 β (trend)=0.000 γ (seasonal)=0.686	6.039	215260.3	294890.3	25.384	0.482	0.913	1540000	4370000	8710000	2220000
A	WM	α (level)=0.357 β (trend)=0.000 γ (seasonal)=0.686	6.749	39243.2	53079.5	21.954	0.538	0.748	259080	623203	1020000	324689
PP	SS	α (level)=0.110 δ (seasonal)=0.872	82.142	6054.2	10448.6	18.638	0.403	0.840	5822	13977	30044	6825
PC	WM	α (level)=0.285 β (trend)=0.001 γ (seasonal)=0.020	8.019	42879.3	61744.5	22.256	0.733	0.412	278050	388919	688388	348976
PCD	SS	α (level)=0.118 δ (seasonal)=0.596	27.673	12782.6	27146.1	20.548	0.493	0.977	34561	146343	62183	65877
PD	DMTS	☑ Yt=303722-2287t ☑ Seasonal indices per quarter: 1: 0.60398 2: 1.08655 3: 1.63551 4: 0.67396	29.765	-	108750.6	-	-	-	82617	146142	216239	87566
PWC	WM	α (level)=0.152 β (trend)=0.000 γ (seasonal)=0.566	15.982	19917.6	32556.8	20.976	0.646	0.359	31786	195435	552708	55475
PEC	WM	α (level)=0.341 β (trend)=0.000 γ (seasonal)=0.375	23.695	80663.3	115526.3	23.509	0.595	0.769	253116	942605	1960000	349748
PMTS	WM	α (level)=0.228 β (trend)=0.000 γ (seasonal)=0.768	12.544	31153.9	44033.5	21.580	0.568	0.051	111435	205063	478801	121487
PCM	SS	α (level)=0.800 δ (seasonal)=0.940	20.379	34210.7	50724.4	21.798	0.437	0.966	69395	122896	257577	107133
PAII	WM	α (level)=0.800 β (trend)=0.001 γ (seasonal)=0.899	24.531	21330.1	28319.9	20.698	0.630	0.426	51579	128663	281568	60866
REAT	SS	α (level)=0.211 δ (seasonal)=1.000	10.632	47950.9	70316.0	22.451	0.416	0.972	144073	684704	1340000	297672
VNSK	SS	α (level)=0.299 δ (seasonal)=0.000	12.430	17012.7	26667.9	20.512	0.573	0.008	64477	177411	525451	77157
L	WM	α (level)=0.209 β (trend)=0.000 γ (seasonal)=0.411	13.749	58622.3	86110.2	22.922	0.702	0.831	95890	588148	1310000	242620

Source: Research Data (2020)

In general, most forecasts gave as MAPE below 20%, so the best fitted methods described relatively good forecasts. Of course, the results should be treated with caution since COVID-19 pandemic does not allow safe conclusions for the forecasting period 2020-2022 in GCS. However, the forecasting of the first quarter of 2020, when pandemic had not fully prevailed, gave encouraging results with little deviations between predicted and actual values.

Further research could be done by using and testing time series data of this analysis against different data tools and methods. By this way the effectiveness of our forecast could be tested and challenged, and possibly higher levels of accuracy achieved.

DOI: 10.25103/ijbesar.143.05

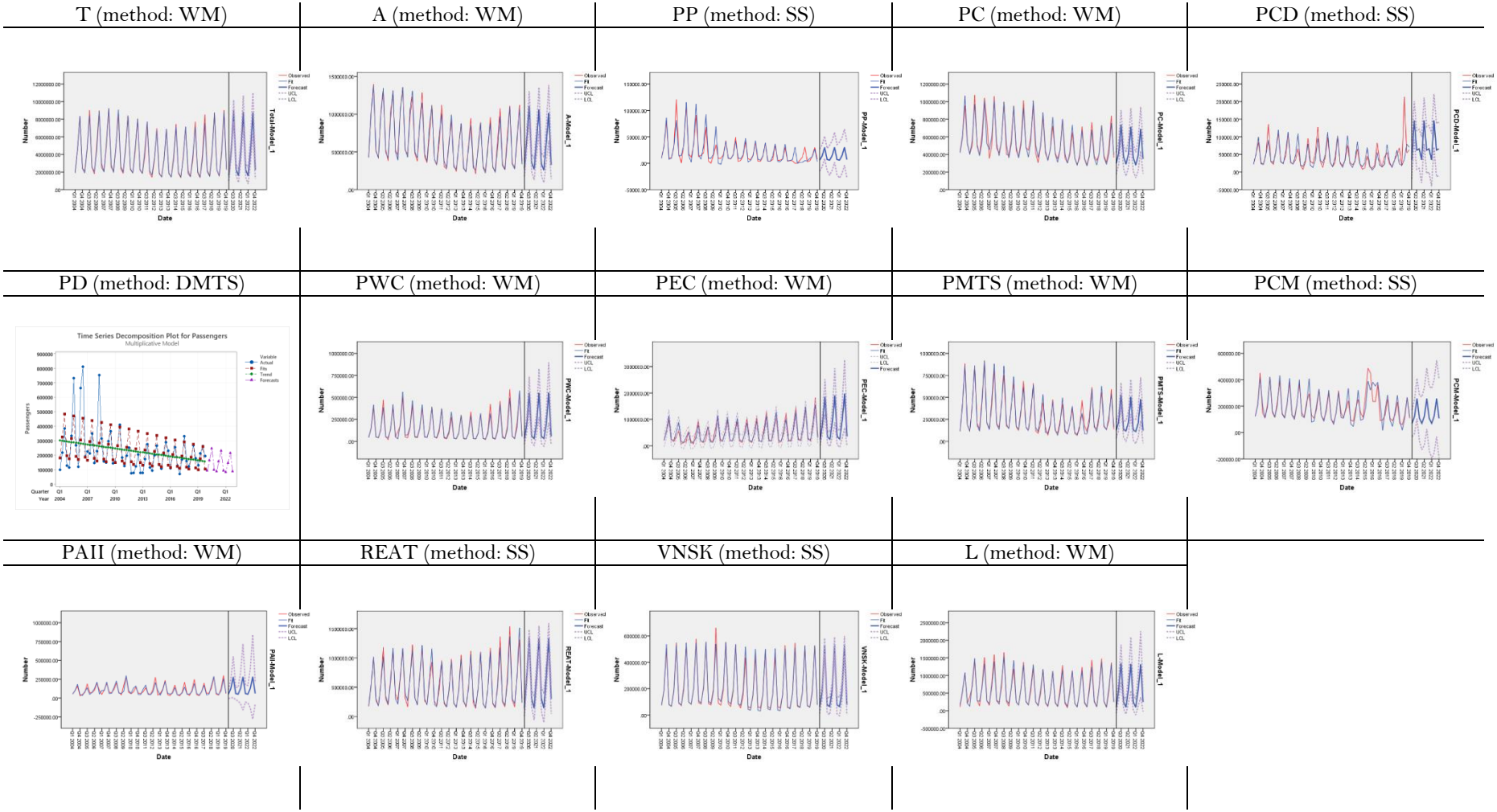


Figure 6: Best fitted method and forecasting results for the main coastal itineraries in Greece (2020-2022) (data on quarterly basis).

DOI: 10.25103/ijbesar.143.05

Nomenclature

GCS	Greek Coastal Shipping
WM	Winters' Multiplicative method
DTMS	Decomposition Multiplicative Trend and Seasonal method
SS	Simple Seasonal method
SARIMA	Seasonal ARIMA models
ACF	Autocorrelation
PACF	Partial autocorrelation
GDP	Gross domestic product

References

Agiakloglou, C. N. & Oikonomou, G. S. (2019). *Forecasting methods and decision analysis*. Athens: Benou.

Ahmad, W. & Ahmad, S. (2013). *Arima model and exponential smoothing method: a comparison*. s.l., Department of Mathematics, Faculty of Science and technology.

Aivazidou, E. (2015). *Development of time series and regression models for the assessment of the effects of the economic crisis on maritime passenger and freight traffic in Greece*, Thessaloniki: UTH.

Chalkos, G. E. (2020). *Statistics: Theory and Practice*. Thessaloniki: Disigma.

Chatfield, C. (2003). *The analysis of time series: An introduction*. New York: Chapman and Hall.

Dhali, N., Barman, N. & Hasan, B. (2019). Determination of optimal smoothing constants for Holt-Winter's multiplicative method. *Dhaka Univ. J.*, July, 2(67), pp. 99-104.

Dingari, M., Reddy, M. & Sumalatha, V. (2019). Air traffic forecasting using time series models. *International journal of recent technology and engineering*, November, 8(4).

Goulielmos, A. & Sambrakos, E. (2002). *Ferry and short-sea shipping*. Piraeus: Stamoulis.

Goulielmos, A. & Sitzimis, I. (2012). Measuring market concentration in the Aegean Ferry System. *Spoudai Journal*, 62(1-2), pp. 7-27.

Goulielmos, A. & Sitzimis, I. (2014). The Liberalization process of the Ferry System in Greece, 2001-2009: What have been the benefits to users of Aegean Sea Transportation?. *Spoudai Journal*, 64(4), pp. 39-66..

Gujarati, D. & Porter, D. (2018). *Econometrics: Principles and applications*. Thessaloniki: Tziolas.

Hansun, S., Vincent, C. & Subanar, C. (2019). Revitising the Holt-Winters' additive method for better forecasting. *International journal of enterprise information systems*, 2(15), pp. 43-57.

Hasudungan, A., Pulungan, A. (2021). An Analysis of the Monetary Transmission Mechanism of M&A, Greenfield FDI, Domestic Investment, and GDP Per Capita Growth: The Structural Vector Correction Model in Indonesia. *International journal of business and economic sciences applied research (IJBESAR)*, 14(2), pp. 29-42.

IBM. (2021). *IBM SPSS Forecasting: Build expert forecasts in a flash.* [Online] Available at: https://www.ibm.com/downloads/cas/OP3RLVLR

IOBE. (2014). *The contribution of passenger shipping to the Greek economy: performance and prospects*, Athens: Foundation for economical and industrial research.

IOBE. (2020). *The Greek coastal shipping during period 2016-2020: Performance, contribution in economy and prospects*. Athens: Foundation for economic and industrial research.

Karmaker, C., Halder, P. & Sarker, E. (2017). A study of time series model for predicting Jute Yarn demand: Case study. *Hindawi, Journal of Industrial Engineering*.

Kyriakidis, M. (2018). *Telecommunications market analysis and forecasting techniques*. Athens: National and Kapodistrian university of Athens.

Makatjane, K. & Moroke, N. (2016). Comparative study of Holt-Winters triple exponential smoothing and seasonal ARIMA: Forecasting short term seasonal car sales in South Africa. *Risk governance: financial markets & institutions*, 6(1).

Ma, L., Hu, C. & Han, Y. (2018). *ARIMA model forecast based on eviews software*. s.l., IOP conf. series: earth and environmental science 208.

Munarsih, E. & Saluza, I. (2019). *Comparison of exponential smoothing method and autoregressive integrated moving average (ARIMA) method in predicting dengue fever cases in the city of Palembang*. s.l., Journal of Physics: conference series.

Ortuzar, D. & Gonzalez, M. (2002). Inter-island demand response with discrete choice models. *Journal of transport economic and policy*, January, 46(1).

Petropoulos, F. & Asimakopoulos, V. (2013). *Business forecasting*. Athens: Symmetria.

Psaraftis, C., 1994. *Greek coastal shipping system: impact of market deregulation and new technologies on modal split*. Capri, Italy, s.n.

Ramanathan, R. (2001). The long-run behavior of transport performance in India: a cointegration approach. *Transportation research*, 35(A).

Rashidi, S. & Ranjitkar, P. (2015). Estimation of bus dwell time using univariate time series models. *Journal of advanced transportation*, Issue 49, pp. 139-152.

Ravinder, H. (2013). Determing the optimal values of exponential smoothing constants - does solver really work?. *American journal of business education*, May/June, 6(3), pp. 347-360.

Sabry, M., Abd-El-Latif, H. & Badra, N. (2007). Comparison between regression and arima models in forecasting traffic volume. *Australian journal of basic and applied sciences*, 126-136, 2(1).

DOI: 10.25103/ijbesar.143.05

Schwarz, G. (1978). Estimating the dimension of a model. *The annals of statistics*, 2(6), pp. 461-464.
Shim, J. K. & Siegel, J. G. (2001). *Managerial economics*. Athens: Kleidarithmos.
Sim, S., Tay, K., Huong, A. & Tiong, W. (2019). Forecasting electricity consumption using SARIMA method in IBM SPSS software. *Universal journal of electrical and electronic engineering*, 6(5B), pp. 103-114.
Sitzimis, I. (2012). *Aegean coastal market: the consequences of cabotage removal by microeconomic tools*. Thesis. Peiraus: University of Peiraus.
Sitzimis, I. (2021a). Economies of scale in Greek coastal shipping. A survivor analysis, Under review in *European Transport/Transporti Europei journal*.
Sitzimis, I. (2021b). An implementation proposal of innovative pricing in Greek coastal shipping. *Oradea journal of business and economics (OJBE)*, 6(2), pp. 69-77.
Spathi, S. (2005). *A comparison between air and coastal services in internal routes: An econometric estimation of demand*, Athens: Center of programming and economical research.
Suhartono. (2011). Time series forecasting by using seasonal autoregressive integrated moving average: Subset, multiplicative or additive model. *Journal of mathematics and statistics*, 1(7), pp. 20-27.
Tamber, Jighjigh, A., Michael, O. & Ojowu, O. (2021). The Holt-Winters multiplicative model of passengers' traffic forecast of the Nigeria airports. *Internationa journal of engineering in computer science*, 3(1), pp. 35-40.
Trull, O., Garcia-Diaz, J. & Troncoso, A. (2020). Stability of multiple seasonal Holt-Winters models applied to hourly electricity demand in Spain. *Applied Sciences*, February, Volume 10.
Tsekeris, T. (2008). Consumer demand analysis of complementarity-substitution relationships among passenger transport modes in Greece. *International journal of transport economics*, 35(3), pp. 415-449.
Tsui, W., Balli, H., Gilbrey, A. & Gow, H. (2014). Forecasting of Hong Kong airport's passenger throughput. *Tourism management*, Issue 42, pp. 62-76.
Vujko, A., Papic-Blagojevic, N. & Gajic, T. (2018). Applying the exponential smoothing model for forecasting tourists' arrivals - example of Novisad, Belgrade and Nis. *Ekonomika Poljoprivrede*, July, pp. 757-473.
Wang, S., Feng, J. & Liu, G. (2013). Application of seasonal time series model in the precipitation forecast. *Mathematical and computer modelling*, Issue 58, pp. 677-683.
Wardono, Arief, A. & Siti, R. (2016). Arima method with the software minitab and eviews to forecast inflation in semarang indonesia. *Journal of theoritical and applied information technology*, December, 94(1).
Wu, J., Zhong, L., Li, L. & Lu, A. (2013). *A prediction model bases on time series data in intelligent transportation system*. Berlin: Springer.
XRTC, B. c. (2004-2020). *Annual survey on Greek coastal shipping*. Athens: s.n.
Yonar, H., Yonar, A., Tekindal, M. & Tekindal, M. (2020). Modeling forecasting for the number of cases of the COVID-19 pandemic with the curve estimation models, the Box-Jenkins and exponential smoothing method. *EJMO*, 4(2), pp. 160-165.

DOI: 10.25103/ijbesar.143.05

International Journal of
Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

ICT as a Re-Engineering Strategy on Claim Settlement in Some Selected Insurance Companies In Nigeria: The Pandemic Experience

Madu Frances[1], Isichei Ejikeme[2], Vincent Onodugo[1].

[1] University of Nigeria, Enugu Campus, faculty of Business Administration, Enugu State, Nigeria.
[2] Federal University Wukari, Faculty of Humanities and Management Sciences, Taraba State, Nigeria.

ARTICLE INFO

Article History

Received 28 May 2021
Accepted 10 November 2021

JEL Classifications
D83, G22, G52

Keywords:
Coronavirus (COVID-19), Information and Communication Technology (ICT), Insurance, Re-engineering, Strategy.

ABSTRACT

Purpose:
This study addresses the effect of ICT on the relationship between re-engineering and the performance of some selected insurance companies in Nigeria. It emphasizes the need to ensure that insurance companies achieve substantial improvement in performance via viable IT infrastructure to modernize all business processes.

Design/Methodology/Approach:
The study adopted a survey design, utilizing a sample of 350 respondents from two selected insurance companies in the southwest geopolitical zone of Nigeria. A questionnaire was used for the collection of data. The data analysis was conducted using the percentage formula and SPSS version 20.

Findings:
The research revealed that there is a significant relationship between ICT and operational performance of the insurance companies, the increase in the use of many ICT tools has proven to be caused by lockdown, which implies insurance companies should endeavor to provide updated ICT facilities to enable good quality service delivery and profitability. Technological innovations through ICT enabled the insurance industry to set up efficient delivery channels, which has capacitated the sector to solve the problems that are posed by the new change. ICT tools aided supervisors, employees, and managers in decision-making. Operational resilience became the proactive measure made by the insurance sector to ensure responsive, adaptable, and scalable services for the insured and stakeholders.

Research limitation/Implication:
This study exhibits practical implications for the financial service provider, as the manager and the insurer (Insurance companies) can be encouraged to find the best approach to redesign strategies and adopt basic IT facilities to automate business activities for optimal productivity and profitability. Coronavirus epidemic has created the need to emphasize the importance of making provision for a viable digital infrastructure, which ensures business continuity and customer retention, and there should be a collaboration between the financial service providers and implementing alternative delivery channels to achieve a thorough transformation that will strengthen the insurance sectors.

Originality/value:
This study furthers strengthens and validates the use of technology and the relevance of re-engineering in operational re-enforcement for increased efficiency and effectiveness of insurance services. The improvement in business process re-engineering is driven by ICT, and as a re-engineering enabler, enhances performance that could lead to competitive advantage and a great priority for insurance companies to gain more control over the final market and good customer relationship, by offering quality services, superior value to the services, affordable price, unique customization and consultation

Corresponding Author: Madu Frances
Email: madufrances50@gmail.com

DOI: 10.25103/ijbesar.143.06

1. Introduction

The outbreak and the spread of the coronavirus disease (COVID-19) in Africa have caused severe infection and high rates of death. An estimate from Africa Centre for disease control and prevention revealed as of 7th July 2020, a total of 492,624 COVID-19 cases and 11,622 (CFR: 2.4%) deaths from 54 African countries, which is 4.3% of all cases worldwide, (Africa CDC, 2020). South Africa (224,665), Egypt (78,304), Nigeria (30,249), Ghana (22,822), and Algeria (17,348) have the most cases as of 9th July 2020 (ECDC, 2020). The virus has caused a surge in health, business interruptions, and cancellation of travels, thus increasing the number of claims. A claim is the payment made by the insurance company to the insured, policyholder, or claimant on the occurrence of the event stated in the contract, in return for the premiums paid for the insured. As the number of inquiries and claims increases, the major objective of insurance companies becomes to provide peace of mind in times of crisis and stress. To offer prompt claims settlement during the pandemic, the insurance companies may need to initiate strategies for managing the crisis from the customers' and stakeholders' perspectives. The environmental change due to the pandemic and customers' demand for products and services have made the insurance sector seek technological solutions to solve the problem the change presents. The technological changes have impacted greatly on the employees, insured, and management, and the advancement in technology may enable the industry to deliver quality and efficient insurance products and services.

In the financial sector, the insurance industry has experienced rapid growth with the advancement in the level of information technology. It has brought a dramatic breakthrough in performance, called "RE-ENGINEERING". Hammer and Stanton (1995), defined re-engineering 'as the fundamental rethinking and radical redesigning of business processes to bring about dramatic performance improvement. Business process re-engineering centers on those approaches that redesign individual internal systems and respond to external forces to achieve sophisticated objectives (Asgarkhani & Patterson, 2012). This is restructuring or repositioning of the insurance operations, by developing advanced information and communication technology, efficient human resources management, strategic planning, good customer service management, prompt service delivery, and claim settlement bring about significant changes. Sungau et al., (2013) posit that change must occur in a service organization to provide quality services to customers without time-wasting. In this vein, Hammer & Champy(1993), Broersma (1997), Hesson (2007), Banham 2010) supported that Customers' demand and technology have contributed to the frequent changes experienced in the organization A change to introduce new ICT technologies that will enhance and strengthen the internal and external operations of insurance businesses regardless of the clients' location. Prompt underwriting services, speedy claim settlement, and effective customer service are the major areas where the use of ICT might play a major role to limit delays, increase the efficacy and enhance operational excellence. The aim of the study is to assess and evaluate the degree to which these aspect of ICT as a re-engineering strategy has affected the business operations of the insurance companies during the corona virus pandemic.

Business process re-engineering has gained increased circulation, over the past years, and enabling role of ICT has become an important factor for implementing business process re-engineering. BPR application became possible for the business upgrade, with the help of technology, employees can operate as a team using intranet and extranets, and increasing workflows which eliminate distances. The aim of working together regardless of distance and location is achieved. The computerized process is to improve quality, avoid time-wasting in processing, share a database, making information available at many places at the same time, allowing the organization to be centralized and decentralized to aid decision making (Mohapatra, 2013). Several studies have provided varying evidence on the relationship between ICT as a re-engineering strategy and the performance of insurance firms in Nigeria and the world. Apampa & Olatunji (2010), Augustine (2017), Kimani (2017) have identified positive relationships and justified the ICT usage in Nigeria. This justifies the view of Bazini & Madani (2015) that there are interrelated factors that are likely influencing the insurance companies' performance. Therefore the need for assessing the interrelationship with other variables is supported to further clarify their relationship. However, re-engineering in most of the world has been considered the most appropriate in today's business environment. There is a paucity of studies that have assessed the role of ICT on the relationship between re-engineering and the performance of the organization in a developing economy such as Nigeria. The study tends to close this gap. Nevertheless, there is limited knowledge on how re-engineering strategies evolved and their contributions to organizational performance. With this more time, processes, and resource investment are needed, which cannot be provided by most insurance companies in developing countries.

Objectives of the Study

The main objective of the study was to evaluate the role of ICT as a re-engineering strategy in some selected insurance companies. The specific objectives were to:

To assess the relationship between ICT as a re-engineering strategy and the efficiency in claim settlement of some selected insurance companies.

DOI: 10.25103/ijbesar.143.06

To determine the effect of ICT on the preparation of policy documents as a re-engineering strategy in some selected insurance companies.

Research Questions

In line with the objectives of the study, the following research questions were formulated.

Is there a significant relationship between ICT as a re-engineering strategy and efficiency in the claim settlement of insurance companies?

Does ICT as a re-engineering strategy relate positively to the timely preparation of policy documents?

Research Hypotheses

The alternate hypotheses were formulated

H_1: ICT as a re-engineering strategy relates positively with the efficiency in claim settlement in insurance companies

H_2: ICT as a re-engineering strategy relates positively with the timely preparation of policy documents in insurance firms.

2. Review of Literature

Recently, the pandemic has led to increased use of technology and it has become essential in every aspect of insurance operation. Being a customer-oriented business, data, or information are collected, processed, stored, and distributed. This has given the insurance industry the drive to embrace emerging technologies, in managing client information, identifying needs and risks, and assisting in the handling of claims. The automation of the insurance business is conducted spending lesser time compared to when the conventional method is applied. Despite all these new potentials and opportunities, there are significant challenges and possible threats faced in the insurance industry. Delayed preparation of policy documents, delayed claim settlement, and error in premium calculation, delay in printing and distribution of customers' statements, unsustainable IT, high cost of establishment, lack of skilled manpower, unreliable power supply, and insecurity. Due to the competitive nature of the business environment, customers' expectations cannot be overemphasized, as getting good quality and prompt services have become their priority, and insurance companies must live up to these expectations, by facing up to competition, if they must survive. Companies can lose the market, due to poor quality services. The use of IT has been relatively ad hoc, and not being able to establish, maintain, and sustain ICT-supported programs could affect the company's performance and existence.

The question now is "what are the effects of the introduction of IT on these problems mentioned and consequently on the management of insurance. In line with the objectives of the study, the aforementioned research questions were formulated.

Recently, the insurance business has been perceived as a crucial business service that creates and adds value, as it facilitates every business by managing the risks, regardless of the enormity of the disaster or catastrophe caused by the pandemic. Insurance focuses on the reduction of the financial obligation incurred from any disaster, thus providing security to the policyholder, and also encourages people to engage in commercial activities with peace of mind, regardless of the degree of uncertainty. The insurance industry is now capable to perform more than it is currently doing, this is due to business process re-engineering which has made most companies achieve the desired optimum level of performance. This has been achieved by re-appraising and reviewing the processes of the organizational system by becoming more effective and efficient in delivering value to the stakeholders. Insurance as a service-oriented industry and also a contract between two parties involves the physical inspection of properties and filling of proposal forms. Having so many lockdown protocols and social distancing to observe, the insurance sector has to employ an organized integrated framework for automating processes to control information productions using the computer, telecommunication devices, software, and other communication gadgets to improve the efficiency of daily operational activities to achieve strategic goals.

2.1 Theoretical and Hypothesis development

Information and communication technology plays an enabling role in the improvement of the BPR activity cycle, by making provision for some compliments that enhance performance, thus bringing competition into the system, (Susanto et al., 2019). The aim of ICT on re-engineering in an organization is to enhance improvement towards raising the efficiency and effectiveness of the processes used within the organization, and organization must take into consideration all their operations in determining how these processes could be improved to bring out the best in the operations of the organizations. Business process re-engineering has gained increased circulation, over the past years, and the enabling role of ICT has become an important factor for implementing business process re-engineering. In running the daily business activities in both public and private organizations, Information and communication technology has been a vital keystone in every aspect of human organization, which without these facets of technology all cleared works, and the daily routine task will be inoperative.

DOI: 10.25103/ijbesar.143.06

The system by which businesses are created by the usage of ICT as an extensional term of information technology emphasizes the combination of these gadgets, telephone lines, and wireless signal, computers software, hardware, storage, and other systems that enable users to have access, to store, transmit and manipulate information. Gathering and analyzing facts aided by information and communication technologies have made communication and data easily accessible. Information and communication technologies are those adequate communication gadgets used in gathering and analyzing facts like telephone, televisions, radio, computers amongst others. The ways by which businesses are being reinforced through gathering and analyzing information, developing strategic vision, and finding the best approach for redesigning and enhancing joint teamwork, are been reshaped by these technologies. Organizations are aided by IT infrastructure, to automate business activities, and to reshape and redesign business processes (Venkatraman, 1994, Akhavan, 2006).

To improve the efficiency of the company's services, attract more profits, reduce cost, and improve turnaround time, most organizations redesign their bursary process and activities to remain relevant in the market. This is referred to as Business Process re-engineering and it is the basal assessment and radical modification of business processes to bring substantial performance improvement (Hammer & Stanton, 1995). In today's business environment, many organizations undergo some processes, imitating designs to decrease the cost of production, reduce time, and increase the efficiency and effectiveness of some specific functions. Achieving a substantial improvement in every organization cannot be overemphasized towards achieving great success, and information technology has become an important tool in enabling business process re-engineering activity in the organization, by spicing up business operations, reducing complexity, and also having significant improvement in the company's performance and this performance can lead to competitive advantage, (Susanto et al., 2019). BPR is also a modification of the business process and unconstrained modernization of all business processes.

2.2 Relationship between ICT and insurance firm's efficiency in claim settlement

There have been differences in opinion regarding the application of ICT in some selected insurance companies. Yusuf et al., (2017) conducted a study on the investigation of insurance claims management among selected insurance companies in Lagos metropolis, Nigeria. The study employed a descriptive survey design using a random sampling technique and thus gathered data through the use of a structured questionnaire. The sample population consisted of 127 respondents made up of claims managers and other members of staff within the surveyed companies. One sample T-test was adopted in the analysis of collected data. The findings from the study confirmed the significance of the various claims handling processing in claims management of insurance companies in Nigeria and these claims handling processing have significant effects on the claims management processes of insurance companies. It, therefore, recommends that claims managers should put forward strategic plans to ensure that insurance claims complaint files are properly kept, monitored, and handled for needs that may warrant their usefulness in the future.

However, recent findings have justified the assessment of ICT in insurance firms. Mukhopadhyay et al., 2013) researched the improvement of claim processing cycle time through lean six sigma methodology. The objective of the study was to present a Lean Six Sigma case study for reducing cycle time in the claim settlement process in insurance services. The study presented an application of Lean Six Sigma Methodology for claim settlement cycle time reduction in the insurance sector. In their Findings, Data have been collected for 84 claimants on processing time for each step. Mixing statistical and analytical techniques helps to improve the processing speed and is very well demonstrated by the Lean Six Sigma approach for service organizations. To identify the waste generated in various processes, one needs to delineate the process in detail and find out whether the steps add value or not, to monitor claim, the overall claim settlement process, a claim pendency calculator (CPC) has been developed in MS-excel for monitoring and ascertaining the claim status by the head office.

Angima and Mwangi, 2017) stated through their research that it has become imperative as ICT today contributes to the underwriting and claims management on the performance of property and casualty insurance companies in East Africa. The study investigated the effect of underwriting and claims management practices on the performance of general insurance firms in East Africa. The study employed multiple linear regression analysis using primary and secondary data collected from 82 general insurers in Kenya, Uganda, and Tanzania. The findings show that there is a significant positive relationship between underwriting and claims management practices employed by the firms and non-financial performance, but the relationship with financial performance was insignificant. The implication is that a profit-oriented insurance firm should embrace the function of a claim that is closely related to the underwriting and pricing of the firm's portfolio for meaningful results. It is recommended that general insurance companies focus on other important factors besides underwriting and claims management to improve overall financial performance. Thus we propose that:

H₁: *ICT as a re-engineering strategy relates positively with the efficiency in claim settlement in insurance companies*

DOI: 10.25103/ijbesar.143.06

2.3 Relationship between ICT as a re-engineering strategy and timely preparation of policy documents in the insurance firms.

It has been observed that ICT is a critical element in the drive for improved performance in the organization, and automated activity is vital to driving sustained improvement when the right facility is provided. Augustine (2017) investigated Information and Communication Technology (ICT), a catalyst for effective operation: the case of Nigerian insurance companies. He held that the emergence of Information and Communication Technology (ICT) has not only influenced our lives style and societal norms in Nigeria but has also created a new terrain for business advancement and success in the country. This study borders on the adoption of ICT into the business operations of insurance companies in Nigeria, to determine the impact of the adoption on product innovations (PI); business operations (BO); and customer satisfaction of the industry. The study adopts survey research methodology and extracted data from a primary source through well-structured designed questionnaires, using correlation and linear regression analysis to examine the present and future relationship between the independent variable (ICT) and the set of dependent variables (PI; BO; and CUST). The findings revealed that the adoption of ICT immense has a positive significant impact on PI, BO, and CUST within the insurance companies' operations if other factors are kept controlled efficiently.

The method the work system applies in an organization is designed to drive employees' innovativeness and creativity and encourages the organization to effectively take advantage of its skilled employees to leverage its available resources to achieve great results. Fadun (2013), conducted a study on the impact of Information and Communication Technology (ICT) on insurance companies' profitability in Nigeria. The study identifies the imperatives for the adoption of ICT to promote efficient service delivery in the insurance industry as a strategy for the attainment of the profit maximization objectives of insurance companies in Nigeria. The study is an empirical design that utilizes responses to the structured questionnaire of 152 respondents from 18 insurance companies to explore the impact of ICT adoption on the quality of service delivery and profitability of insurance companies in Nigeria. The study concludes that there is a positive relationship between ICT adoption and insurance companies' profitability in Nigeria. This implies that the adoption of ICT by insurance companies can enhance their efficiency, quality of service delivery, and their profitability. The findings for practice imply that insurance companies should endeavor to update their ICT facilities regularly, given its impacts on quality of service delivery and profitability. The paper also highlights the need for regular training of insurance personnel to keep them abreast of the current innovations in the use of ICT to ensure that the industry contributes positively to the economy.

Given this Kimani (2017) carried out a study on the effect of Information and Communication Technology (ICT) strategy implementation on customer service delivery in the insurance industry in Kenya. The study used a descriptive research design. The target population of the study consisted of individual policyholders with active policies in the top 10 insurance companies in Kenya. The list of the top 10 insurance companies was obtained from the Insurance Regulatory Authority (IRA). A list of the active policyholders was obtained from the respective insurance companies. The sampling technique for this study was a stratified random sampling technique. Questionnaires were used to collect data from the selected respondents. The study concludes that customers understood customer service delivery that was offered by the insurance industry and the rating of customer service delivery by the insurance providers in Kenya was high. From the study, it can be concluded that customers were familiar with the automated online insurance application processes and the usability of the online underwriting process was highly better than the manual process. Hence we propose that:

H₂: *ICT as a re-engineering strategy relates positively with the timely preparation of policy documents in insurance firms.*

3. Methodology

The design adopted for the study was a survey research design. Primary and secondary data were used for the study. A structured questionnaire was also used to generate responses from members of staff. The population of the study consist of all senior and junior staff of these selected insurance companies. The population of IGI PLC and Leadway Assurance staff was 2830. The study adopted the Freund and William statistical formula in calculating the sample size which is 350. Two evaluators from the University of Nigeria Nsukka, and Enugu State University of Science and Technology respectively, validated the questionnaire instrument. In testing the reliability of the questionnaire, test re-test methods were employed, by administering 15 copies of the questionnaires to similar respondents, and was re-administered to the same respondents after two weeks, two sets of responses obtained correlation using the Pearson product-moment correlation(r) and a coefficient of reliability of 0.95 was obtained, which is above the threshold of 0.70 (Hair et al., 2010). This evidence shows that the instrument is reliable for data collection. Five research assistants were employed to distribute and collate the questionnaires. Pearson product-moment correlation technique was used for analysis with the aid of SPSS version 20. The study chose Lagos state as the area of study since the headquarters of the aforementioned insurance companies are situated there. Lagos state is located in the southwest geopolitical zone of Nigeria. The choice of the state was guided by the fact that most re-engineering activities occur at head offices. The author could not visit

DOI: 10.25103/ijbesar.143.06

these insurance companies, because the movement was restricted in some parts of the country, but a soft copy was sent to the contacts, who printed out and distributed the questionnaires to the staff working in marketing, account, underwriting, claims, and ICT departments. The study was conducted in July – September 2020, shortly after the lifting of the lockdown.

4. Result and Discussion

The usable questionnaires gathered were three hundred and fifty (350) of the three hundred and eighty-five retrieved. The researchers dropped the thirty-five questionnaires because they had varying issues such as mutilation, missing responses on some major items and double ticking in some cases. Common method variance was assessed using factor analysis and it was found that none of the variables accounted for more than 50%, which indicates the absence of bias. Chi-square for the difference was assessed given the difference in the time frame the data was received and because some of the instrument was not retrieved. The result indicates that there is no significant difference.

Sequel to this, the three hundred and fifty (350) instrument was used for further analysis. The demographic distribution of the instrument shows that 200 (57.1%) are male, while 150(42.9%) are female respondents that took part in the survey. The instrument also shows the age distribution of the respondent to be 18-30 are 90, which is 25.71 % of the respondents, 31-40years are 172, which is 49.14 % of the respondents, 41 -50years are 51, which is 14.57 % of the respondents, and 50years and above are 37, which is 10.57% of the respondents.

Table 1: Educational level of the employees

The educational level of employees	**Frequency**	**Percent**
WASC/SSCE and below	2	0.57
NCE/OND	16	4.57
HND/BSc	250	71.43
Master degree and above	74	21.14
Other specify	8	2.29
Total	350	100

Source: Field survey, 2020

Table 2, shows that the majority of the respondents are graduates of higher institutions, which shows that the respondents are educated enough to fill the questionnaires.

Table 2 Designation and grade

Option	**Frequency**	**Percent**
Top Management	40	11.43
Middle Management	250	71.43
Lower Management	60	17.14
Total	350	100

Source: Field survey, 2020

The field experience shows that the largest number of respondents is in the middle management cadre with 71.43% respondents from the category.

Table 3 Respondent department/section

Department	**Frequency**	**Percent**
Underwriting	60	17.14
Claims	43	12.29
Marketing	130	37.14
Account	65	18.57
Other specify	52	12.86
Total	350	100

Source, Field survey, 2020

The data from the above table 3 shows that a large number are from the marketing department follows by the underwriting and accounts department and the small numbers are from claims and other departments such as the administrative and ICT.

DOI: 10.25103/ijbesar.143.06

Table 4: Descriptive Statistics on ICT as a re-engineering strategy in insurance firms in Nigeria			
	Mean	Std. Deviation	N
ICT	4.0114	.87295	350
policy document preparation	3.9486	.87151	350
Claim settlement	4.0771	.79561	350

Source: Fieldwork, 2020

The descriptive means and standard deviation of the variable shows a good mean response for each of the study variables. This indicates that responses to the variables are sufficient for further analysis.

Table 5: Correlations result on ICT as a re-engineering strategy in insurance firms in Nigeria				
		ICT	policy document preparation	Claim settlement
ICT	Pearson Correlation	1	.456**	.205**
	Sig. (2-tailed)		.000	.000
policy document preparation	Pearson Correlation	.456**	1	ss
	Sig. (2-tailed)	.000		.001
Claim settlement	Pearson Correlation	.205**	.175**	1
	Sig. (2-tailed)	.000	.001	

Source: Author's fieldwork, 2020.

Table 5 above represents a correlation analysis that depicts the relationship between ICT and efficiency in the Nigerian insurance sector. The result indicates there is a positive and significant relationship between ICT as a re-engineering strategy and the efficiency in claim settlement and the effective and timely preparation of policy documents. The result shows that ICT as a re-engineering strategy has a 20.5% shared relationship with claim settlement, though, the relationship is weak, but, it is positive. However, hypothesis one is accepted, as the p-value (0.001) is less than 0.05., it thus implies that ICT as a re-engineering strategy positively relates to the efficiency with claim settlement in insurance firms. Further, relying on the coefficient of determination, the result indicates that ICT as a re-engineering would only influence about 4% of changes in the way insurance firms manage claim settlement. The low relationship could be because the firms also feel that efficiency in claim settlement is dependent on the honesty of the claimant. This result agrees with the findings of Apampa, and Razaq (2010) and Fadun (2013) that also found that insurance firms would improve in their ability to meet their obligation when they adopt ICT in their operations. Similarly, the result is consistent with the views of Idris, Olumoko, and Ajemunigbohun (2013) that found that ICT is foundational towards driving better performance of insurance firms in Nigeria. Further, Sarkar et al., (2013) outcomes are similar to the current study, as it was found that ICT is necessary to drive the performance of insurance firms in Nigeria.

Further, the result indicates that ICT as a re-engineering strategy relates positively to the timely preparation of policy documents. The result shows that ICT as a re-engineering strategy has a 45.6% shared relationship with the timely preparation of policy documents in insurance firms. The relationship is described as moderate given the r-value, though the relationship is positive and significant as the p-value is less than 0.05, which justified the acceptance of hypothesis two. The result also indicates that ICT as a re-engineering strategy accounts for 21% of changes in the timely preparation of policy documents in insurance firms in Nigeria. The result conforms to the findings of Kimani (2017), Angima, and Mwangi (2017) which found that ICT is vital to drive increased efficiency in firms. Similarly, Adeyemo and Soye's (2017) findings also align with the study outcome, and the study of Bazini and Madani (2015) supports the study findings that ICT is fundamental as a strategy towards advancing the insurance sector. The result is also supported by the finding from the study of Yusuf et al., (2017) that found that ICT plays a major role in the improvement of the insurance sector.

5. Conclusions and Recommendations

The study concluded that information and communication technology has a great role to play as a re-engineering strategy in some selected insurance companies. There is a significant relationship between ICT and the operational

DOI: 10.25103/ijbesar.143.06

performance of the insurance companies in regards to improvement on speedy and quality services to the policyholders of the insurance companies. There is an improved fast and accurate data entry for policyholders and insurers for efficient insurance services. There is reduced human error and increased speedy decision-making and processing of recorded information. The organizations experience an increased opportunity to establish great contact with international insurers through the use of global knowledge and expertise; reducing to a large extent or eliminating the lengthy and expensive process of issuing insurance policies, thus increasing accuracy and running effective call centers.

The study advances a new perspective on measures that would help the improvement of the insurance sector in Nigeria, as the study advances the need for increased attention to strategies that would help improve the overall performance of the sector. The study concludes that claim settlement as an important aspect of the insurance sector's activities requires a new approach that addresses the generality of the activities of the insurance firms. Re-engineering activities cut-across all sectors of the firm, as such, in improving the claim settlement of claimants, these firms can ensure that they advance the need for a deliberate strategic approach that supports refining of the insurance firms, thereby improving their capacity to meet the expectations of their existing and prospective clients.

The study recommends there should be a frequent update of ICT facilities regularly, to impact greatly on the quality of service delivery and efficiency. There should also be the need for regular training of insurance personnel, to improve their skills, and keep them abreast of the current innovation in the use of ICT, to ensure the industry's survival in the global market. There should be a good collaboration between the insurance administrators and regulators at all levels, to ensure that every relevant information are collated which should in one way or the other assist in contributing meaningfully to the usefulness of IT ineffective service delivery

The study focused on revealing the role of ICT as a re-engineering strategy in some selected insurance companies, from the analysis of the findings, it was concluded that ICT has been able to reduce transaction costs and thereby improving productivity and offering immediate connectivity, efficiency, transparency, and accuracy, thus proving it to be a good factor of re-engineering strategy. Given this development, managers are encouraged to further invest in ICT and develop electronic insurance and electronic marketing framework that would help improve the sector. This is because it keeps them thriving in a competitive environment and ensures appropriate provision for quality service delivery to customers and enhancement of overall performance of the organizations.

References

Africa CDC. (2020, October 7). Outbreak Brief 25: COVID-19 Pandemic – 07 July 2020. *Africa CDC*. https://africacdc.org/download/outbreak-brief-25-covid-19-pandemic-07-july-2020/

Akhavan, P. P. (2006). *Exploring the interdependency between reengineering and information technology by developing a conceptual model*.

https://www.academia.edu/10973551/Exploring_the_interdependency_between_reengineering_and_information_technology_by_developing_a_conceptual_model

Angima, K., & Mwangi, M. (2017, May). *Effects of Underwriting and Claims Management on Performance of Property and Casualty Insurance Companies in East Africa | Request PDF*. ResearchGate. https://doi.org/10.19044/esj.2017.v13n13p358

Apampa, O., & Olatunji, R. (2010). Evaluation of ICT Penetration in Selected Insurance Companies: The Lagos Experience. *Journal of Emerging Trends in Computing and Information Sciences*.

Asgarkhani, M., & Patterson, B. (2012). *Information and Business Process Re-engineering through Application of Information and Communication Technologies (ICTs)*. 6.

Augustine, S. Y. (2017). INFORMATION AND COMMUNICATION TECHNOLOGY (ICT), A CATALYST FOR EFFECTIVE OPERATIONS: CASE OF NIGERIAN INSURANCE COMPANIES. *International Journal of Advancement in Development Studies,*.

https://www.academia.edu/37991989/INFORMATION_AND_COMMUNICATION_TECHNOLOGY_ICT_A_CATALYST_FOR_EFFECTIVE_OPERATIONS_CASE_OF_NIGERIAN_INSURANCE_COMPANIES

Banham, H. (2010, December). *(PDF) External Environmental Analysis For Small And Medium Enterprises (SMEs)*. https://www.researchgate.net/publication/293022386_External_Environmental_Analysis_For_Small_And_Medium_Enterprises_SMEs

Bazini, E., & Madani, F. (2015). ICT Application in the Insurance Industry: Its Impact in Customer Relationship Management. *Academic Journal of Interdisciplinary Studies*. https://doi.org/10.5901/ajis.2015.v4n3s1p307

DOI: 10.25103/ijbesar.143.06

Broersma, H. (1997). *A theoretical bapproach to Business process re-engineering in south africa*. RAND AFRIKAANS UNIVERSITY.

ECDC. (2020, October 9). *COVID-19 situation update worldwide, as of 9 July 2020*. European Centre for Disease Prevention and Control. https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases

Fadun, S. (2013, October). *Information and Communication Technology (ICT) and Insurance Companies Profitability in Nigeria | Journal of Accounting, Business and Management (JABM)*. http://journal.stie-mce.ac.id/index.php/jabminternational/article/view/170

Hammer, M., & Champy, J. (1993). *Reengineering the Corporation: A Manifesto for Business Revolution*. HarperBusiness.

Hammer, M., & Stanton, S. A. (1995). *The Reengineering Revolution: A handbook* (Illustrated edition). HarperBusiness.

Hesson, M. (2007). Business process reengineering in UAE public sector A naturalization and residency case study. *Business Process Management Journal*, *13*, 707–727. https://doi.org/10.1108/14637150710823174

Kimani, M. (2017). *Effects of Information Communication Technology Strategy Implementation on the Customer Service Delivery in the Insurance Industry in Kenya* [Thesis, United States International University - Africa]. http://erepo.usiu.ac.ke:8080/xmlui/handle/11732/3163

Mohapatra, S. (2013). *Business Process Reengineering: Automation Decision Points in Process Reengineering*. Springer US. https://doi.org/10.1007/978-1-4614-6067-1

Mukhopadhyay, A., Ashok, S., & Ghosh, K. (2013). Improvement of Claim Processing Cycle Time through Lean Six Sigma Methodology, by Ashok Sarkar, Arup Ranjan Mukhopadhyay & Sadhan Kumar Ghosh, International Journal of Lean Six Sigma, Volume 4, Number 2, pp. 171-183. *International Journal of Lean Six Sigma*, *4*, 171–183.

Sungau, J., Ndunguru, P., & Kimeme, J. (2013, April). *(PDF) The influence of Business Process re-engineering on Service Quality: Evidence from Service Industry in Tanzania*. ResearchGate. https://www.researchgate.net/publication/243964088_The_influence_of_Business_Process_re-engineering_on_Service_Quality_Evidence_from_Service_Industry_in_Tanzania

Susanto, H., Leu, F.-Y., Chen, C. K., Leu, F.-Y., & Chen, C. K. (2019). *The Emerging Technology of Big Data: Its Impact as a Tool for ICT Development*. Apple Academic Press. https://doi.org/10.1201/9781351241250

Venkatraman, M. (1994). *It-enabled business transformation: From automation to business scope redefinition*. Undefined. /paper/It-enabled-business-transformation%3A-from-automation-Venkatraman/c8a5b5fdf0da179822d15b57259cdd1cb5cf9058

Yusuf, T. O., Ajemunigbohun, S. S., & Alli, G. N. (2017). A Critical Review of Insurance Claims Management: A Study of Selected Insurance Companies in Nigeria. *SPOUDAI Journal of Economics and Business*, *67*(2), 69–84. https://ideas.repec.org/a/spd/journl/v67y2017i2p69-84.html

Appendix - Questionnaire

Instruction: Only staff from underwriting, claims, account, customer services marketing, and ICT Department are required to answer the questions in all sections;

Section A: Personal Data

Kindly tick [✓] the appropriate against each chosen answer

DOI: 10.25103/ijbesar.143.06

1. Name of Organization _____
2. Sex
   (a) Male [ ] (b) Female[ ]
3. Age (a) 18 -30 yrs. [ ] (b) 31-40yrs [ ] (c) 41-50 yrs. [ ] (d) 50 yrs. and above [ ]
4. What is your "highest" educational qualification?
   (a) WASC/SSC and below [ ] (b) NCE/OND [ ] (c)HND/B.SC [ ]
   (d) MASTER DEGREE AND ABOVE [ ] (e) Others Specify _____
5. Kindly state your Job designation
   (a) Top management (b) Middle management (c) low management
(6) What is your department?
   (a) Underwriting (b) Claims (c) Marketing (d) Account (e) Other specify

Section B: Research Questions

Please indicate by ticking [✓] in the appropriate box, showing your level of agreement/ disagreement to each of the questions. The key is explained thus: SA= strongly agree; A= Agree; UN= Undecided; D= Disagree; and SD=strongly disagree.

Research question 1

What are the roles of ICT on claim settlement as a re-engineering strategy in some selected insurance companies?

S/N	The roles of ICT on claim settlement	SA	A	N	D	SD
7	Use of information technology tools improves claim settlement related works.					
8	Deployment of IT tools has increased efficiency in database management and reconciliation of claims payments					
9	The deployment of ICT has enabled operational efficiency in your organization and the time for the claim settlement process has been reduced substantially.					
9	The aim of working resiliently regardless of the social distancing and lockdown in every part of the country was achieved, thus eliminating organizational distancing.					
10	The computerized process has improved quality services, curbed time-wasting in processing, shared a database, and made information available at many branches at the same time.					

Research Question 2

What is the effect of ICT on preparation of policy documents as a re-engineering strategy in some selected insurance companies?

S/N	ICT on preparation of policy document	SA	A	N	D	SD
11	Company's advancement in technology has transformed some techniques in underwriting management					
12	ICT invention and initiative has helped your organization in meeting the customer's demand and increased customers' satisfaction.					
13	ICT tools are crucial in underwriting process.					
14	The deployment of ICT in the preparation of policy documents has reduced cost and improved turnaround time					
15	During the pandemic lockdown, the use of ICT has consistently improved the service delivery of your organization.					
16	During the lockdown, ICT eliminated face-to-face contact and facilitated electronic insurance.					

DOI: 10.25103/ijbesar.143.06

International Journal of Business and Economic Sciences Applied Research

IJBESAR
ijbesar.ihu.gr

The Economic Cost of ill Health due to Air Pollution: Evidence from Greece

Maria Panteli†[1], Sofia Delipalla[2]

[1,2]Department of Balkan, Slavic and Oriental Studies, University of Macedonia, Thessaloniki, Greece

ARTICLE INFO

Article History

Received 24 May 2021;
Accepted 29 October 2021

JEL Classifications
I18, Q51, Q53

Keywords:
Air Pollution; Health Effects; Economic Cost; Mortality and Morbidity Cost; Healthcare Expenses; Greece

ABSTRACT

Purpose:
Air pollution and its adverse health effects result in an economic cost to society. Given that the burden of disease from air pollution is to a large extent preventable, estimation of the magnitude of its economic cost is important. We estimate the economic cost of the health impact from exposure to ground-level ozone, and ambient and household $PM_{2.5}$ air pollution, as well as their joint effects, in Greece.

Design/methodology/approach:
We analyze the economic cost of the health impact from air pollution using the Cost-of-Illness (COI) as well as the Willingness to Pay (WTP) approach.

Finding:
Based on the COI approach, air pollution attributable diseases resulted in a total economic cost of €1.27 billion in 2019, or 0.68 percent of GDP. Under the WTP approach, mortality cost is significantly higher.

Research limitations/implications:
In spite of some standard methodological limitations, giving a monetary value to the burden of disease from air pollution highlights the significance of curbing air pollution, providing at the same time guidance in prioritizing among various competing policy objectives. Air pollution abatement interventions can yield significant benefits for global health and the economy.

Originality/value:
To the best of our knowledge, this is the first study estimating direct and indirect costs of air pollution-attributable health consequences in Greece, using the most recent data for all specific-cause mortality and morbidity outcomes. Employing two alternative methodologies, COI and WTP, we provide a lower and an upper bound of the economic cost of air pollution, respectively. The COI estimates provide a financial measure of the potential gains (by age and gender) if air pollution were to be extensively mitigated. The WTP estimates are a starting point in a cost-benefit analysis evaluating certain environmental regulation policies. Our results and their policy implications could be a guide to other economies with similar characteristics and comparable air pollution levels with those in Greece.

1. Introduction

Since the second half of the past century, a tremendous increase in global population, the global pressure of increased economic activity, energy usage and pollution emissions (especially carbon emissions) have induced various crises, with the most obvious and pressing one being the climate crisis (Harris, 2019). The present times are increasingly defined by the need to tackle the 'grand challenges', including climate change, demographic issues, improvement of health and well-being for all, while promoting sustainable but also inclusive growth (Mazzucato, 2020). It has been advocated that the pressing need for action requires a reconsideration of the role of the government. It should not merely correct arising market failures, for example, due to negative externalities, but also advance on an active creation of markets confronting the most pressing issues and challenges faced by societies today, leading the way towards a green transition (Mazzucato and McPherson, 2018; Mazzucato, 2020).

This green transition requires a fast and extensive transformation in the fields of energy, management of ecosystems, investment in infrastructure and a redesign of governments' industrial policies, providing opportunities for green investment and innovation to tackle climate change and social inequalities (Mazzucato and McPherson, 2018; Galvin and Healy, 2020). For more on the proposed idea of a green new deal see, for example, Luke (2009), Custers (2010), Aşici and Bünül (2012), White (2019), and Galvin and Healy (2020). In line with this debate, our paper considers the important issue of environmental degradation and its negative consequences for human health due to air pollutants. According to the most recent round of the Global Burden of Disease Study (GBD 2019, 2020), air

†Corresponding Author: Maria Panteli
Email: panteli@uom.edu.gr

DOI: 10.25103/ijbesar.143.07

pollution is the fourth leading risk factor causing death and disability, contributing to the burden of disease worldwide. The World Health Organization (WHO) has estimated that 91 percent of the population around the globe is exposed to air pollution levels exceeding the WHO air quality guideline limit values. The joint health effects of ambient and household air pollution result in more than seven million premature deaths each year (WHO, n.d.), an estimate which can be considered conservative when compared to the findings of Burnett et al. (2018) and Lelieveld et al. (2019) regarding the impact of ambient air pollution. Lelieveld et al. (2019) find the mean per capita mortality rates in Europe to be higher than the global average, with the difference being even more pronounced in Eastern Europe.

Air pollution exposure (including ambient fine particulate matter ($PM_{2.5}$), household $PM_{2.5}$ and ambient ozone air pollution) has been associated, among others, with upper and lower respiratory infections, lung cancer, stroke, ischemic heart disease, diabetes mellitus and chronic obstructive pulmonary disease (GBD 2019, 2020). The majority of these health conditions are non-communicable. Specifically, the estimated share of non-communicable diseases in the air pollution-related global disease burden is more than 70 percent (Landrigan et al., 2018). This suggests that interventions for air pollution abatement can yield significant benefits in global health.

Polluted air and its negative consequences for human health result in a significant economic cost. According to the Lancet Commission on pollution and health, diseases related to air pollution are responsible for productivity losses which in many low- and middle-income countries can be as high as 2 percent of their Gross Domestic Product (GDP) (Landrigan et al., 2018). Also, healthcare costs resulting from air pollution-attributable diseases are significant in both high- and middle-income countries, with estimated costs ranging from 1.7 percent to 7 percent of their total annual healthcare spending (Landrigan et al., 2018). Global economic cost of air pollution, measured in welfare terms, is estimated to reach many trillion US dollars each year (WHO and OECD, 2015; Landrigan et al., 2018), a cost which is projected to rise significantly in the coming decades (OECD, 2016).

In Greece, the issue of air pollution has been recurrent. In the beginning of the 2000s, the largest cities have been among the top 20 cities in Europe with the 'most days per year of poor air quality' (European Commission (EC), 2007, p. 116). In the decade from 2000 to 2010, concentration levels of many air pollutants stabilized (or declined) due to a more widespread use of higher quality fuels, major investment in public transportation and the use of technologically enhanced road transport vehicles (European Environmental Agency (EEA), 2008; Organization for Economic Co-operation and Development (OECD), 2009). Concentrations of $PM_{2.5}$ and ozone, however, remained persistently high (OECD, 2009). From 2010 onwards, a gradual improvement of air quality has been documented due to reduction of primary pollutant emissions, mainly driven by the Greek economic crisis but also by the obligations stemming from European legislation (National Centre for the Environment and Sustainable Development (NCESD), 2018). All recorded mean annual concentrations of $PM_{2.5}$, however, exceeded the WHO guideline limit value of 10 $\mu g/m^3$, although they did not exceed the European Union (EU) set air quality standard of 25 $\mu g/m^3$ (WHO, 2006; EC, n.d.). Ground-level ozone concentrations also have had a less pronounced long-term improvement, due to regional climatological conditions which aid the manifestation of high concentration episodes (NCESD, 2018). The most recent health data available indicate that exposure to ambient and household $PM_{2.5}$, as well as ambient ozone air pollution jointly, constituted the fifth leading risk factor causing death in Greece, in 2019, behind metabolic risks, tobacco use, dietary risks and non-optimal temperature (GBD 2019, 2020). During the same year, air pollution was the seventh leading risk factor causing disability. More than 90 percent of air pollution-attributable diseases are non-communicable (GBD 2019, 2020). See Figures A1 & A2, in Appendix A, for mortality and morbidity due to air pollution, by disease, gender and age.

As already noted, the burden of disease from air pollution is to a large extent preventable. To guide public policy to this end, estimation of the magnitude of the economic cost resulting from air pollution exposure is important. Such estimates for Greece, however, are scarce. Existing research has focused on particular metropolitan regions, and/or emissions and concentrations from certain activities or sectors. Specifically, Georgakellos (2007) estimated the external cost of various air pollutants from thermal power stations; Mirasgedis et al. (2008) estimated the cost of environmental damage from air pollution emitted from industrial activities in the greater area of Athens; Vlachokostas et al. (2012) calculated the social cost of the health impact of particulate matter (PM_{10}) and ozone air pollution in the greater area of Thessaloniki; Sarigiannis et al. (2015) estimated the economic cost of the health impact from exposure to PM_{10} air pollution resulting from biomass burning in Thessaloniki.

Estimates of the economic cost, in terms of mortality and morbidity, from exposure to many pollutants emitted from major industrial facilities in Greece are also included in a European study (EEA, 2011). Estimates from the Impact Assessment for the EC Integrated Clean Air Package (EC, 2013) show that the external cost resulting from air pollution reaches €7 billion (income adjusted, 2010) per year. A global study estimated mortality cost, resulting from exposure to ambient and household $PM_{2.5}$ air pollution in Greece, to be equal to 7.1 percent of GDP in 2010 (WHO and OECD, 2015). The World Bank (WB) and the Institute for Health Metrics and Evaluation (IHME) found mortality cost to be equal to 8.55 percent of Greece's GDP, in 2013, when using the same methodology, the Willingness to Pay approach (WTP) (WB and IHME, 2016); using the Cost-of-Illness (COI) approach, economic cost due to mortality from air pollution was found to be 0.14 percent of GDP. The relative magnitude of the estimated cost in Greece, compared to the 142 countries included in the report, varied widely under the two alternative methodologies employed. Under the WTP method, Greece was found to be among the top ten countries with the highest mortality cost estimates, a result which is in contrast with the findings of the WHO and OECD (2015) study. On the other hand, under the COI method, more than 58 percent of the countries had a relatively higher estimate for mortality cost due to air pollution. The methodological assumptions, differences in health data, as well as differences in economic conditions, are of paramount importance and greatly influence economic cost estimates.

Neither of the studies conducted by major international organizations focuses specifically on Greece nor does it calculate morbidity cost and healthcare expenditure due to air pollution. Our paper integrates the health impact from exposure to air pollutants with the strongest epidemiological evidence, regarding their negative health outcomes, while the spatial coverage concerns the whole country. We estimate the economic cost of air pollution, first, using a market-based methodology, the COI approach, which is one of the most common economic evaluation methods employed in the context of health economics (Tarricone, 2006; Jo, 2014). All cost components related to health impact of air pollution are taken into account, with estimates concerning not only ambient air pollution but also household air pollution from cooking with polluting fuels and technologies. The analysis is detailed, with cost estimates being offered by gender and age group for mortality and morbidity cost. The most recent data available on the burden of disease are used.

We estimate the cost of air pollution-related mortality with a non-market valuation method, as well, that is, the WTP approach. In the original application of the methodology, a stated preferences survey elicits people's WTP through the valuation of 'realistic, but hypothetical, [mortality] risk reduction scenarios' (Lindhjem et al., 2011, p. 1382). The resulting measure, commonly referred to as value of statistical life (VSL), is essentially a trade-off rate between wealth/money and fatality risk (Viscusi, 2010; Lindhjem et al., 2011), serving as a reference point against which governments can assess the benefits of policies aimed at mortality risk reductions (Viscusi, 2003). The alternative scenario is an implicit and arbitrary valuation through policy decision-making, a process which is often non-transparent and can potentially result in inefficient resource allocation (Lindhjem et al., 2011).

Due to the lack of a primary WTP survey for Greece, we make use of the OECD-recommended VSL with the necessary adjustments made (OECD, 2012, 2014).[1] The OECD-recommended VSL is based on a meta-analysis of 92 published research studies on stated preferences within the context of environment, health and traffic (OECD, 2012). The estimated monetary value is best suited for welfare cost analysis (see, Hunt, 2011; OECD, 2012, 2014; Narain and Sall, 2016 and references therein) and represents welfare losses to the Greek society resulting from air pollution-induced mortality.

By employing the two alternative methodologies, COI and WTP, we provide a lower and an upper bound of the economic cost of air pollution in Greece, respectively (Cropper, 2000; Meisner, 2015; Narain and Sall, 2016). Our estimates, under the COI approach, can be viewed as a financial measure of the gains that would have been achieved if air pollution were to be extensively mitigated in the country. WTP estimates, on the other hand, can be used as a starting point in cost-benefit (CB) analysis for evaluating environmental regulation policies aimed at reducing mortality risk due to air pollution. In general, giving a monetary value to the burden of disease from air pollution can redirect the allocation of resources in favour of further curbing air pollution, and highlights the significance of the issue among various competing policy objectives and priorities. Our qualitative results and their policy implications are expected to be of international relevance. The estimates could serve as a guide to economies with similar characteristics and comparable air pollution levels with those in Greece.

2. Materials and Methods

We estimate the economic cost of the health impact resulting from exposure to ground-level ozone, and ambient and household $PM_{2.5}$ air pollution, as well as their joint effects (total air pollution). Both the COI and the WTP approaches are employed.

2.1 Cost-of-Illness Approach

The COI method has been developed originally by Rice (1967) and Rice et al. (1985), employed thereafter by numerous studies valuing the health burden of a disease. The information provided by the COI estimates can guide the formulation and prioritization of policies and interventions in the healthcare system and, ultimately, guide allocation of healthcare resources for policy efficiency, given the budgetary constraints (Jo, 2014). In this context, the COI framework has been frequently used in the analysis of the health burden due to air pollution in various countries or even sub-regions within countries (e.g., Alberini and Krupnick, 2000; Croitoru et al., 2010; Patankar and Trivedi, 2011; Meisner et al., 2015; Sander et al., 2015; Lu et al., 2016; Bherwani et al., 2020). To the best of our knowledge, such a detailed analysis for Greece does not exist.

According to COI, there are direct and indirect costs. Direct cost includes healthcare expenses for diagnosis and treatment of diseases related to air pollution exposure. The associated non-healthcare expenses, such as transportation expenditure to hospitals and expenses for healthcare providers, are not included (as usual) due to lack of data.

Direct cost, or attributable health expenses, is estimated according to the formula

$$PAE_j = PAF_j \times THCE \quad (1)$$

where PAE is health expenses attributable to air pollution by air pollution subcategory j, PAF is mean estimated air pollution attributable fraction based on number of deaths by j, and $THCE$ is total healthcare spending, including all domestic and international financing sources in 2019.

[1] We have pinpointed a single study employing a contingent valuation method to elicit WTP for a marginal reduction in the risk of premature mortality due to air pollution in the Greek context by Vlachokostas et al. (2011). However, in this study, WTP is estimated only for the city of Thessaloniki and therefore it was deemed inappropriate to be used for the whole country.

DOI: 10.25103/ijbesar.143.07

Indirect cost measures productivity losses stemming from morbidity and early mortality due to illnesses attributable to air pollution exposure. The indirect cost component is quantified with the Human Capital method. Human life is valued through the stream of present and future market earnings and the resulting economic cost of a disease is measured through the disruption of this stream of productive output by morbidity and premature mortality (Max et al., 2004).

Mortality cost consists of present and future income lost as a result of early mortality from air pollution attributable illnesses. The attributable mortality cost $PAMC$ for each pollution subcategory j, from premature death by disease i in the population subgroup k, is estimated as:

$$PAMC_{jik} = PAF_{jik} \times \sum_{a=min}^{max} (DTH_{jika} \times PVLE_{ka}) \quad (2)$$

where PAF is the mean estimated value of the attributable to air pollution death fraction, DTH is total number of deaths, $PVLE$ is the estimated present value of lifetime earnings and min - max are the minimum and maximum age groups, respectively.

To calculate the present value of lost productivity, that is, productivity that would have been achieved in future years had a person not died prematurely from air pollution attributable diseases, we use the formula by Max et al. (2004). Under this approach, we take into account life expectancy in the different five-year age groups in males and females, as well as labour force participation in each five-year age group and gender, respectively:

$$PVLE_{ag} = \sum_{n=a}^{max} \left(SP_{ag}(n)\right) \times \left[PR \times EMP_g(n)\right] \times \frac{(1+\mu)^{n-a}}{(1+r)^{n-a}} \quad (3)$$

where $PVLE$ is the present value of lifetime earnings, a is the present age of a person and g its gender and SP stands for survival probability. This survival probability can be interpreted as the probability that a person of gender g which dies at age a would have survived at age n. PR is the chosen productivity measure, GDP per worker, $EMP_g(n)$ is the ratio of employment-to-population at gender g and age n, μ is the growth rate of labour productivity and r is the chosen discount rate. Regarding the annual labour productivity growth rate, we make the common assumption of 1 percent increase. We assume no discounting for human life. A sensitivity analysis is undertaken below assuming 3 percent discount rate.

The age groups included in the analysis are infants under 1 year of age (minimum) to 75-79 years of age (maximum age group). We assume that no person above the age of 79 years is working. Defining the workforce in such a fashion could raise concerns of overestimation of indirect mortality cost. This is because not all people will start working from age 15 and many individuals will retire around the age of 65 (Narain and Sall, 2016). As already noted above, to account for this possible source of overestimation, indirect mortality cost (and morbidity cost below) is weighted by labour force participation, following the approach used by WB & IHME (2016), discussed in Narain and Sall (2016, pp. 39-47).

Air pollution attributable indirect morbidity cost (PAIC) is calculated as:

$$PAIC_{jik} = PAF_{jik} \times YLD_{jik} \times EMP_k \times PR \quad (4)$$

where PAF is the mean estimated value of air pollution attributable fraction of morbidity by air pollution subcategory j, disease i and population subgroup k. YLD is the total number of Years Lived with Disability (YLD) by j, i and k, EMP is employment-to-population ratio by population subgroup k, and PR is again GDP per worker.

The population subgroups included in the analysis are males and females of age 15-19 years to 75-79 years. As in the case of the estimation of indirect mortality cost, no person above the age of 79 years is assumed to be working. Unfortunately, the nature of the measure used to capture morbidity and the formula employed does not permit the estimation of morbidity cost in the age group of less than a year old up to 14 years old, a major difference compared to mortality cost estimation.

Finally, total economic cost of air-pollution attributable diseases $TPAC$ by pollution subcategory j is the sum of the direct and indirect morbidity and mortality costs:

$$TPAC_j = PAE_j + PAMC_j + PAIC_j \quad (5)$$

A frequent criticism of the COI methodology is that it underestimates the true cost of a disease in two ways. First, it yields low or no values for children and older people after the age of retirement. Second, it does not include 'psychological costs', in the sense that pain and suffering caused by a disease are not included in the indirect cost calculations (Max at al., 2004). In order to overcome these two shortcomings, the WTP approach has been proposed as an alternative method to valuing human life.

2.2 Willingness to Pay Approach

The origins of the WTP method date back in the late 1960s and early 1970s, when authors such as Schelling (1968) and Mishan (1971) suggested that valuing the prevention of premature mortality should be done through the amount that a person would be willing to pay for a decline in risk of early death (holding expected utility constant). Since then, the concept of WTP has gained an increasing importance in environmental decision-making and management, while WTP estimation for 'non-market-traded goods' has become a significant subfield of study in environmental economics (Baumgärtner et al., 2017).

Formally, according to the WTP approach, life is valued through the monetary amount individuals are willing to pay for marginal reductions in their risk of dying from a given risk factor (OECD, 2012). Mortality cost of air pollution is calculated using the aggregate WTP or the VSL multiplied by the total number of premature deaths in a particular year. Since WTP surveys that provide information on the valuation of mortality risks associated with exposure to air pollution are not available for all countries, a set of OECD-recommend VSL values can be employed, adjusted for differences in income (OECD, 2012, 2014). The formula used for making the necessary adjustments for transferring the VSL is

$$VSL_{2019} = VSL_{OECD,2005} \times \left(Y_{2005}/Y_{OECD,2005}\right)^{\beta} \times (1 + \%\Delta P + \%\Delta Y)^{\beta} \quad (6)$$

where VSL_{2019} is the value of statistical life for Greece in 2019, $VSL_{OECD,2005}$ is the VSL base value for the OECD countries (US$ 3 million), Y_{2005} is Greek GDP per capita at PPP in 2005, $Y_{OECD,2005}$ is the average GDP per capita of the OECD countries at PPP in 2005, $\%\Delta P$ is the percentage change in consumer price and $\%\Delta Y$ is the percentage change in real GDP per capita growth from 2005 to 2019. Finally, β is the income elasticity of VSL.

2.3 Data

For the COI approach, we used the most recent data available (for 2019) on health effects of air pollution from the Global Burden of Disease 2019 study (GBD 2019, 2020), including attributable to air pollution fractions of death and disability (PAFs in formulae (1), (2) and (3)), as well as the total number of YLD (needed in formula (4)) and the total number of deaths (necessary in formula (2)).

$THCE$ was retrieved from the IHME Global Expected Health Spending 2018-2050 dataset (2020). Age and gender specific employment-to-population ratios were obtained from the International Labour Organization (ILO) statistical database, as was the case with the total number of workers which we used in the calculation of the GDP per worker (ILO, 2020). Data on GDP were taken from the International Monetary Fund's (IMF) World Economic Outlook Database, October 2020 (IMF, 2020). Probabilities of survival were calculated using life tables available from the WHO (n.d.). All data concern the year 2019, except for life tables which are for 2016, the latest data available.

For the WTP approach, data for the necessary calculations were obtained by the World Bank's Word Development Indicators database (WB, 2020). The income elasticity of the VSL is assumed to be 0.8, following the OECD recommendation for transfers of the VSL between OECD (and EU) member countries (OECD, 2012). Formula (6) yields the VSL value for 2019 in 2005 US$. This value is subsequently converted into local currency (€), using the PPP-adjusted exchange rate (for private consumption, as proposed by OECD) for 2005 (OECD, 2012, p. 128). In order to convert the VSL from 2005 monetary value into 2019 monetary value, we used the national CPI for 2005 and 2019 (WB, 2020).

3. Results

3.1 Cost-of-Illness Approach

The share of healthcare expenditure due to air pollution attributable diseases in total healthcare expenditure was 4.8 percent in 2019. From this, 4.44 percent was due to ambient $PM_{2.5}$ air pollution, 0.4 percent was due to ambient ozone pollution and 0.03 percent due to household $PM_{2.5}$ air pollution related illnesses (see Table 1, at the end of this subsection).

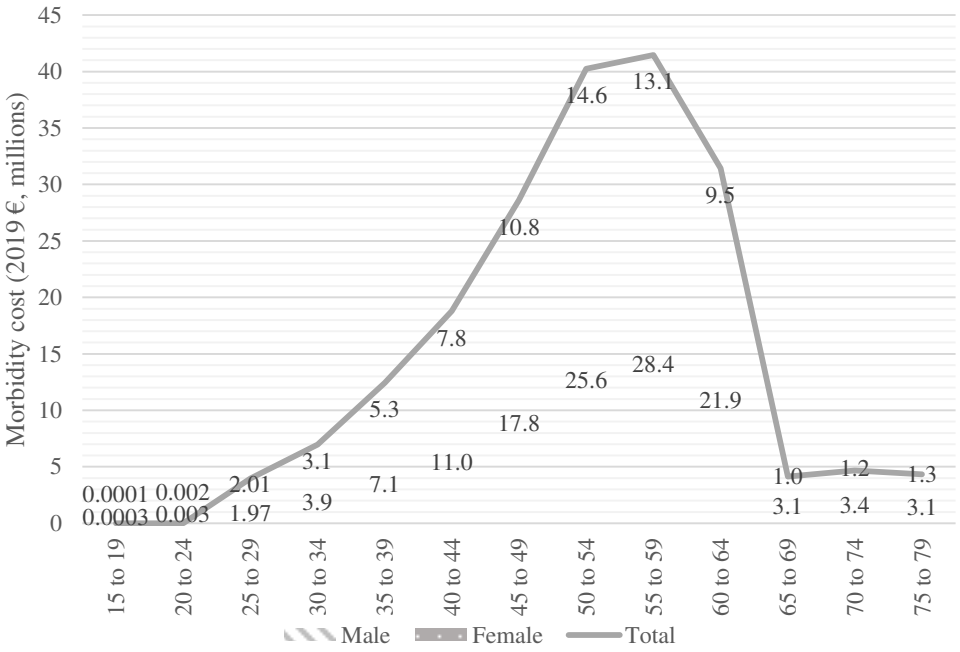
Direct cost is estimated at €742.16 million. Direct cost due to ambient $PM_{2.5}$ air pollution related illnesses comprised the largest share of the direct cost due to total air pollution, estimated to be €682.11 million, while healthcare expenditure due to ozone air pollution attributable diseases was estimated at €60.97 million. Direct cost due to exposure to household $PM_{2.5}$ air pollution was €4.91 million, being by far the smallest component of direct cost due to exposure to total air pollution (see Table 1).

Turning to indirect cost, total morbidity cost was estimated at €197.1 million. From this, 99.2 percent was related to diseases attributed to ambient $PM_{2.5}$ air pollution, while only 0.8 percent was due to household $PM_{2.5}$ air pollution related illnesses. Morbidity cost accounted for 37.25 percent of the indirect cost of air pollution, while it was 15.5 percent of the total cost of air pollution. The economic cost of morbidity from air pollution is the smallest component of the total economic cost, while the largest component is by far the direct cost (see Table 1).

The distribution of morbidity cost from total air pollution, by age and gender, is depicted in Figure 1. The sharp decline of morbidity cost after the age of 59 years, and the particularly low estimates of morbidity cost for the 65-79 age group, are a result of the decreasing employment to population ratio. Morbidity cost resulting from males is higher than the one resulting from females in all age groups, except for the 25-29 age group. This is because both the number of YLD resulting from exposure to air pollution and participation in the labour market are higher in males than in females in all age groups, with the exception of the 25-29 age group, in which the number of YLD is higher for females. Figures A3 and A4 in Appendix A describe the age and gender distribution of morbidity cost from ambient and household $PM_{2.5}$ air pollution, respectively.

DOI: 10.25103/ijbesar.143.07

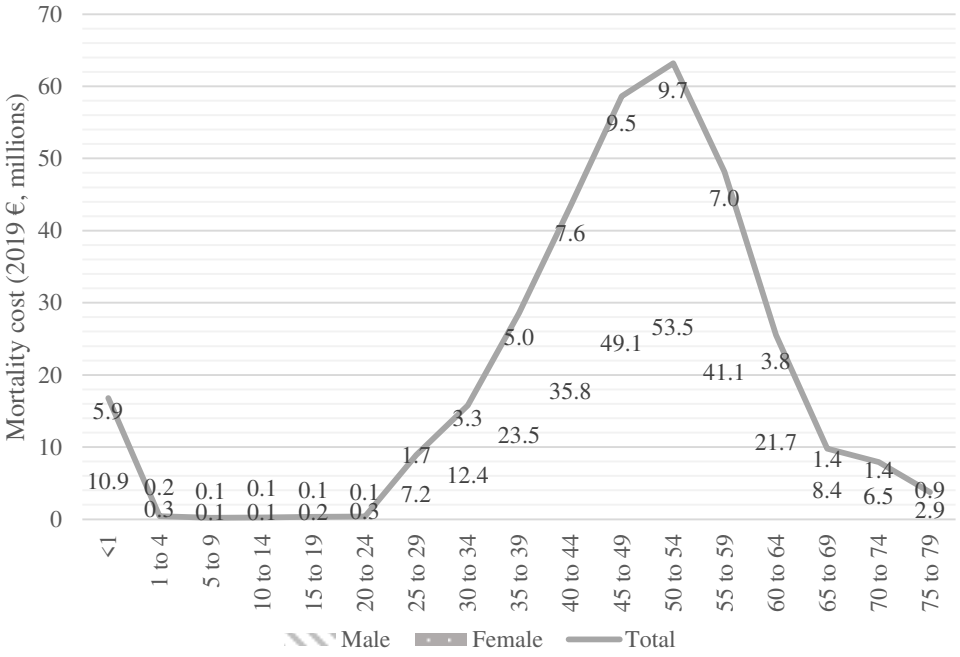
Figure 1. Morbidity cost from total air pollution by age and gender, Greece, 2019



Sources: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO

Mortality cost was estimated at €331.9 million in 2019 (Table 1). From this, 97.67 percent was due to ambient $PM_{2.5}$ air pollution, 1.7 percent was due to ambient ozone pollution and only 0.63 percent resulted from exposure to household $PM_{2.5}$ air pollution. The share of mortality cost in total cost was 26.1 percent, while the shares of direct and indirect morbidity cost were 58.4 percent and 15.5, respectively. The distribution of mortality cost from total air pollution, by age and gender, is presented in Figure 2. The distribution of mortality cost from each subcategory of air pollution, by age and gender, is presented in Figures A5-A7 in Appendix A.

Figure 2. Mortality cost from total air pollution by age and gender, Greece, 2019



Sources: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO

The highest proportion of mortality cost resulted from males in all age groups (see Figure 2). This is driven by the fact that the PVLE is higher for males than females in all age groups, but also by the fact that the health impact in terms of mortality is more severe in males than females in almost all age groups and from all air pollution subcategories. Noticeable exceptions are mortality estimates from exposure to ambient, household $PM_{2.5}$ air pollution and the joint effects of all air pollutants in the age group 10-14, which are higher in females than in males. The same

applies in the case of mortality from exposure to household $PM_{2.5}$ air pollution in the 75-79 age group. Even in these cases, however, the relatively higher estimated PVLE in males results in higher mortality cost estimates for men.

Total cost resulting from exposure to air pollution was estimated at €1.27 billion in 2019. From this, 94.1 percent was attributed to exposure to ambient $PM_{2.5}$ air pollution and 5.2 percent to ambient ozone air pollution, while 0.7 percent resulted from household $PM_{2.5}$ air pollution related diseases. The share of total cost from air pollution in GDP was 0.68 percent.

Assuming a 3 percent discount rate, mortality cost from total air pollution is estimated at €261.3 million (2019). That is, mortality cost due to exposure to air pollution is 21.3 percent lower, compared to 1 percent discount.

Table 1: Direct, indirect and total cost from air pollution, Greece, 2019

		Direct cost	Indirect cost			Total cost
			Morbidity	Mortality	Total	
Total air pollution	value[a]	742.16	197.1	331.9	529	1.27[b]
	cost per capita[c]	69.25	18.4	31	49.4	118.65
	% GDP	0.4	0.1	0.18	0.28	0.68
	% total cost	58.4	15.5	26.1	41.6	100.0
	% indirect cost	-	37.25	62.75	100.0	-
	% health exp.	4.8	-	-	-	-
Ambient $PM_{2.5}$	value[a]	682.11	195.5	324.7	520.2	1.2[b]
	cost per capita[c]	63.65	18.25	30.3	48.55	112.2
	% GDP	0.36	0.11	0.17	0.28	0.64
	% total cost	56.7	16.3	27	43.3	100.0
	% indirect cost	-	37.6	62.4	100.0	-
	% health exp.	4.44	-	-	-	-
Household $PM_{2.5}$	value[a]	4.91	1.57	2.1	3.67	8.58
	cost per capita[c]	0.46	0.15	0.2	0.35	0.8
	% GDP	0.0026	0.0009	0.0011	0.002	0.0046
	% total cost	57.25	18.35	24.4	42.75	100.0
	% indirect cost	-	42.9	57.1	100.0	-
	% health exp.	0.03	-	-	-	-
Ambient ozone	value[a]	60.97	-	5.63	5.63	66.6
	cost per capita[c]	5.7	-	0.5	0.5	6.2
	% GDP	0.033	-	0.003	0.003	0.036
	% total cost	91.55	-	8.45	8.45	100.0
	% indirect cost	-	-	100.0	100.0	-
	% health exp.	0.4	-	-	-	-

Note: The sum of estimated costs and cost shares in GDP related to ambient, household $PM_{2.5}$ and ambient ozone air pollution are slightly higher than estimates corresponding to total air pollution, reflecting the structure of the health data used. Costs reported for individual air pollution risk factors quantify the economic impact of each subcategory separately, while those reported for total air pollution signify joint effects.
Source: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO
a Monetary amount in 2019, 2019 €, millions
b Monetary amount in 2019, 2019 €, billions
c Monetary amount in 2019, 2019 €

3.2 The Willingness to Pay Approach

Using formula (5), the VSL for Greece in 2019 is

$$VSL_{Greece,2019} = (US\$\ 3\ million) \times (0.86)^{0.8} \times (1 + 0.195 + (-0.154))^{0.8} = 2.75$$

That is, the VSL is US$ 2.75 million measured in 2005 PPP-adjusted. When converting this monetary value into local currency, the VSL value becomes €2.08 million (in 2005 terms). Finally, we convert the VSL to 2019 national monetary value, which is €2.49 million.

By multiplying this VSL value with the total number of deaths resulting from exposure to air pollution, mortality cost was estimated at €6.48 billion in 2019 or, equivalently, 3.46 percent of GDP. As expected, the estimate using the WTP approach is significantly higher than the one obtained under the COI approach, as the former represents welfare losses due to premature mortality from air pollution attributable diseases, while the latter concerns only market losses due to forgone income from early mortality resulting from exposure to air pollution.

The WTP approach is a methodology suitable for calculating the welfare cost from reduced air quality and the associated mortality outcome in the society as a whole, including the 80 years and above group of age. In this case, the economic cost of mortality from total air pollution becomes even higher, as it is estimated at €15.47 billion, or 8.25 percent of GDP. This result was, of course, expected, since the number of deaths attributable to air pollution related diseases skyrockets in the age group of 80 years and above (Figure A2 in Appendix A).

For a sensitivity analysis using alternative income elasticities of the VSL, that is, income elasticities of 0.4 (proposed by OECD (2012)), 0.6 and 1.0 (following the WB and IHME (2016) work), see Table A1, in Appendix A.

DOI: 10.25103/ijbesar.143.07

4. Discussion

Our findings, based on the COI approach, indicate that air pollution attributable diseases resulted in a total economic cost of €1.27 billion in 2019, or equivalently to 0.68 percent of GDP. From this cost, €742.16 million (0.4 percent of GDP) is related to healthcare expenditure due to air pollution related diseases, €331.9 million (0.18 percent of GDP) results from premature mortality, and €197.1 million (0.1 percent of GDP) is due to morbidity from exposure to air pollution.

To estimate morbidity cost, we took into account the number of YLD from all health conditions resulting from exposure to ambient, household $PM_{2.5}$ and ambient ozone air pollution, as estimated by IHME. The EC Impact Assessment (EC, 2013) bases morbidity cost estimates on the number of lost working days resulting mainly from respiratory conditions from ambient particulate matter and ambient ozone air pollution, while household air pollution is not taken into account. Moreover, healthcare cost is calculated through the number of respiratory and cardiovascular hospital admissions as well as the cases of chronic bronchitis, while in the present analysis data on all specific-cause health outcomes were taken into account. It should be noted, however, that our calculation of direct cost was conducted through air pollution attributable fractions which were based on premature mortality estimates and, therefore, healthcare expenditure due to air pollution may be either underestimated or overestimated.

When it comes to mortality cost estimation, our analysis (under the COI method) is closer to the WB & IHME (2016) report. However, the assumptions regarding the growth rate of labour productivity and the discount rate differ, and the PVLEs are calculated in a slightly different way. While mortality cost estimates are close to, but higher than, the ones offered by the WB & IHME (2016) study, our overall estimate of total economic cost accounts for almost 0.7 percent of GDP.

By analysing all relevant cost components resulting from the health impact of air pollution, it becomes more than clear that indirect morbidity cost and healthcare expenditure due to air pollution should not be overlooked in relevant international research. Direct cost due to total air pollution was found to be the component with the largest share in total cost (58.4 percent) followed by indirect mortality cost (26.1 percent). At the same time, the share of morbidity cost in indirect cost resulting from the joint effects of all air pollutants under examination was 37.25 percent. From the air pollution subcategories under examination, ambient $PM_{2.5}$ air pollution was by far the most significant contributor to total economic cost.

In terms of limitations present when employing the COI method, one of the most common criticisms relates to the valuation of human life, which is done through the estimation of PVLE in the case of mortality and forgone income due to disability. This means that people that do not participate in the labour market (e.g., older people after the age of retirement) are excluded from the analysis (Max et al., 2004, pp. 7-8). This is more important when examining the economic cost of the burden of disease from air pollution exposure, compared to other risk factors commonly studied in the literature, since the health effects due to air pollution are particularly high for old people (see Appendix A). We calculated the economic cost of air pollution-related diseases for a wider range of age groups (<1–79 years of age) than in similar analyses (e.g., <1–65 years of age) but, nevertheless, people over the age of 80 years were excluded, as it was assumed that no person in this age group is participating in the labour market. Moreover, for the age group of 65-79 years, the resulting economic cost was low (compared to younger age groups) due to its low participation rate in the labour market (and despite the fact that mortality and morbidity estimates were high compared to younger ages). As a result, these shortcomings bring about an underestimate of the economic cost of the health effects from air pollution exposure.

Under a welfare-based approach (WTP), mortality cost due to exposure to air pollution was found to be even higher and equal to 3.46 percent of GDP, when mortality estimates in the age group under 1 year and up to 79 years old are taken into account. This welfare cost accounts for 8.25 percent of GDP, when mortality estimates for the whole population, including the age group of 80 years and above, are provided. These estimates are obtained using the OECD-recommended (2012; 2014) base VSL, a common practice especially among OECD and EU member countries due to the lack of primary WTP surveys. Note, however, that WTP depends heavily on income, inequality of income distribution and other socio-economic characteristics related to a specific context (Baumgärtner et al., 2017). This means that, if a primary WTP survey were to be conducted in Greece, a different VSL could possibly be uncovered, leading to a different welfare cost estimate of the impact of air pollution on health. Despite the fact that in our calculations we have made all the necessary adjustments with respect to income, inflation and income growth, the lack of WTP surveys covering the whole country is a potential shortcoming. Investigating this issue further presents research opportunities for the future.

Finally, under both cost estimation methods, data unavailability prevented the examination of the economic cost resulting from the burden of disease due to exposure to other air pollutants causing negative health effects, such as Nitrogen Dioxide (NO2) and Sulphur Dioxide.

5. Policy implications and conclusion

Offering incentives for the use of alternative energy fuels by households could lead to a reduction in $PM_{2.5}$ air pollution concentrations and the attributable health impact. Despite the decreasing trend in the reported ambient $PM_{2.5}$ air pollution concentrations recorded over the last years in Greece, there is room for further abatement efforts in major sectors, such as industrial processes and transportation. In the period 2010 to 2018, the largest amount of $PM_{2.5}$ air pollution emissions resulted from households (EEA, 2020). Among others, wood and solid fuels combustion

for heat generation has been an activity that greatly contributed to the problem of reduced air quality, with available data pertaining not only to the case of Greece but also to other parts of the European continent (EEA, 2019).

Environmental incentives should be examined under a CB approach. Offering an incentive for the use of natural gas, instead of wood/biomass as a heating fuel, would require a lower environmental tax on the former, leading to reduced revenue from this source. On the other hand, lower $PM_{2.5}$ air pollution concentrations would lead to a reduction in the economic cost resulting from diseases attributed to this risk-factor. The matter is complicated even further, if we take into account that, despite the negative impact on human health, biomass is considered a renewable and carbon-neutral source of energy and, generally speaking, its burning for heating purposes is promoted under energy and climate policies (Banja et al., 2020). Therefore, within a market-based framework, all relevant costs and benefits should be taken into account. This means that collaboration of different governmental agencies is important for improvements in both public health and the public budget.

In the context of energy transition and for meeting the EU 2030 energy and climate targets, Greece has decided to progressively phase out lignite-fired power generation and completely cease the use of coal/lignite in electricity production by 2028 (Hellenic Ministry of Environment and Energy (HMEE), 2019). An ambitious target has also been set regarding the share of renewable energy sources (RES) in electricity consumption, with a provision for this share to exceed 60 percent (HMEE, 2019, p.5). If this target is met, not only the health impact and the associated economic cost of ambient $PM_{2.5}$ air pollution concentrations will decrease (especially in the regions in which lignite power plants were located), but also greenhouse gas emissions will fall significantly. This way, the transition into a 'climate neutral' economy will be facilitated and Greece will contribute to global efforts in mitigating the effects of climate change. It is worth mentioning, however, that if an increased penetration of RES in electricity generation is not achieved finally, the substitution of lignite with other non-renewable sources, such as natural gas, will have a less profound impact on abatement targets regarding greenhouse gas emissions.

The "zero pollution action plan" (EC, COM (2021) 400 final) provides opportunities for further action. For climate neutrality to be achieved by 2050, all EU relevant laws, policies and initiatives should include key targets of pollution reduction and prevention, adopted and implemented by 2030. One of the most noteworthy targets, in the context of our analysis, is the goal of reducing premature mortality due to air pollution exposure by more than 55 percent. To this end, it is recognized that air quality standards set by the EU are less stringent than the WHO air quality guidelines (WHO, 2006) and the EU Ambient Air Quality Directives should be revised to be more closely aligned with the WHO recommendations. This is expected to happen in 2022. Taking into account both our market and welfare cost estimates, significant cost savings are expected to be realized, provided Greece takes action in a timely fashion and achieves the health-related target by 2030. An issue of concern, however, is the frequent delays in the transposition and implementation of EU environmental legislation. It is only recently that Greece's National Air Pollution Control Programme (obligatory under the Directive (EU) 2016/2284, with a submission deadline by April 1 2019) has been adopted (January 2021).

Energy related restructuring, from the reduction of fossil fuels-based electricity generation to the de-carbonization of energy consumption patterns in households and transport, can lead to significant co-benefits in the fields of climate change mitigation and protection of human health. The synergies that would result, if appropriate policy measures were to be designed and implemented, can be important. For example, Nitrogen Oxides and especially NO2 concentration limit target values set by the EU should be met in the major Greek metropolitan areas. Nitrogen Oxides are harmful for human health by themselves, but they are also important precursors of ground-level ozone air pollution.

These policy considerations are relevant not only for the case of Greece, since they can also serve as a guide to other economies with similar structural characteristics and comparable levels of exposure to air pollution. Data from the OECD environment at a glance indicators platform, for example, reveal that mean annual exposure of the population to $PM_{2.5}$ in Greece is slightly higher than the OECD average (in 2019) (OECD, 2020). Despite improvements in air quality in advanced economies, air pollution abatement efforts should continue. The end goal should be a reduction in exposure to harmful air pollutants and consequently a decrease in air-pollution related health effects, which would, ultimately, lead to a reduced market and welfare cost.

The need for limiting emissions/concentrations of air pollutants and the negative externalities associated with their adverse effects on public health is an issue that concerns all people irrespective of age, gender and income in all countries (Health Effects Institute, 2019). Recent evidence has indicated that long-term air pollution exposure increases the susceptibility of the affected population to other risk factors affecting human health, such as the COVID-19 disease (Pozzer et al., 2020; Wu et al., 2020). Given the budgetary resources necessary for fighting the challenges of the healthcare systems during the ongoing pandemic, and the welfare costs associated with the loss of human life and the consequences of the COVID-19 health crisis for the economy, future policy measures should concentrate (among other things) on limiting the negative impact of air pollution on public health. Reduced air quality can be a potentially important cofounding factor leading to premature mortality from infectious respiratory diseases. Investing in clean air can be a policy priority with clear long-term benefits. Apart from current cost savings in terms of direct and indirect (mortality and morbidity) costs, enhanced air quality can lead to improved public health, which can be seen as a preventive action designed to mitigate harm in the event of a pandemic.

Taking into account that epidemiological research is advancing in documenting the adverse effects on human health form exposure to various other air pollutants (not included here) and that more health conditions are currently being associated with exposure to air pollution, economic cost estimates of the burden of disease from this risk factor are expected to be revised upwards in the near future.

DOI: 10.25103/ijbesar.143.07

References

Alberini, A., Krupnick, A., 2000, Cost-of-Illness and Willingness-to-Pay Estimates of the Benefits of Improved Air Quality: Evidence from Taiwan, *Land Economics*, 76(1), pp. 37-53, https://doi.org/10.2307/3147256

Aşici, A., Bünül, Z., 2012, Green new deal: a green way out of the crisis? *Environmental Policy Governance*, 22(5), pp. 295-306, https://doi.org/10.1002/eet.1594

Banja, M., Đukanović, G., Belis, C.A., 2020, *Status of Air Pollutants and Greenhouse Gases in the Western Balkans: Benchmarking the Accession Process on Environment*. EUR 301113 EN. Publications Office of the European Union, Luxembourg, viewed 15 December 2020, https://publications.jrc.ec.europa.eu/repository/bitstream/JRC118679/air_qualityghg_western_balkans_online.pdf

Baumgärtner, S., Drupp, M.A., Meya, J.N., Munz, J.M., Quaas, M.F., 2017, Income inequality and willingness to pay for environmental public goods, *Journal of Environmental Economics and Management*, 85, pp. 35-61, https://doi.org/10.1016/j.jeem.2017.04.005

Bherwani, H., Nair, M., Musugu, K., Gautam, S., Gupta, A., Kapley, A., Rakesh, K., 2020, Valuation of air pollution externalities: comparative assessment of economic damage and emission reduction under COVID-19 lockdown, *Air Quality, Atmosphere & Health*, 13, pp. 683-694, https://doi.org/10.1007/s11869-020-00845-3

Burnett, R., et al., 2018, Global estimates of mortality associated with long-term exposure to outdoor fine particulate matter, *Proc Natl Acad Sci U S A*, 115(38), pp. 9592-9597, https://doi.org/10.1073/pnas.1803222115

Croitoru, L., Cervigni, R., Jabarin, A., 2010, Air Pollution: The Case of Jordan, *In*: Croitoru, L., and Sarraf, M. ed. *The Cost of Environmental Degradation: Case Studies from the Middle East and North Africa*, Washington, D.C.: World Bank, pp. 37-52

Cropper, M.L., 2000, Has Economic Research Answered the Needs of Environmental Policy? *Journal of Environmental Economics and Management*, 39(3), pp. 325-350, https://doi.org/10.1006/jeem.2000.1128

Custers, P., 2010, The tasks of Keynesianism today: green new deals as transition towards a zero growth economy? *New Political Science*, 32(2), pp. 173-191, https://doi.org/10.1080/07393141003722032

European Commission (EC), n.d., *Air Quality Standards*, viewed 25 January 2021, https://ec.europa.eu/environment/air/quality/standards.htm

EC, 2007, *State of European Cities Report: Adding Value to the European Urban Audit*, viewed 10 January 2021, https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/urban/stateofcities_2007.pdf

EC, 2013, Impact Assessment – accompanying the documents {COM(2013)917} {COM(2013)918} {COM(2013)919} {COM(2013)920} {SWD(2013)532}. Commission Staff Working Document, SWD (2013) 531 final.

EC, 2021, EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil, COM(2021) 400 final, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0400

European Environmental Agency (EEA), 2008, *Air Pollution in Athens: Existing Status and Abatement Practices*, viewed 30 January 2021. https://www.eea.europa.eu/publications/2599XXX/page018.html

EEA, 2011, *Revealing the Costs of Air Pollution from Industrial Facilities in Europe*, (EEA Technical Report No. 15/2011), Publications Office of the European Union, Luxembourg, viewed 10 December 2020, https://www.eea.europa.eu/publications/cost-of-air-pollution

EEA, 2019, *The European Environment – State and Outlook 2020: Knowledge for Transition to a Sustainable Europe*. Publications Office of the European Union, Luxembourg, viewed 15 February 2021, https://www.eea.europa.eu/publications/soer-2020

EEA, 2020, *Greece – Air Pollution Country Fact Sheet 2020*, viewed 1 February 2021, https://www.eea.europa.eu/themes/air/country-fact-sheets/2020-country-fact-sheets/greece

Galvin R., Healy, N., 2020, The Green New Deal in the United States: What it is and how to pay for it, *Energy Research & Social Science*, 67, https://doi.org/10.1016/j.erss.2020.101529

Georgakellos, A.D., 2007, External cost of air pollution from thermal power plants: case of Greece, *International Journal of Energy Sector Management*, 1(3), pp. 257-272, https://doi.org/10.1108/17506220710821134

Global Burden of Disease Collaborative Network, 2020, *Global Burden of Disease Study 2019 (GBD 2019) Results*. Institute for Health Metrics and Evaluation (IHME), viewed 10 November 2020, http://ghdx.healthdata.org/gbd-results-tool

Global Burden of Disease Collaborative Network, 2020, *Global Expected Health Spending 2018-2050* (Data set). Institutive for Health Metrics and Evaluation (IHME), viewed 10 November 2020, https://doi.org/10.6069/0PWC-PV84

Harris, J.M., 2019, Ecological Economics of the Green New Deal, Global Development And Environment Institute (GDAE), Climate Policy Brief No. 11, viewed 28 August 2021, https://sites.tufts.edu/gdae/files/2019/10/ClimatePolicyBrief11_GreenNewDeal.pdf

Health Effects Institute, 2019, *State of Global Air 2019*. Special Report. Health Effects Institute, Boston, MA, viewed 20 December 2020, https://www.stateofglobalair.org/sites/default/files/soga_2019_report.pdf

Hellenic Ministry of Environment and Energy (HMEE), 2019, *National Energy and Climate Plan (NECP)*, viewed 6 February 2021, https://ec.europa.eu/energy/sites/ener/files/el_final_necp_main_en.pdf

International Labour Organization (ILO), 2020, Labour Force statistics: Employment-to-population ratio by sex and age (Data set), ILOSTAT, viewed 15 November 2020, https://ilostat.ilo.org/data/

ILO, 2020, ILO modelled estimates and projections: Employment by sex and age, Nov. 2019 (thousands) (Data set), ILOSTAT, viewed 15 November 2020, https://ilostat.ilo.org/data/

International Monetary Fund (IMF), 2020, World Economic Outlook Database, October 2020, viewed 12 December 2020, https://www.imf.org/en/Publications/WEO/weo-database/2020/October/

Jo, C., 2014, Cost-of-illness studies: concepts, scopes, and methods, *Clin Mol Hepatol*, 20(4), pp. 327-337, https://doi.org/10.3350/cmh.2014.20.4.327

Landrigan, P., et al., 2018, The Lancet Commission on pollution and health, *Lancet*, 391, pp.462-512, https://doi.org/10.1016/S0140-6736(17)32345-0

Lelieveld, J., Klingmüller, K., Pozzer, A., Pöschl, U., Fnais, M., Daiber, A., Münzel, T., 2019, Cardiovascular disease burden from ambient air pollution in Europe reassessed using novel hazard ratio functions. *European Heart Journal*, 40(20), pp. 1590-1596

Lindhjem, H., Navrud, S., Braathen, N.A., Biausque, V., 2011, Valuing Mortality Risk Reductions from Environmental, Transport, and Health Policies: A Global Meta-Analysis of Stated Preference Studies, *Risk Analysis*, 31(3), pp. 1381-407, https://doi.org/10.1111/j.1539-6924.2011.01694.x

Lu, X., Yao, T., Fung, J.C.H., Lin, C., 2016, Estimation of health and economic costs of air pollution over the Pearl River Delta region in China, *Science of The Total Environment*, 566-567, pp. 134-143, https://doi.org/10.1016/j.scitotenv.2016.05.060

Luke, T., 2009, A green new deal: why green, how new, and what is the deal? *Critical Policy Studies*, 3(1), pp. 14-28, https://doi.org/10.1080/19460170903158065

Martinez, G.S., Spadaro, J.V., Chapizanis, D., Kendrovski, V., Kochubovski, M., Mudu, P., 2018, Health Impacts and Economic Costs of Air Pollution in the Metropolitan Area of Skopje, *International Journal of Environmental Research and Public Health*, 15(4), pp. 626, https://doi.org/10.3390/ijerph15040626

Max, W., Rice, D., Sung, H., Michel, M., 2004, Valuing Human Life: Estimating the Present Value of Lifetime Earnings, 2000, https://escholarship.org/uc/item/82d0550k

Mazzucato, M., 2020, Covid-19 and the Green New Deal, *United Nations Department of Economic and Social Affairs (UNDESA)*, 25(12), viewed 28 August 2021, https://www.un.org/development/desa/undesavoice/more-from-undesa/2020/12/50538.html

Mazzucato, M., McPherson, M., 2018, *The Green New Deal: A bold mission-oriented approach*, UCL Institute for Innovation and Public Purpose (IIPP), Policy Brief Series (IIPP PB 04), viewed 28 August 2021, https://www.ucl.ac.uk/bartlett/public-purpose/publications/2018/dec/green-new-deal-bold-mission-oriented-approach

Meisner, C., Gjorgjev, D., Tozija, F., 2015, Estimating health impacts and economic costs of air pollution in the Republic of Macedonia (Original research). *South Eastern European Journal of Public Health*, IV, https://doi.org/10.4119/seejph-1809

Mirasgedis, S., Hontou, V., Georgopoulou, E., Sarafidis, Y., Gakis, N., Lalas, D.P., Loukatos, A., Gargoulas, N., Mentzis, A., Economidis, D., Triantafilopoulos, T., Korizi, K., Mavrotas, G., 2008, Environmental Damage Costs from Airborne Pollution of Industrial Activities in the Greater Athens, Greece Area and the Resulting Benefits from the Introduction of BAT. *Environmental Impact Assessment Review*, 28(1), pp. 39-56, https://doi.org/10.1016/j.eiar.2007.03.006

Mishan, E.J., 1971, Evaluation of Life and Limb: A Theoretical Approach, *Journal of Political Economy*, 79(4), pp. 687-705

Narain, U., Sall, C., 2016, *Methodology for Valuing the Health Impacts of Air Pollution: Discussion of Challenges and Proposed Solutions* (English). World Bank Group, viewed 8 November 2020, http://documents.worldbank.org/curated/en/832141466999681767/Methodology-for-valuing-the-health-impacts-of-air-pollution-discussion-of-challenges-and-proposed-solutions

National Centre for the Environment and Sustainable Development (NCESD), 2018, *Greece: State of the Environment Report, Summary/ 2018*, viewed 2 January 2021, https://ekpaa.ypeka.gr/wp-content/uploads/2019/10/Greece-State-of-the-Environment-Report-Summary-2018-English-Version_WEB.pdf

Organisation for Economic Cooperation and Development (OECD), 2009, *OECD Environmental Performance Reviews: Greece 2009*, viewed 30 January 2021, https://dx.doi.org/10.1787/9789264061330-en

OECD, 2012, *Mortality Risk in Environment, Health and Transport Policies*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264130807-en

OECD, 2014, *The Cost of Air Pollution: Health Impacts of Road Transport*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264210488-en

OECD, 2016, *The Economic Consequences of Outdoor Air Pollution*, OECD Publishing, Paris, https://doi.org/10.1787/9789264257474-en

OECD, 2020, *Environment at a Glance Indicators: Air quality*, viewed 30 January 2021, https://www.oecd-ilibrary.org/sites/80661e2d-en/index.html?itemId=/content/component/80661e2d-en#section-d1e2181

Patankar, A.M., Trivedi, P.L., 2011, Monetary burden of health impacts of air pollution in Mumbai, India: Implications for public health policy, *Public Health*, 125(3), pp. 157-164, https://doi.org/10.1016/j.puhe.2010.11.009

Pozzer, A., Dominici, F., Haines, A., Witt, C., Münzel, T., Levieveld, J., 2020, Regional and global contributions of air pollution to risk of death from COVID-19. *Cardiovascular Research*, 116(14), pp. 2247-2253, https://doi.org/10.1093/cvr/cvaa288

Rice, D., 1967, Estimating the Cost of Illness, *American Journal of Public Health*, 57(3), pp. 424-440, https://doi.org/10.2105/AJPH.57.3.424

Rice, D., Hodgson, T., Kopstein, A., 1985, The economic cost of illness: a replication and update. *Health Care Finance Rev*, 7(1), pp. 61-80, PMID: 1031139

Sander, K., Mira-Salama, D., Feuerbacher, A., 2015, *The Cost of Air Pollution: A Case Study for the City of Cuenca, Ecuador*, Washington, D.C.: World Bank, https://openknowledge.worldbank.org/handle/10986/22579

Sarigiannis, A.D., Karakitsios, S.P., Kermenidou, M.V., 2015, Health Impact and Monetary Cost of Exposure to Particulate Matter Emitted from Biomass Burning in Large Cities. *Science of the Total Environment*, 15(524-525), pp. 319-330, https://doi.org/10.1016/j.scitotenv.2015.02.108

Schelling, T.C., 1968, The life you save may be your own, *In*: Chase S.B. Jr. ed. Problems in Public Expenditure Analysis, Washington, D.C.: The Brookings Institution

Tarricone, R., 2006, Cost-of-illness analysis: What room in health economics? *Health Policy*, 77(1), pp. 51-63, https://doi.org/10.1016/j.healthpol.2005.07.016

Viscusi, W.K., Aldy, J.E., 2003, The Value of a Statistical Life: A Critical Review of Market Estimates Throughout the World, *Journal of Risk and Uncertainty*, 27(1), pp. 5-76, https://doi.org/10.1023/A:1025598106257

Viscusi, W.K., 2010, The heterogeneity of the value of statistical life: Introduction and overview, *Journal of Risk and Uncertainty*, 40(1), pp. 1-13, https://doi.org/10.1007/s11166-009-9083-z

Vlachokostas, C., Achillas, C., Slini. T., Moussiopoulos, N., Banias, G., Dimitrakis, I., 2011, Willingness to pay for reducing the risk of premature mortality attributed to air pollution: a contingent valuation study for Greece, *Atmospheric Pollution Research*, 2(3), pp. 275-282, https://doi.org/10.5094/APR.2011.034

Vlachokostas, C., Achillas, C., Moussiopoulos, N., 2012, Health effects and social costs of particulate and photochemical urban air pollution: a case study for Thessaloniki, Greece. *Air Quality Atmosphere & Health*, 5(3), pp. 325-334, https://doi.org/10.1007/s11869-010-0096-1

White, D., 2019, Just Transitions/Design for Transitions: Preliminary Notes on a Design Politics for a Green New Deal, *Capitalism Nature Socialism*, 31(2) pp. 20-39, https://doi.org/10.1080/10455752.2019.1583762

DOI: 10.25103/ijbesar.143.07

World Bank (WB) and Institute for Health Metrics and Evaluation (IHME), 2016, *The Cost of Air Pollution: Strengthening the Economic Case for Action*, World Bank, Washington, DC, viewed 30 October 2020, https://openknowledge.worldbank.org/handle/10986/25013
WB, 2021, World Development Indicators (Data set), viewed 10 May 2021, https://databank.worldbank.org/source/world-development-indicators
World Health Organization (WHO), n.d., *Air pollution*, viewed 20 August 2021, https://www.who.int/health-topics/air-pollution
WHO Regional Office for Europe, 2006, *Air Quality Guidelines: Global Update 2005*, viewed 28 January 2021, https://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf
WHO Regional Office for Europe & Organisation for Economic Co-operation and Development (OECD), 2015, *Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth*, WHO Regional Office for Europe, Copenhagen, viewed 15 November 2020, https://www.euro.who.int/__data/assets/pdf_file/0004/276772/Economic-cost-health-impact-air-pollution-en.pdf?ua=1
WHO, n.d., Global Health Observatory data repository: Life tables by country (Data set), viewed 23 October 2020, https://apps.who.int/gho/data/node.main.687?lang=en
Wu. X., Nethery, R.C., Sabath, M.B., Braun, D., Dominici, F., 2020, Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis. *Science Advances*, 6(45), pp. 1-6, https://doi.org/10.1126/sciadv.abd4049

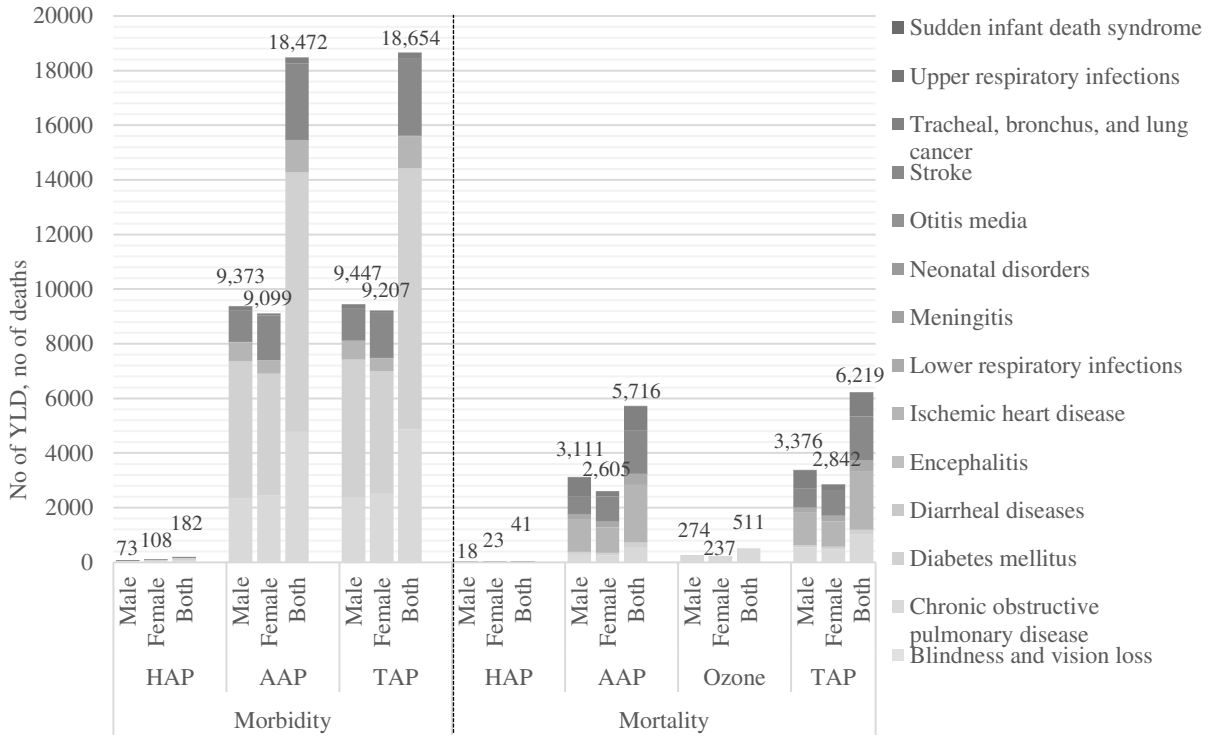
Appendix A

Table A1: Greece-specific VSL value & mortality cost from air pollution, 2019

	Income elasticity of VSL of 0.4	Income elasticity of VSL of 0.6	Income elasticity of VSL of 1.0
OECD VSL base value (2005) US$, millions, PPP-adjusted	3.00	3.00	3.00
Country-specific VSL (2019) in 2005US$, millions, PPP-adjusted	2.87	2.81	2.69
Country-specific VSL (2019) in 2019 €, millions[1]	2.6	2.54	2.43
Mortality cost (2019) in 2019 €, billions, ages <1 to 79	6.78	6.63	6.34
Mortality cost % GDP, ages <1 to 79	3.62	3.54	3.38
Mortality cost (2019) in 2019 €, billions, all ages	16.17	15.82	15.13
Mortality cost % GDP, all ages	8.63	8.44	8.07

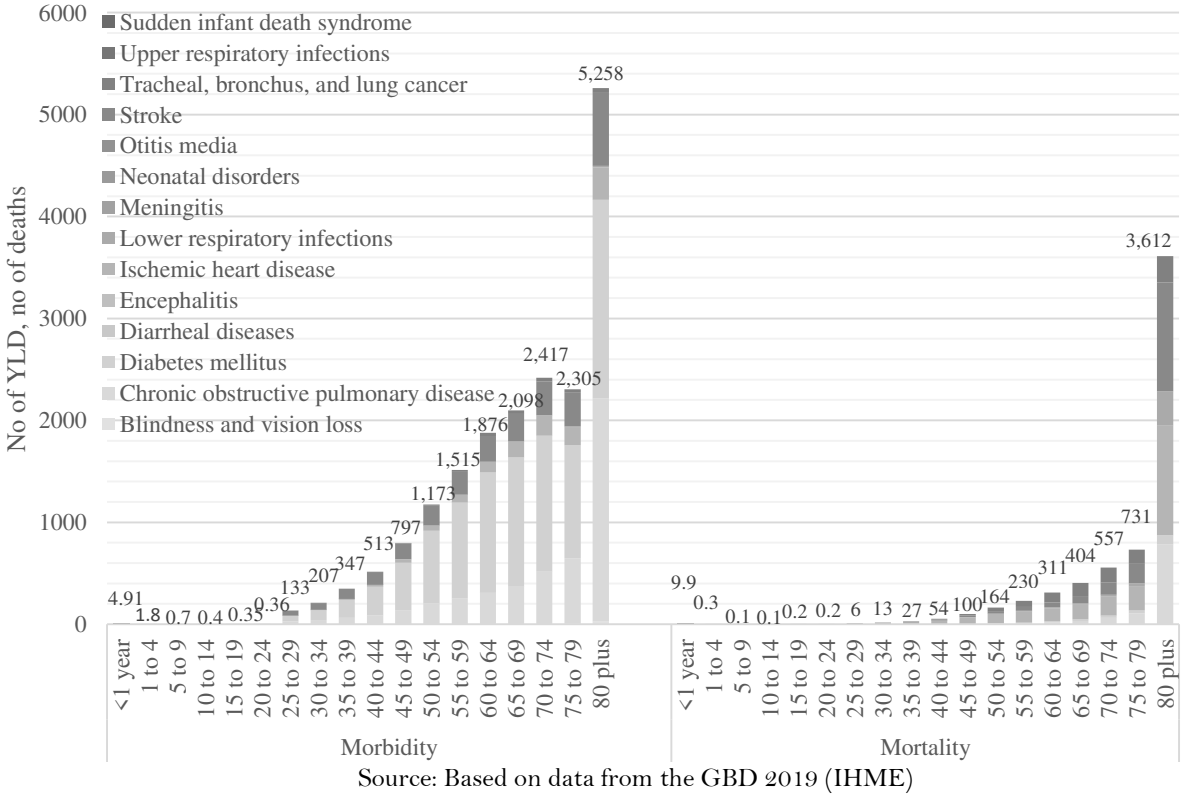
[1]Calculated using the OECD base value of US$ 3 million (PPP-adjusted) in 2005, with adjustments being made with respect to differences in per capita income, post-2005 income growth and inflation. The income elasticities of the VSL employed are 0.4, 0.6 and 1.0, respectively, following the recommendations of OECD (2012) and the work of WB – IHME (2016) as described in the technical report by Narain and Sall (2016).
Source: Own calculations based on data from the GBD 2019 (IHME), OECD and the World Bank

Figure A1. Number of Years lived with Disability and number of deaths from air pollution by gender, Greece, 2019



Source: Based on data from the GBD 2019 (IHME)

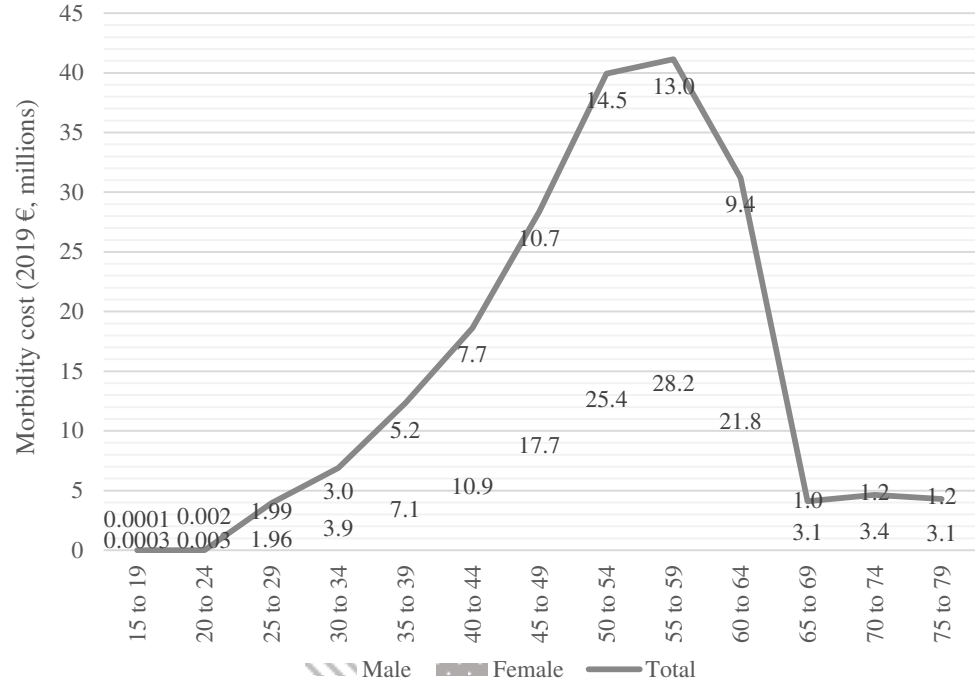
Figure A2. Number of Years lived with Disability and number of deaths from air pollution by age, Greece, 2019



Source: Based on data from the GBD 2019 (IHME)

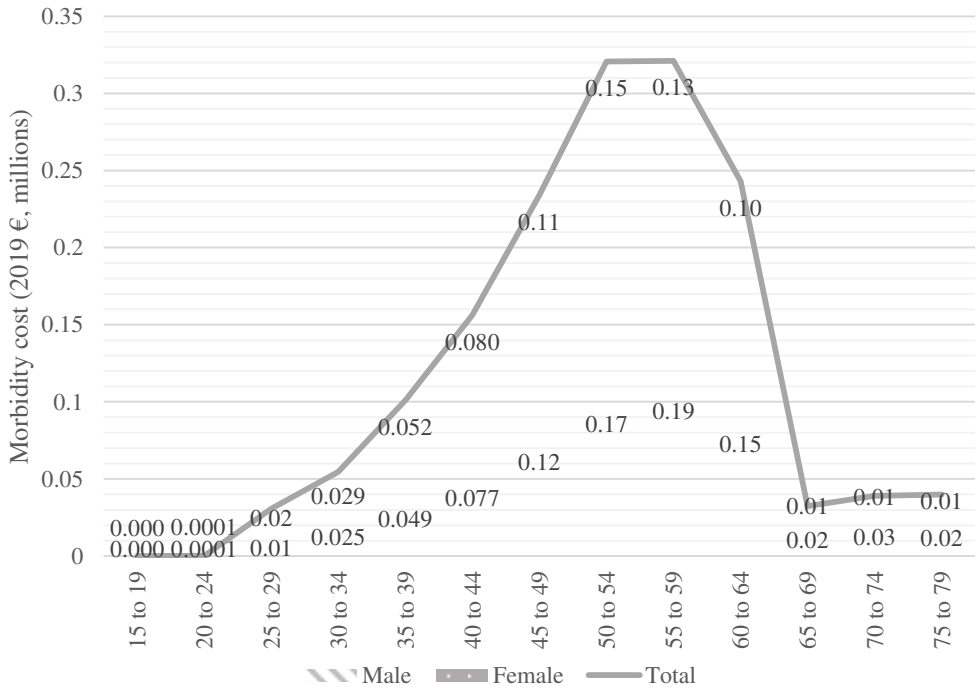
DOI: 10.25103/ijbesar.143.07

Figure A3. Morbidity cost from ambient $PM_{2.5}$ air pollution by age and gender, Greece, 2019



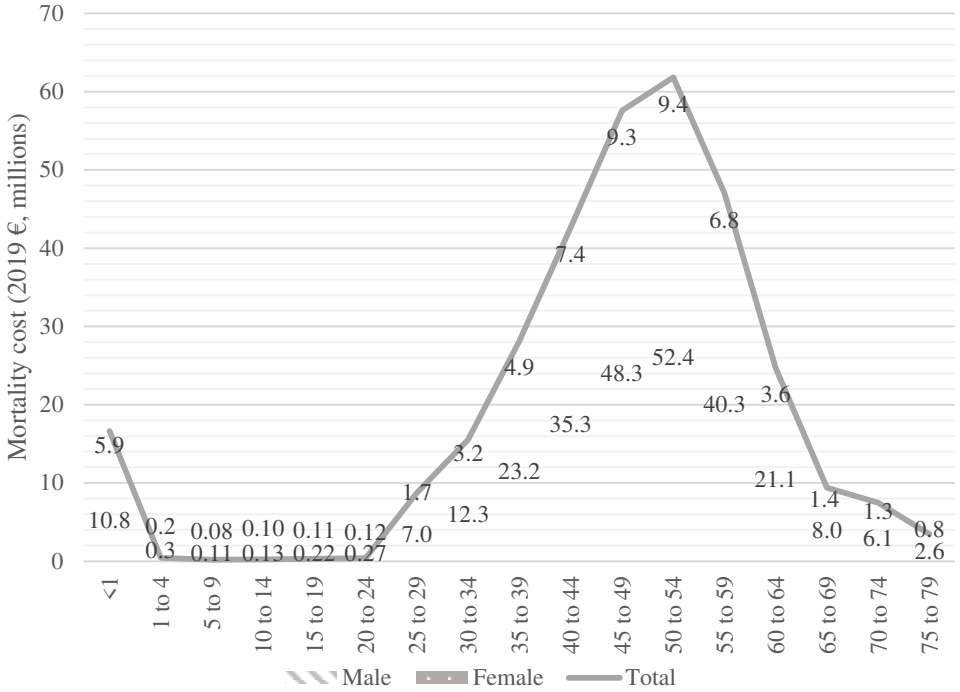
Source: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO

Figure A4. Morbidity cost from household $PM_{2.5}$ air pollution by age and gender, Greece, 2019



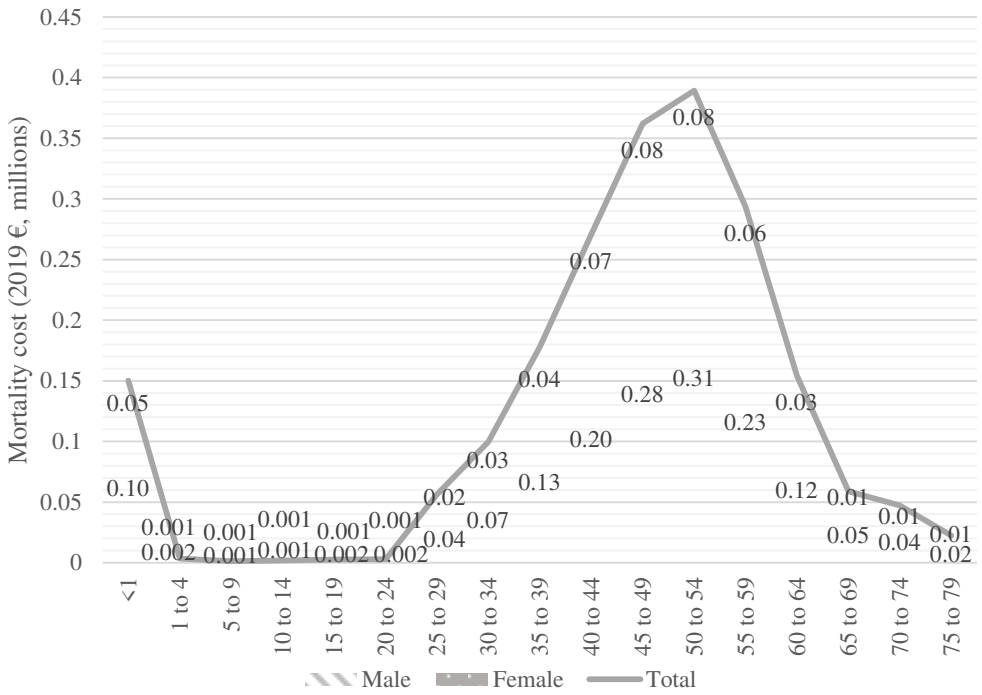
Source: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO

Figure A5. Mortality cost from ambient $PM_{2.5}$ air pollution by age and gender, Greece, 2019



Source: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO

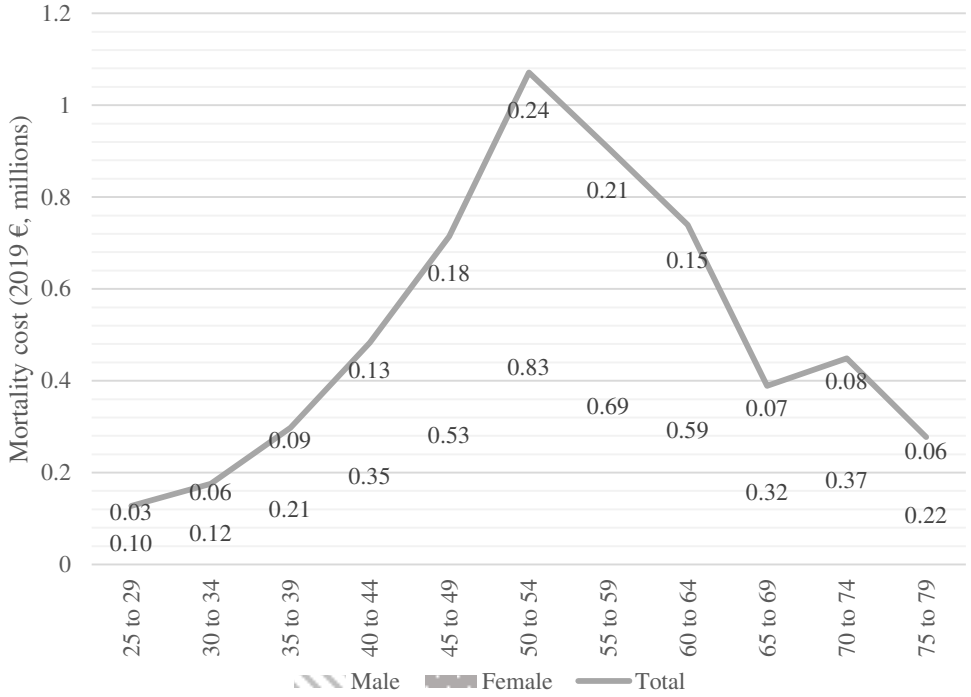
Figure A6. Mortality cost from household $PM_{2.5}$ air pollution by age and gender, Greece, 2019



Source: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO

DOI: 10.25103/ijbesar.143.07

Figure A7. Mortality cost from ambient ozone air pollution by age and gender, Greece, 2019



Source: Own calculations based on data from the GBD 2019 (IHME), IMF and ILO