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Contact
Alexandru Ioan Cuza University of Iasi
Faculty of Economics and Business Administration
Bd. Carol I no. 22, Iasi, 700505, Romania
Tel.: +40232201433, +40232201435, Fax: +40232217000
Email: saeb@uaic.ro, Website: http://saeb.feaa.uaic.ro

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Pretending to be Socially Responsible? The Role of Consumers' Rewarding Behaviour

Margarida Catalão-Lopes[*], Joaquim P. Pina[**], Ana S. Costa[***]

Abstract: Extant evidence on corporate social responsibility (CSR) shows that consumers are willing to pay a premium if they infer that the firm is truly "prosocial" (i.e if it is altruistic), but their valuation of the product will not increase as much (and may even decrease) if they believe the company has an ulterior motive for CSR (i.e. if the firm is opportunistic). We pose that the CSR level of investment can be strategically used as a signalling tool to help consumers identify the true nature of the firm and solve this incomplete information problem. Using a signalling game, where altruistic firms want to express their nature and opportunistic ones want to conceal it, we explore the relative effectiveness of consumers' premiums and penalties (expressed as demand increases or decreases, respectively) in the promotion of corporate truth-revealing behaviour. We also characterize the conditions for market equilibria in which altruistic firms are distinguished from opportunistic ones, allowing consumers to solve the information asymmetry and, with that, influence firms' profits. Contrary to what might be expected, we show that rewards for altruistic CSR and penalties for opportunistic CSR are not symmetrically effective. Our results help companies to improve their CSR decisions, by understanding how consumers solve the information asymmetry regarding the true nature of the CSR investments. Especially for altruistic firms, this may be important to guarantee that CSR effort and expenses are not just a cost but turn into higher revenues and profits.

Keywords: Corporate Social Responsibility (CSR); firm behaviour; consumers' perceptions; consumers' reactions.

JEL classification: D12; D21; M14.

[*] CEG-IST, Instituto Superior Técnico, Universidade de Lisboa, Portugal; e-mail: *mcatalao@tecnico.ulisboa.pt* (corresponding author).

[**] MARE – Marine and Environmental Sciences Centre, Associate Laboratory; ARNET – Aquatic Research Network, and Departamento de Ciências Sociais Aplicadas, Faculdade de Ciências e Tecnologia, Universidade NOVA de Lisboa, Portugal; e-mail: *jagl@fct.unl.pt*.

[***] CEG-IST, Instituto Superior Técnico, Universidade de Lisboa, Portugal; e-mail: *ana.costa@novasbe.pt*.

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1. INTRODUCTION

Over the past decades, corporate social responsibility (CSR) practices have become increasingly important in firms' positioning strategies. Offering CSR attributes may improve consumers' evaluation (Alan *et al.*, 2019) and even reduce the risk of consumer boycotts (Luo & Bhattacharya, 2009). Specially under changing economic conditions that may lead firms to reorient social responsibility practices (Cassely *et al.*, 2021) or in face of humanitarian disasters, CSR may play a crucial role in shaping consumers' perceptions about companies. Although not all CSR investments respond in the same way to economic determinants (e.g., Acabado *et al.* (2020)) and/or receive the same attention in all countries (Pimentel *et al.*, 2016), during economic downturns CSR may be an important demand enhancing instrument (Catalão-Lopes *et al.*, 2016).

But are consumers' perceptions and reactions independent of the CSR motivation? Skilton and Purdy (2017, p. 117) conclude that stakeholders respond to CSR activities "dynamically by evaluating both their content and the motivations behind them". Consumers know that firms' CSR effort may not be altruistic. For instance, if greenwashing purposes exist behind CSR, this may backfire on the company and its reputation (Gatti *et al.*, 2019). CSR's influence on consumers' purchase intentions is more complex than just a simple positive influence. According to Ribeiro *et al.* (2022), consumers' reaction to CSR initiatives takes into account the proactive or reactive nature of the observed CSR, the CSR dimension (environment, employees, or social) and the price of the product.

In the literature, there is ample evidence of how consumers react to CSR. Moisescu (2017) found that the perceptions of customers about the corporate social responsibility of their service providers impacted consumers' loyalty. Hashimoto and Karasawa (2018) concluded that consumers' empowerment derived from the massification of social network drives them to show negative psychological and behavioural reactions to misbehaving firms. Brandão *et al.* (2022) found that consumers are more likely to join anti-brand communities depending on how firms behave regarding CSR. Consumers' involvement is confirmed by several experiments (Chernev & Blair, 2015; Ribeiro *et al.*, 2022). Clients are willing to pay more when part of the payment goes to a charitable cause (Elfenbein & McManus, 2010). The positive influence of CSR on the way that consumers evaluate a company's products can exist even when the acts of social goodwill are unrelated with the company's core business (Chernev & Blair, 2015). However, this positive influence may be attenuated if consumers believe that the firm is acting by self-interest rather than by altruism. (Du *et al.*, 2010) found evidence that the benefits and business returns of CSR are contingent on customers awareness of a company's CSR activities. In a literature review, Neacșu and Georgescu (2023) concluded that the transparency of the decision-making process in the field of sustainability and financial performance helps the integration of these two areas. Additionally, CSR improves the firm's image when consumers attribute sincere motives and hurts the firm's image when motives are perceived as insincere (Yoon *et al.*, 2006). As Alhouti *et al.* (2016, p. 1242) put it, "it is not enough for a firm to simply engage in CSR. A firm's CSR strategy must also consider the extent to which consumers perceive the CSR initiative to be authentic". Schlegelmilch and Pollach (2005, p. 284), reinforce this notion when considering "people's distrust of and cynicism about corporate ethics" as a challenge for companies' ethics communication.

Polls evidence supports the existence of socially responsible consumers, the existence of beliefs about the nature of CSR, and highlights the role of information. We offer an

overview of these findings in the Annex, covering polls from 2000 to 2019. In the current paper we follow these results by admitting a consumers' reward for altruistic behaviour and a lower reward (or even a penalty) for opportunistic CSR, with the aim of identifying conditions for separation of the two firm types (altruistic and opportunistic) and each type's optimal CSR investment, based on consumers' perceptions. Throughout the article we employ the terminology "altruistic" versus "opportunistic" meaning firms' other-regarding and self-regarding behaviours, respectively. Also, the words "separate" and "distinguish" are used interchangeably to denote separating equilibrium in which consumers can identify altruistic CSR behaviour, as opposed to "pooling" equilibrium, in which the two types of firms send signals to consumers that they are unable to distinguish. Consumers use a visible outcome, manipulated by the firm, to try to infer an unobservable firm's characteristic.

Signalling models have been applied to many settings in the literature, including job markets, insurance, advertising expenses, warranties, and several other adverse selection contexts. Among empirical works, applications to capital markets (e.g., Ritter & Welch, 2002) and to management practices (e.g., Haas & Hansen, 2007) are worth mentioning.

Following Zerbini (2017) that suggested the use of signalling theory to explore the problem of adverse selection when there is asymmetric information between the firm and its customers on the ethicality of the firm, we adopt the CSR level of investment as a signalling tool. The signalling approach points "to the cueing process that links the CSR initiatives to the market response" (Zerbini, 2017, p. 3), and, as such, is adequate to explore the nature of firms' CSR behaviour and the corresponding customers' perceptions and behaviour. In the spirit of Kirmani and Rao (2000), the use of CSR as a signalling instrument can be regarded as a "no pain no gain" argument. CSR initiatives can be seen as shortcuts by which customers infer the hidden ethical nature of the firm and choose their providers. The power of the 'CSR level of investment' as a signalling tool depends on the *a priori* probability attached by consumers regarding the existence of altruistic and opportunistic companies, and also on consumers' response to CSR effort. Of course, it is also subject to financial constraints, as noted by Kumar *et al.* (2019).

One of our research hypotheses is thus that, under some conditions depending on the level of consumers' reward and penalty and prior probability of the two types of firms, altruistic firms may be able to separate from opportunistic. This research hypothesis is confirmed by the model developed, and quantitatively assessed by the simulations performed. Given this, a second research hypothesis has to do with the best instrument consumers may use to lead to separation. We hypothesize, and then prove, that rewards and penalties are not symmetrically effective in helping consumers distinguish altruistic from opportunistic CSR. We furthermore derive conditions under which one instrument is more effective than the other.

In the current paper, two types of asymmetries are present: on the one hand, there is information asymmetry between firms and customers, as customers observe the strategies and actions of companies but do not observe the true motives behind these strategies. Customers try to infer those motives, and their decisions will reflect their perceptions. On the other hand, we find an asymmetry between penalties and rewards that customers use to encourage companies to separate. Contrary to what might be expected, we show that rewards for altruistic CSR and penalties for opportunistic CSR are not symmetrically effective at leading to separation. These results parallel those obtained by Mulder (2008) for punishments and rewards in fostering moral concerns in social decision making, where punishing non-cooperation fosters moral concerns regarding cooperation more strongly than rewarding

cooperation. Wagner *et al.* (2009) conclude that a proactive communication strategy generates higher levels of perceived hypocrisy than a reactive one. In an experimental design to compare proactive and reactive CSR, Ribeiro *et al.* (2022) test consumers' response to these two types of CSR, in terms of awards or penalties, and find that consumers tend to reward more proactive CSR initiatives and are willing (in a lesser extent) to reward some CSR initiatives that follow a reactive approach, also confirming the existence of asymmetries.

Although from a social point of view a separating equilibrium is not necessarily preferable to a pooling one if the latter involves a sufficiently larger amount of CSR, we focus on the likelihood of the former. CSR initiatives are valuable, and the more valuable the more information they convey. As Zerbini (2017, p. 1) notes, social and ethical initiatives may have the (additional) advantage of signalling "the ethical nature of the business to a target audience, when this is not directly observable." They are shortcuts that enclose informational value to help solving adverse selection problems and change the market outcome. We perform some numerical simulations that reveal that the likelihood of separation may be high, which means solving the uncertainty associated with CSR's nature and helping consumers in their decision-making process.

The rest of the article is organized as follows. Section 2 presents the model. Interpretations and results on the relative effectiveness of rewards and penalties are provided in Section 3. Section 4 offers some numerical simulations. Section 5 concludes and presents suggestions for future work. An Annex contains all formal proofs.

2. MODEL

This section develops a standard signalling model that incorporates consumers' reaction to CSR investment. Consumers know that there are two types of firms in the market, those with altruistic CSR behaviour and those with opportunistic CSR behaviour. Thus, they are sceptical about observed CSR. Altruistic firms (A) care about social motives besides profit. Opportunistic ones (O) only care about profit and their CSR initiatives are entirely aimed at increasing profit. Each firm knows its type, but consumers cannot perfectly distinguish between the two. Consumers attach an *a priori* probability to each type, $0<\theta<1$ and $1-\theta$ respectively. These beliefs are assumed to be common knowledge. The *a priori* probability for a firm to be altruistic (θ) can be as small as desired, provided it is positive. As seen before, the existence of (some) altruistic firms is sometimes assumed in the CSR literature. Some consumer uncertainty about the type of the firm exists, hence θ must be strictly positive.

Consumers are socially responsible (we thus focus on the subset of consumers who care about CSR) and observe (through firms' disclosure and CSR reporting) the amount of the firm's CSR. From this observation they may be able to extract information about the type of the firm and update their *a priori* probability θ. Let us admit a standard inverse market demand

$$p = 1 - q$$

where p is price and q is quantity in the absence of CSR activity. Without loss of generality, and to avoid additional parameters, we follow the common procedure of normalizing to one the maximum willingness to pay and the sensitivity of demanded quantity to price. If firms invest in CSR and consumers believe that the observed amount of CSR corresponds to altruistic conduct, this impacts positively on demand which becomes:

$$p = 1 - q + \delta$$

where $\delta>0$ means that consumers are willing to pay a reward for the products (indifference to CSR activity would imply $\delta=0$). In the words of (Smith, 2008), this corresponds to 'ethical consumerism', as opposed to 'negative ethical consumerism' which often involves a penalty.

If firms invest in CSR but consumers believe that the observed amount of CSR corresponds to opportunistic conduct, demand becomes:

$$p = 1 - q - \mu$$

where $0<\mu<1$ means that consumers are only willing to pay a lower price, penalizing companies for their perceived opportunistic behaviour (indifference to CSR activities would imply $\mu=0$). Given that we focus on the subset of consumers who care about CSR, $\delta\neq0$ and $\mu\neq0$.

If we consider $\mu<0$ we are admitting that consumers always reward CSR. If this is the case, to assure that this reward is lower than when CSR is taken for altruistic, we must still impose $|\mu|< \delta$. In this context CSR is always desirable (for instance when some company contributes to an important medical advance, consumers will probably reward it independently of the true motivation), however the true motivation may make some difference in consumers' willingness to reward the CSR effort. In other words, consumers prefer that opportunistic firms spend some money on CSR as compared with no money at all, even if their motives are not genuine.

Hence, to take both penalties and "smaller" rewards into account, we will assume the union of both intervals above, that is, $-\delta<\mu<1$. A possible interpretation for these demand shifts is that consumers regard firm types as selling a vertically differentiated product. Note that in case of penalty the value for μ can be as close to zero as desired (almost no penalty) or, on the other extreme, demand may be completely eroded ($\mu\rightarrow1$).

Firm losses are bounded (by demand declining to zero) but gains may be very high, which is consistent with a view where consumers preferably reward prosocial behaviour and are less willing to change their buying habits when it comes to punishing. Consumers' valuation of CSR behaviour is reflected on the magnitudes of δ and μ relative to demand. We are interested in how δ and μ compare with 1, the upper bound for the willingness to pay. This is what will be used in the 'what if' analysis ahead. Of course, if no CSR is observed demand does not change.

A signalling game allows modelling the conditions under which we have a separating equilibrium, that is, a solution in which the CSR amounts chosen by A and O firms are sufficiently different so that consumers perceive the true nature of firms, or a pooling equilibrium, in which the two types of firms remain mixed. The sequence of our game is standard in signalling models and is as follows. Nature chooses the firm's type (A or O). In stage 1, after observing its type, the firm chooses the amount R to invest in CSR (this decision is contingent on the type), considering the expected reaction by consumers. In stage 2, after observing R, consumers revise their expectations about the type of the firm and decide how much to buy (this decision is contingent on the firm's choice in period 1). We look for the perfect Nash equilibrium of this game. Firms want to understand how much to spend in CSR to be perceived as altruistic and benefit from it. Altruistic firms want to know the minimum amount they need to spend in CSR to be correctly perceived as altruistic. Opportunistic firms want to know the minimum amount they need to spend in CSR to be incorrectly perceived as altruistic.

For simplicity, we assume that fixed and variable production costs are zero. CSR costs are fixed and equal to *R*. This is consistent with donations but can also be related with other CSR dimensions as long as they have a fixed cost nature: investments in employee relations (healthcare benefits, training opportunities or other), community, human rights or environment. Although in these cases assessing the amount involved may be more difficult than for donations, companies' accounting and disclosure practices will try to guarantee that consumers get to know them.

To evaluate how consumers' reaction impacts on firms' decisions, we need to consider profits under different scenarios. If no investment is made in CSR, profit maximization under the demand conditions specified above simply yields the following value for profit (π):

$$\pi = \frac{1}{4}$$

On the other hand, if some investment is made and consumers perceive altruistic CSR concerns, profit becomes:

$$\pi_R(\delta) = \frac{(1+\delta)^2}{4} - R$$

If the firm invests in CSR but consumers believe that this is opportunistic, profit becomes:

$$\pi_R(\mu) = \frac{(1-\mu)^2}{4} - R$$

Note that the no CSR profit is a particular case of the last two expressions, when there is no CSR and thus demand is not impacted. It will serve as a reservation profit in the analysis that follows, that is, the value firms can guarantee themselves by not performing any CSR.

Finally if consumers cannot distinguish the two types of CSR, the expected profit $E_R(\pi)$ is a weighted average of the gross profit (before deducting R) when being perceived as altruistic and the gross profit when being perceived as opportunistic, where each term is multiplied by the corresponding probability, deducted of the amount spent in CSR:

$$E_R(\pi) = \theta\frac{(1+\delta)^2}{4} + (1-\theta)\frac{(1-\mu)^2}{4} - R$$

2.1 How consumers' reaction influences the CSR strategy sets

Altruistic firms maximize a utility function that combines social concerns (W) and private profit (in line with Beltratti (2005)) with a weighting parameter (call it γ) that captures the relative preference for social concerns (altruism parameter): $U=\gamma W+(1-\gamma)\pi$, where W is increasing in the amount of CSR (and π is non monotone). Altruistic firms may thus have different levels of altruism, captured by γ. Their choice of the amount to spend in CSR, R^A, is an increasing function of γ, the willingness to sacrifice profit for social causes, and must be bounded from above by a non-negativity expected profit condition ($E_R^A(\pi)\geq 0$), which gives rise to the following participation constraint, where $\overline{R^A}(\theta,\delta,\mu)$ is the upper limit for R^A:

$$R^A \leq \overline{R^A}(\theta, \delta, \mu) = \frac{\theta(1+\delta)^2 + (1-\theta)(1-\mu)^2}{4}$$

In turn, the participation constraint of the opportunistic firm requires that profits do not decline as compared with the no CSR case. Consequently the opportunistic firm's profits should be above the no investment threshold ($E_R{}^O(\pi) \geq 1/4$) and, hence, their choice of the amount to spend in CSR, R^O, must be bounded from above by $\overline{R^O}(\theta, \delta, \mu)$, given by the following expression:

$$R^O \leq \overline{R^O}(\theta, \delta, \mu) = \frac{\theta(1+\delta)^2 + (1-\theta)(1-\mu)^2 - 1}{4}$$

Notice that the maximum amount the altruistic company is willing to invest in CSR ($\overline{R}^A$) is positive for all admissible θ, δ and μ (*a priori* probability, reward, and punishment, respectively), thus the decision set for the *A* (altruistic) firm includes positive levels of CSR. Given the altruistic nature of the firm we exclude $R^A=0$ from the possible choices of the *A* firm. However, for the opportunistic firm to invest in CSR (i.e., for a positive $\overline{R^O}$) the *a priori* probability θ must exceed the following threshold θ*:

$$\theta > \theta^* = \frac{\mu(2-\mu)}{\delta(2+\delta)+\mu(2-\mu)}$$

We note that $0<\theta^*(\delta,\mu)<1$ for $\delta>0$ and $0<\mu<1$, but $\theta^*(\delta,\mu)<0$ for $\mu<0$. This means that when the *O* (opportunistic) company faces the possibility of a penalty for opportunistic behaviour ($0<\mu<1$), it decides to invest in CSR only if the *a priori* probability θ that consumers attach to altruism is high enough, in which case there is a large chance of being pooled with *A*. On the contrary, if *O* knows there is no penalty for opportunistic CSR (but only a smaller reward, that is, $\mu<0$ and $|\mu|<\delta$), then it always invests in CSR (θ must then be higher than a negative value, which always happens).

As expected, the opportunistic firm is more likely to invest in CSR when the reward δ is high (larger demand expansion following CSR), and when the penalty μ is low (small demand contraction when consumers perceive opportunistic CSR, or even some expansion if $\mu<0$). This can be easily seen from $\frac{\partial\theta^*(\delta,\mu)}{\partial\delta} < 0$ and $\frac{\partial\theta^*(\delta,\mu)}{\partial\mu} > 0$. If there was no reward for prosocial behaviour ($\delta=0$) but there was a penalty for pretending to be altruistic ($\mu>0$), then opportunistic firms would never invest in CSR ($\theta^*=1$), because there was no incentive to try to be perceived as altruistic. On the other hand, if there was no penalty for opportunistic behaviour ($\mu<0$) we would obtain $\theta^* \leq 0$ which means that *O* companies would always invest in CSR.

In conclusion, the amount R^{*A} that the altruistic firm invests in CSR belongs to the interval $(0, \overline{R^A}]$. In turn, the amount R^O invested by the opportunistic firm belongs to the interval $(0, \overline{R^O}]$, with $\overline{R^O} < \overline{R^A}$.

2.2 Equilibria CSR as a function of consumers' reaction

This section describes how consumers' reaction determines the equilibrium type (that is, the firms' CSR choice) – separating or pooling.

2.2.1 Low a priori probability ($\theta \leq \theta^*(\delta,\mu)>0$)

As we have seen, when the a priori probability of the firm being altruistic is low enough the participation constraint for the O firm is not satisfied, which means that it does not invest in CSR. Since the altruistic firm always invests in CSR, the equilibrium is obviously separating. The following Proposition states this result.

Proposition 1: For a positive reward δ and a positive penalty μ, when the *a priori* probability θ of the firm being altruistic is low the market equilibrium is separating, and consumers can distinguish altruistic from opportunistic CSR. (The opportunistic firm chooses $R^{*O}=0$ and the altruistic chooses $0 < R^{*A} \leq \frac{(1+\delta)^2}{4}$).

Figure no. 1 illustrates the situation.

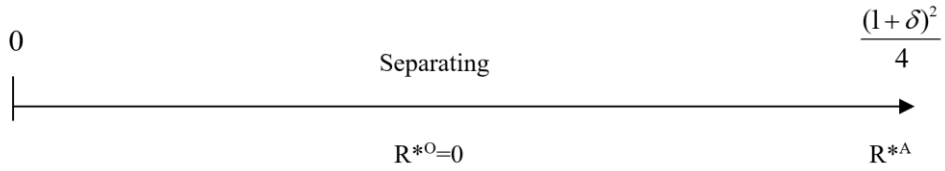

Figure no. 1 – CSR equilibria when $\theta \leq \theta^*(\delta,\mu)$

Separation occurs for all admissible values of CSR by *A* firms. This large set of equilibria contains the CSR level that maximizes U, which will be the chosen one.

2.2.2 High a priori probability ($\theta > \theta^*(\delta,\mu)>0$)

When the *a priori* probability of the firm being altruistic is sufficiently high, the participation constraint for the opportunistic firm *O* is satisfied, which means that it invests in CSR. Clearly, if altruistic firms have a relatively weak preference for social concerns, they do not invest much in CSR and the equilibrium is pooling, meaning that consumers are not able to distinguish companies. In the opposite case, *A* firms invest largely in CSR and the equilibrium becomes separating, as expected. The next Proposition states this result.

Proposition 2: Let γ* be the altruistic firm's preference for social concerns such that this firm chooses the same CSR level as the opportunistic firm (that is, $R^{*A}(\gamma^*) = \bar{R}^O$). For a sufficiently high a priori probability θ of the firm being altruistic, given a positive reward δ and a positive penalty μ, or also a reward for opportunistic behaviour but lower than the reward for altruistic behaviour (μ<0 and <|μ|<δ),

i) for $\gamma \leq \gamma^*$ the market equilibrium is pooling with $R^{*A} \leq \bar{R}^O$; consumers cannot distinguish altruistic from opportunistic CSR;

ii) for $\gamma > \gamma^*$ the market equilibrium is separating with $R^{*A} > \bar{R}^O$, $R^{*O}=0$ if μ>0, and $R^{*O} < \bar{R}^O$ if μ<0; consumers can distinguish altruistic from opportunistic CSR.

Figure no. 2 illustrates these results, which, qualitatively, are as expected in a signalling model. In quantitative terms, the results obtained define some regions that will be useful in what follows for comparative statics regarding the use of rewards and/or penalties, as well as for simulation purposes.

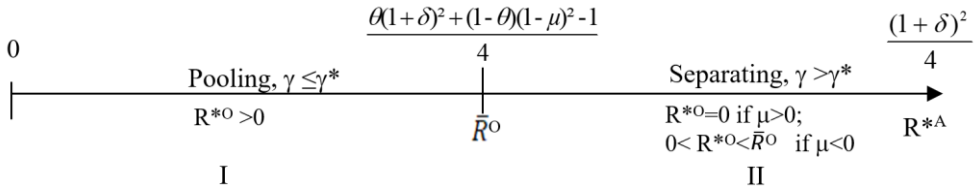

Figure no. 2 – CSR equilibria when $\theta > \theta^*(\delta,\mu)$

The large set of separating equilibria can be restricted to a single point, the one corresponding to the *A* choice by maximizing U. The same applies to the set of pooling equilibria, in which case the *O* firm also chooses this CSR level.

With Propositions 1 and 2 we confirm our first research hypothesis: that altruistic firms may be able to separate from opportunistic, under some conditions depending on the level of consumers' reward and penalty and prior probability of the two types of firms.

Note that changes in the reward and/or in the penalty level (δ, μ) can result in a switch from the case examined in Proposition 1 to the case examined in Proposition 2, or vice-versa, as they alter the value of θ^*. This is relevant for the simulations presented ahead.

3. COMPARING THE EFFECTIVENESS OF REWARDS AND PENALTIES

Although in real life distinguishing altruistic from opportunistic CSR may be difficult for consumers, the signalling model shown proves that it is possible. If the consumers' *a priori* probability associated with altruistic CSR is low enough, it does not pay opportunistic firms to try to mimic altruistic ones, consequently the equilibrium is separating for every choice of R^A. In turn, when the consumers' *a priori* probability associated with altruistic CSR is high enough two outcomes may occur: i) in markets where the investment in CSR is modest as compared with expected profits (area I in Figure no. 2, which happens when the "degree" γ of altruism is low), information is not enough for consumers to be able to discern about the two types of corporations and the equilibrium is pooling; ii) high levels of *R* (area II) signal altruism, so the information asymmetry between demand and supply is solved and the equilibrium is separating.

Note that if consumers were insensitive to CSR (δ=μ=0) there would always be separation. Opportunistic companies would choose not to invest in CSR ($R^{*O}=0$), because by selecting a positive amount of CSR they would decrease their profits below the reservation level ¼, without any chance of increase. Altruistic firms would choose $0<R^{*A}\leq 1/4$, increasing in γ, because they do not mind reducing their profits below the no CSR level, and they are just constrained by a nonnegative profit condition. Consumers would infer the type of the firm by simply observing whether *R* is null or positive, but they really would not care about that (because δ=μ=0). So, if consumers do not respond to CSR, only altruistic firms spend some resources in CSR, as expected.

Consider now that a reward for altruistic CSR is introduced but with no penalty for opportunistic behaviour (i.e., $\delta>0$ and $\mu\leq 0$). In this case the threshold for θ is non positive ($\theta^*\leq 0$), which implies that $\theta > \theta^*(\delta,\mu)$, therefore the equilibrium is pooling for R^{*A} below $\bar{R}^O$ and separating otherwise (with $R^{*O}=0$). On the other hand, in case of penalty but no reward ($\mu>0$ and $\delta=0$), opportunistic firms do not want to participate ($\theta^*=1$), and the equilibrium is always separating with $R^{*O}=0$ and $0<R^{*A}\leq 1/4$ increasing in γ. Not surprisingly, but formally proven, it is the existence of a reward by consumers that may turn the investment in CSR attractive for opportunistic firms, thus generating the untangling problem.

The possibility of pooling is indeed introduced by the existence of a reward ($\delta>0$). Actually, rewards and penalties have asymmetric impacts on firms' CSR decisions as is clear from the quadratic profit expressions $\pi_R(\delta)$ and $\pi_R(\mu)$ presented before. $\pi_R(\delta)$ grows with δ and $\pi_R(\mu)$ declines with μ, as expected, but the impact of an increase in δ is stronger than the impact of a reduction in μ, in absolute value.

Some comparative statics tell us how changes in the parameters of the model (one at a time) affect the relative magnitude of the pooling and separating areas when both types invest in CSR ($\theta > \theta^*(\delta,\mu)>0$), that is, the likelihood of the two equilibria (Proposition 3). After that we compare the effectiveness of the different consumer "instruments" (Propositions 4 and 5).

Let us define the relative magnitude of the separation area II in Figure no. 2 as

$$S = \frac{\frac{(1+\delta)^2}{4} - \frac{\theta(1+\delta)^2+(1-\theta)(1-\mu)^2-1}{4}}{\frac{(1+\delta)^2}{4}} = \frac{(1-\theta)\left[(1+\delta)^2-(1-\mu)^2\right]+1}{(1+\delta)^2}$$

Proposition 3: For a high a priori probability θ that consumers attribute to the firm being altruistic, ceteris paribus

i) If reward δ rises (falls), the relative magnitude of the separation area is reduced (enlarged).

ii) If penalty μ falls (rises), the relative magnitude of the separation area is reduced (enlarged).

iii) If the prior θ rises (falls), the relative magnitude of the separation area is reduced (enlarged).

Proposition 3 confirms that lower consumer rewards for altruistic CSR make the separating equilibrium more likely (and the consumers' effort in distinguishing altruistic from opportunistic companies is eased). Higher penalties do the same. Very high penalties may even push the threshold θ^* above θ, which means that consumers no longer expect *O* firms to invest in CSR and the equilibrium is always separating. If consumers become more sceptical about firms being altruistic (lower θ), the separating equilibrium becomes more likely too. For too low prior the expected profit just depends on the reward δ again because *O* firms are not expected to invest in CSR.

We conclude that while rewarding is effective at stimulating CSR, it may also have the perverse effect of pooling different types and creating untangling problems for consumers. Firms know their type and anticipate consumers' reaction to CSR investment, then decide the amount to invest in order to be taken as an altruistic company. Altruistic firms invest according to their

social preference and constrained by positive profit. If *O* firms know the market is willing to pay low rewards for CSR efforts or assign high penalties for opportunistic CSR investment, incentives to invest and mimic *A* firms are reduced, up to a point where those firms decide not to invest. If they decide that it pays to invest in CSR, their investment will depend on the *a priori* beliefs (θ) and other market parameters that can be observed (reward δ and penalty μ).

It is important to note that although the separation area increases as the penalty μ rises, this occurs at a rate that is diminishing with θ, the consumers' *a priori* probability of altruistic CSR (in other words, the second cross derivative is negative). Additionally, the separation area increases at a growing rate with θ as the reward δ declines. In other words, a large *a priori* probability of altruistic CSR reduces the effectiveness of a penalty increase as compared with a reward reduction. This happens because consumers are more prone to believe the firm is altruistic, and hence to reward its CSR effort, rather than punish it. The inverse happens when θ is low.

We now ask: which consumers' instrument is more effective at increasing the likelihood of being able to distinguish, a reward reduction or a penalty increase? As pointed out before, rewards and penalties have asymmetric impacts on firms' CSR decisions, so this comparison is relevant. The answer depends on the different parameter configurations that may take place, as Propositions 4 and 5, with complementary parameter sets, detail (see proof in the Annex for the complete explanation of all the thresholds). We admit $\delta<1$, that is, rewards are not as high as to duplicate the willingness to pay. We also admit positive penalties ($\mu>0$).

Proposition 4: When altruistic and opportunistic firms invest in CSR, a penalty increase is more effective at making consumers distinguish altruistic from opportunistic firms than a reward reduction when:

i) the penalty is low ($0<\mu<0.382$) and

   a. the prior is low ($0<\theta<\frac{\mu^2-3\mu+1}{\mu^2-3\mu+2}$), independently of the reward level (δ);

   b. the prior is high ($\theta>\frac{\mu^2-3\mu+1}{\mu^2-3\mu+2}$) and the reward is high ($0<\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}<\delta$);

ii) the penalty is intermediate ($0.382<\mu<0.586$) and the reward is high ($\delta>\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}$), independently of the level of the a priori probability θ.

Proposition 5: When altruistic and opportunistic firms invest in CSR, a reward reduction is more effective at making consumers distinguish altruistic from opportunistic firms than a penalty increase when:

i) the penalty is low ($0<\mu<0.382$), the prior is high ($\theta>\frac{\mu^2-3\mu+1}{\mu^2-3\mu+2}$) and the reward is low ($\delta<\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}$);

ii) the penalty is intermediate ($0.382<\mu<0.586$) and the reward is low ($\delta<\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}$), independently of the level of the a priori probability θ;

iii) the penalty is high ($\mu>0.586$), independently of the levels of the reward δ and the a priori probability θ.

Table no. 1 summarizes the results of Propositions 4 and 5. Low penalty means $0<\mu<0.382$, intermediate penalty means $0.382<\mu<0.586$ and high penalty means $0.586<\mu<1$; low prior means $0<\theta<\frac{\mu^2-3\mu+1}{\mu^2-3\mu+2}$ and high prior means $0<\frac{\mu^2-3\mu+1}{\mu^2-3\mu+2}<\theta$; low reward means $0<\delta<\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}<1$ and high reward means $0<\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}<\delta$. In the Table, P4 refers to results from Proposition 4 and P5 refers to results from Proposition 5.

Table no. 1 – Data of the study Comparison of penalty (μ) increase versus reward (δ) reduction effectiveness, for given a priori probability (θ) of altruistic behaviour

		μ low		**μ intermediate**		**μ high**	
		δ		**δ**		**δ**	
		High	**Low**	**High**	**Low**	**High**	**Low**
θ	High	P4 ib)	P5 i)	P4 ii)	P5 ii)	P5 iii)	P5 iii)
	Low	P4 ia)	P4 ia)	P4 ii)	P5 ii)	P5 iii)	P5 iii)

With Propositions 3, 4 and 5 we confirm our second research hypothesis: that rewards and penalties are not symmetrically effective in helping consumers distinguish altruistic from opportunistic CSR.

Notice that, as mentioned before, a higher reward (δ) and/or a higher penalty (μ) raise θ^*, the threshold for the *a priori* probability that consumers attach to altruism above which opportunistic firms invest in CSR. If the conditions of Proposition 1 are met, they will continue so, and the probability of separation remains one. Instead, if the conditions of Proposition 2 are met, either they will continue so but with a higher likelihood of separation, or we switch to the conditions of Proposition 1, with the probability of separation becoming 1. In either case, the separating equilibrium becomes more likely.

Propositions 4 and 5 tell us that when the penalty chosen by consumers is high, a lower reward is always preferable to an even higher penalty. For intermediate penalties the current level of the reward also matters for the relative effectiveness of the two instruments, and for low penalties the *a priori* probability attached by consumers to altruistic CSR becomes relevant too. When the penalty is at an intermediate level, it may still be more effective to reduce the reward if it is low, but not if it is considered high. Finally, when the penalty is low the balance depends on the *a priori* probability θ: i) if θ is low too, it is better to use a penalty increase because, as explained earlier, low θ decreases the relative effectiveness of a reward reduction (consumers are less prone to believe the firm is altruistic and hence to reward its CSR effort rather than punish it, which is consistent with the signs of the second cross derivatives mentioned before); ii) if θ is high it is more effective to increase the penalty when the reward is high, and to reduce the reward even more when this is already low.

We conclude that the type of consumers' response is not irrelevant to solve the uncertainty problem associated with the nature of CSR activity. Contrary to what might be expected, the two instruments - rewards and penalties - are not interchangeable. Their impact is asymmetric. The reason for this has to do with the quadratic profit expressions $\pi_R(\delta)$ and $\pi_R(\mu)$, as mentioned before, and with the fact that the maximum profit any firm can attain, and which shapes the separation area, is defined by the reward δ, but not by the penalty μ. Sometimes it is more effective that consumers reduce their premiums for altruistic behaviour

rather than increase penalties for opportunistic CSR. Under other circumstances the reverse happens. These findings stress the importance of consumers' responses in shaping firms' social attitudes. Although the levels of the reward and the penalty are not under the control of the firms, altruistic firms benefit from their knowledge, as they determine the CSR investment level that must be made in order to be separated from opportunistic rivals. Similarly, it is valuable for opportunistic firms to know the minimum amount they must invest if they want to be mixed with altruistic rivals.

As we have seen, Propositions 4 and 5 present several possible cases. They also set an upper bound on the effectiveness of increasing penalties, such that it is not worth to increase the penalty μ above 58.6% of the maximum willingness to pay that the market bears to ease detection of opportunistic CSR. In other words, it is not worth to set a penalty that decreases demand by more than 41.4%, rather it is better to reduce the reward for altruistic CSR. If firms know that consumers are better off acting this way, they can adjust their CSR efforts to either reach separation or pooling.

It is important to analyse the robustness of our main findings to the assumptions made. Most of the intuitions presented are robust to different specifications and results apply with some qualifications. For example, if we relaxed our simplifying assumption of zero marginal production costs (which is a realistic hypothesis in some sectors like telecommunications, transports, and others), the computations performed would include another variable (the marginal cost). The results obtained would again depend on the level of the parameters, with several possibilities, but now would also depend on this. Setting the maximum willingness to pay and/or the sensitivity of demanded quantity to price different from 1 would also introduce more parameters in the analysis, would change the expression for the separation likelihood, but with no relevant new qualitative insights. The asymmetry result concerning rewards and penalties subsists in both cases, although with the cut-off levels of δ, μ and θ having more complex expressions that now also depend on the additional parameters.

A more interesting extension could consider multiplicative rewards and penalties, instead of additive. This means that demand would change to $(1-q)\delta$ with $\delta > 1$ if consumers believe the observed CSR is altruistic, and to $(1-q)\mu$ with $0<\mu<\delta$ if consumers believe that the observed CSR is opportunistic. For μ to represent a penalty we must impose $\mu < 1$ (the lower μ, the stronger the penalty), otherwise we admit that consumers always reward CSR, but less when they think it is opportunistic than when they think it is altruistic. This multiplicative approach changes both the maximum price and the elasticity: in case of a reward, demand expands and becomes less elastic (which both work in favour of the firm); in case of a penalty, demand shrinks and becomes more elastic (which both work against the firm). Profits in this case are linear functions of δ and of μ. A lower reward and a higher penalty both increase the likelihood of separation, but we can prove that the prevalence of the reward reduction is reinforced, as it now becomes more effective than the penalty increase for all possible parameter configurations. A reward reduction shrinks the set of possible values for the CSR investment (the upper limit in Figure no. 2, which is now $\delta/4$ instead of $(1+\delta)^2/4$), thus contributing, *ceteris paribus*, to enlarge the relative weight of the separation area. This effect is already present in the additive approach but becomes stronger in the multiplicative one, hence generating the dominance of the reward reduction strategy by consumers instead of the penalty increase, with the resulting implications for firms' choices. The asymmetry between the two instruments is thus reinforced.

4. NUMERICAL SIMULATIONS

When $\theta > \theta^*(\delta,\mu)$ the minimum likelihood of a separating equilibrium is 25%, reached for $\theta=\delta=1$. This means that, under the specified conditions, it is possible to distinguish altruistic from opportunistic CSR at least in 25% of the cases.

Tables no. 2 and no. 3 present a "what-if" analysis that allows assessing the likelihood of separation for different parameter combinations under the hypothesis of our model. The model seems to adhere well to parameter values which are acceptable in a real-world context. Again, we admit $\delta<1$, that is, rewards are not as high as to duplicate willingness to pay.

Table no. 2 – Likelihood of separating equilibrium as δ and θ change, $\theta > \theta^*(\delta,\mu)$

$\theta^* = \frac{\mu(2-\mu)}{\delta(2+\delta)+\mu(2-\mu)}$	Separation area for θ=0.1	Separation area for θ=0.2
δ=0.04, μ=0.01, $\theta^* = 0.196$	____	99.96%
δ=0.05, μ=0.01, $\theta^* = 0.16$	____	99.6%
δ=0.1, μ=0.01, $\theta^* = 0.09$	99.7%	97.8%
δ=0.2, μ=0.01, $\theta^* = 0.04$	98.2%	95.0%

Table no. 3 – Likelihood of separating equilibrium as μ and θ change, $\theta > \theta^*(\delta,\mu)$

$\theta^* = \frac{\mu(2-\mu)}{\delta(2+\delta)+\mu(2-\mu)}$	Separation area for θ=0.1	Separation area for θ=0.2
δ=0.05, μ=0.005, $\theta^* = 0.09$	99.9%	98.9%
δ=0.05, μ=0.01, $\theta^* = 0.16$	____	99.6%
δ=0.05, μ=-0.005, $\theta^* = -0.10841$	98.3%	97.4%

As is apparent from the tables, the separation area can be considerably large. For instance, for a prior probability corresponding to the existence of 10% altruistic firms (θ=0.1), a reward by consumers corresponding to a 20% increase in the willingness to pay (δ=0.2) and a penalty corresponding to a 1% reduction in the willingness to pay (μ=0.01), the likelihood of a separating equilibrium is equal to 98.2% (Table no. 2). If the reward decreases to 10%, keeping the other parameters constant, the separation area enlarges to 99.7%. A reward of 10% or more is in line with the evidence from polls. If the prior consumers' belief rises to 20%, the separation area shrinks to 97.8% when δ=0.1 and to 95.0% when δ=0.2, but if the reward decreases for instance to 5% the separation area covers 99.6% of the total (Table no. 3). *Ceteris paribus*, cutting the penalty to a half (Table no. 3) only decreases the likelihood of separation to 98.9%.

So, results point to a large possibility that altruistic firms achieve separation. Changing the hypotheses of the model, namely the functional form of demand, would change these figures, but the qualitative results obtained before would remain valid, as already explained. With these simulations we illustrate how our first research hypothesis is confirmed.

It is interesting to observe that our model helps explain some famous real-life cases. Let us consider the classical TOMS and Bobs shoes' example (e.g., Torelli *et al.* (2012)). Before Bobs shoes entered the market, consumers were rewarding TOMS for altruistic philanthropy ($\delta>0$). The prior probability θ was high and hence CSR was paying for *O* (opportunistic) firms. At first the newcomer benefitted from the reward too. However, consumers became

suspicious and finally punished the new operator, which means that μ became positive. In the terminology of Figure no. 2, this corresponded to the frontier between pooling and separating equilibria, which stood at $R=\theta\delta(2+\delta)/4$, moving to the left towards $R = \frac{\theta(1+\delta)^2+(1-\theta)(1-\mu)^2-1}{4}$. If firms were spending in between these two points, the equilibrium would change from pooling to separation, which happened.

Consider now the also well-known Nike's case (e.g., Torres *et al.* (2012)). At first consumers were sympathetic to Nike's campaigns, thus $\delta\geq0$ and $\mu=0$. In these circumstances, the equilibrium could either be pooling or separating. As consumers started seeing Nike's policies as hypocritical, the situation eventually changed to $\delta=0$ and $\mu>0$, in which separation is the only equilibrium. It is no longer worth for opportunistic firms to spend resources trying to mimic altruistic concerns. The same happens when the amount invested in proactive disclosure is too large as compared with the social contribution itself.

5. CONCLUDING REMARKS

The current article analyses the impact of asymmetric information between consumers and firms on the nature of CSR activity (opportunistic or altruistic), and how consumers' perception of CSR true motivation and response influence the firms' decisions as to the level of CSR investment.

Using a two-period incomplete information game, we characterize the conditions for market equilibria in which altruistic firms separate from opportunistic ones, showing that it may be possible for consumers to identify the two types, with the corresponding consequences on firms' profits, thus confirming our first research hypothesis. We then explore the sensitiveness of the likelihood of separation to the model's parameters. Not surprisingly, separation becomes easier when the consumers' prior belief about altruistic CSR is sufficiently low, because then opportunistic firms do not have much to gain from pretending to be altruistic. For the same reason, separation also becomes easier when the reward for altruistic CSR is low and when the penalty for opportunistic CSR is high. Interestingly, we show that while rewarding CSR is effective at stimulating separation, it may also have the perverse effect of pooling different types of CSR.

In addition, we derive conditions under which a reward reduction is more effective at leading to separation than a penalty increase. Contrary to what might be expected, the two instruments are not symmetrically effective, which confirms our second research hypothesis. When the penalty is high (as compared with demand magnitude), a reward reduction is more effective than increasing the penalty even further, so, to assure that CSR conveys more information about the firm's nature, consumers are advised to reduce the benefits they give to altruistic CSR. On the one hand, this consumers' response harms the altruistic companies' profits by contracting the demand they face; on the other hand, however, by increasing the likelihood that the altruistic companies are correctly perceived, their profits may eventually end up increasing. For intermediate levels of the penalty the answer as to the most effective instrument is not as straightforward since it also depends on the current level of the reward. For low penalty levels the answer additionally depends on the *a priori* probability attached by consumers to altruistic CSR, in a way explained in detail in Propositions 4 and 5. To the best of our knowledge this is the first time that this asymmetry is shown to exist.

Our results help companies to improve their CSR decisions, by understanding how consumers solve the information asymmetry regarding the true nature of these investments and open the door to future experimental testing. It would be interesting, for instance, to test whether consumers opt for a penalty increase or a reward reduction as uncertainty about the nature of the observed CSR activity varies (the *a priori* belief). Namely, if that choice is dependent on the penalty or reward levels currently employed, and if consumers choose these instruments interchangeably, admitting different approaches to rewards and penalties (additive, multiplicative, other). This would be an interesting complement to the current article.

Schlegelmilch and Pollach (2005) research suggested that corporate ethics, corporate communication, and corporate image should be aligned, and that companies should adjust their messages as they change their business conduct, so that public perceptions fairly reflect corporate behaviour. Our whole analysis is based on consumers being able to observe firms' CSR effort, that is, full disclosure. However, too much proactive disclosure may refrain consumers from believing that firms are acting in an altruistic way or induce suspicions of opportunistic disclosure while misreporting on issues such as child labour (e.g., Arena *et al.* (2018)). Hence, altruistic firms must balance the benefits from disclosing and increasing the likelihood of separation with the risks of being taken for opportunistic. Further research may enlighten this trade-off.

Finally, the model developed in the current article applies to socially responsible consumers who react to CSR initiatives. But not all consumers are socially responsible. At least some may simply pretend to be. Another interesting extension would hence admit two types of consumers - socially and not socially responsible - besides the two types of firms.

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ORCID

Margarida Catalão-Lopes http://orcid.org/0000-0003-0849-6568
Joaquim P. Pina https://orcid.org/0000-0001-7234-3799
Ana S. Costa https://orcid.org/0000-0002-7618-8578

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ANNEX

Evidence from polls

Poll	Sample	Prosocial behaviour
Ipsos MORI, 2000, "Ethical Consumerism Research" (http://www.ipsos-mori.com/researchpublications/researcharchive/1496/Ethical-Consumerism-Research.aspx)	1970 interviews in 151 sampling points, between 18 and 22 May 200, to British public aged 15 and over.	- recommend a company, choose product, 51%; - avoid products, 44%; - buy product, 29%; - actively seek information, 24%; - felt guilty, 17%; - actively campaigned, 15%.
Ipsos MORI, 2003, "Ethical Companies" (http://www.ipsos-mori.com/researchpublications/rese	2026 interviews in 161 sampling points, between 7 July and 11 August 2003, to British public aged 16 and over.	- availability of more information influences consumer behaviour, 74%; - buy product (because charity link), 29%;

Poll	Sample	Prosocial behaviour
archarchive/849/Ethical-Companies.aspx)		- boycott products, 17%; - choose product, 14%; - seek information, 5%; - invest, 4%.
Ipsos MORI, 2008, "Climate Change — The Expected Role for Business" (http://www.ipsos-mori.com/researchpublications/researcharchive/2343/Climate-Change-The-Expected-Role-for-Business.aspx)	975 interviews, June 2006, all British public.	- foreseen (for companies' behaviour): - concern with environment, 44%; - conserving energy, 29%.
Ipsos MORI, 2009, "Ethical purchasing squeezed by recession, but companies will continue to invest in company responsibility (CR)" (http://www.ipsos-mori.com/researchpublications/researcharchive/2505/Ethical-purchasing-squeezed-by-recession-but-companies-will-continue-to-invest-in-company-responsibility-CR.aspx)	1011 interviews in 157 sampling points, between 4 and 10 September 2009, to British public aged 16 and over.	- buying, 70% or more over last decade; - continue to invest in CSR despite the crisis: - reputation council (within companies), 85%; - corporate responsibility experts, 70%; - Non-Governmental Organizations, 64%; - captains of industry, 57%.
Ipsos MORI, 2014, "Public views on ethical retail" (https://www.ipsos-mori.com/researchpublications/researcharchive/3408/Public-views-on-ethical-retail.aspx)	2,257 public aged over 16, UK, online survey, 13-17 June 2014	- ethical standards matter (83%, of which 49% "a great deal" or "a fair amount") - being ethical requires proof besides telling, 63% - lack of information reliability and intensive advertisement are barriers to buy ethically (24% and 30%, respectively)
Ipsos MORI, 2017, "Over a third of consumers believe social purpose should come before profit" (https://www.ipsos.com/ipsos-mori/en-uk/over-third-consumers-believe-social-purpose-should-come-profit)	1001 adults above 18, UK, 26 May - 9 June	- 48% of consumers prefer businesses that behave ethically - 37% consider that businesses should put social drive before profits
Ipsos Global Trends Survey, 2017, "Just how much do sustainability and brand purpose matter?" (https://www.ipsosglobaltrends.com/just-how-much-do-sustainability-and-brand-purpose-matter/)	18180 adults from 23 countries, online, 12 September – 11 October 2016	- 67% of people agree on the higher importance that chosen brands make positive contributions to society - social media amplifies reputation problems from unethical practice or accidents, wherever they take place
Ipsos Global Advisor Poll, November 2019, "A Throwaway	19515 online adults across 28 countries, 26 July 26 – 9 August 2019	- 77% UK citizens and 75% global respondents say they would feel better about a brand

Poll	Sample	Prosocial behaviour
World: the challenge of plastic packaging and waste" (https://www.ipsos.com/ipsos-mori/en-uk/throwaway-world-challenge-plastic-packaging-and-waste)		that makes changes to achieve better environmental outcomes - 80% global respondents consider that manufacturers should be obliged to help with the recycling and reuse of packaging that they produce

Proof of Proposition 1: Given that the participation constraint for the *O* firm is not satisfied, $R^{*O}=0$ and so if consumers observe $R>0$ they infer that the company is *A* (θ is updated to 1) and expand demand to $p=1-q+\delta$. Altruistic firms choose R^{*A} in the interval $(0,(1+\delta)^2/4]$ to maximize U (so taking into account the magnitude of γ), where $(1+\delta)^2/4= E(\pi)$ since θ has been updated to 1. ■

Proof of Proposition 2: Let us start with case ii). Given that the participation constraint for the *O* type is satisfied, consumers try to distinguish altruistic from opportunistic CSR expenditure. We know that $\bar{R}^{O} < \bar{R}^{A}$. Therefore, if the firm chooses $R \geq \bar{R}^{O}$ consumers infer that it is *A*, because the *O* firm would never make such a choice. In this case, the equilibrium is separating. The altruistic firm's profits are equal to $\frac{(1+\delta)^2}{4} - R^{*A}>0$, with R^{*A} increasing in γ. The opportunistic type then chooses the least-cost strategy $R^{*O}=0$ for $\mu>0$ and $0<R^{*O}< \bar{R}^{O}$ for $\mu<0$. This proves ii).

In turn, if the firm chooses $0<R^{*}< \bar{R}^{O}$ consumers cannot tell whether it is *A* or *O*. The equilibrium is pooling. The *a priori* probability θ remains unaltered, so the firm earns $\frac{\theta(1+\delta)^2+(1-\theta)(1-\mu)^2}{4} - R^{*}$, with $R^{*}=R^{*A}=R^{*O}$. Note that choosing $R^{*}=0$ is a dominated strategy for the *O* company, because it will be perceived as such and earn $¼< E_R(\pi)-R^{*O}$, since the *A* company always performs a positive level of CSR. Both types choose positive levels of CSR. This proves i). ■

Proof of Proposition 3: Immediate, by considering the appropriate derivatives and considering the effect on θ:

i) The variation is monotone, as a change in δ implies an opposite sign change in θ^{*}. Hence, even if δ falls, the relative size of the separation area enlarges and may eventually become 1 (a shift from the results of Proposition 2 to the results of Proposition 1).

ii) The variation is monotone, as a change in μ implies a change in θ^{*} with the same sign. Hence, even if μ rises, the relative size of the separation area enlarges, and may eventually become 1 (a shift from the results of Proposition 2 to the results of Proposition 1).

iii) The variation is monotone. Even in case θ rises, the relative size of the separation area enlarges, and may eventually become 1 (a shift from the results of Proposition 2 to the results of Proposition 1). ■

Proof of Propositions 4 and 5: Let us compare the effects of a reward reduction and a penalty increase (so for the cases where $\mu>0$) on the relative magnitude of area II in Figure no. 2, which is defined by $S=\frac{\frac{(1+\delta)^2}{4}-\frac{\theta(1+\delta)^2+(1-\theta)(1-\mu)^2-1}{4}}{\frac{(1+\delta)^2}{4}}$. It is easy to see that $\frac{\partial S}{\partial \delta}=\frac{-2[\theta(1-\mu)^2+\mu(2-\mu)]}{(1+\delta)^3}<0$, $\frac{\partial S}{\partial \mu}=\frac{2[(1-\mu)(1-\theta)]}{(1+\delta)^2}>0$ and $\left|\frac{\partial S}{\partial \delta}\right|-\frac{\partial S}{\partial \mu}=\frac{(1-\theta)(3\mu-\delta+\mu\delta-\mu^2)+2\theta-1}{(1+\delta)^3}$. The sign of $\left|\frac{\partial S}{\partial \delta}\right|-\frac{\partial S}{\partial \mu}$ depends on δ, μ and θ as the following expression shows: $\left|\frac{\partial S}{\partial \delta}\right|-\frac{\partial S}{\partial \mu}>0 \Leftrightarrow (1-\theta)(3\mu-\delta+\mu\delta-\mu^2)+2\theta-1>0$.

This expression is linearly decreasing in δ, being positive if and only if $\delta<\delta_1=\frac{2\theta-1+\mu(1-\theta)(3-\mu)}{(1-\theta)(1-\mu)}$. However, it is easy to see that $\delta_1>1$ for $\theta>\theta_1=\frac{\mu^2-4\mu+2}{\mu^2-4\mu+3}$, and that $\theta_1<0$ if and only if $\mu>\mu_2=0.586$.

We proceed the proof starting with high penalties ($\mu>\mu_2$), then intermediate ($\mu_1<\mu<\mu_2$), and finally low ($\mu<\mu_1$).

From the above, we conclude that for $\mu_2<\mu<1$ we have $\delta_1>1$ for all θ, which implies that $\left|\frac{\partial S}{\partial \delta}\right|-\frac{\partial S}{\partial \mu}>0$. This proves Proposition 5 iii).

Notice that the denominator of δ_1 is positive for all $0<\theta, \mu<1$, and that the numerator is positive for $\theta>\theta_2=\frac{\mu^2-3\mu+1}{\mu^2-3\mu+2}$. It is easy to see that $\mu^2-3\mu+2>0$ for all $0<\mu<1$, because it is convex in μ and its roots are 1 and 2. It is also easy to see that $\mu^2-3\mu+1>0$ if and only if $0<\mu<\mu_1=0.382$. Hence, for $\mu_1<\mu<\mu_2$ we have $\theta_2<0$, so $\delta_1>0$. This implies Proposition 4 ii) and Proposition 5 ii).

Finally, for $0<\mu<\mu_1$ we have $\theta_2>0$. Therefore, $\delta_1>0$ if and only if $\theta>\theta_2$. Hence, $\theta<\theta_2$ implies that increasing the penalty is always more effective than reducing the reward, which proves Proposition 4 i) a). In turn, $\theta>\theta_2$ implies that the two situations may occur: increasing the penalty is always more effective than reducing the reward if and only if δ is high ($\delta>\delta_1$). This proves Proposition 4 i) b) and Proposition 5 i). ■

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Internet Adoption, Digital Divide, and Corruption: Evidence from ECOWAS Countries

Driss Tsouli*

Abstract: This paper aims to extend the existing literature on Internet adoption and corruption by analyzing the factors impacting the digital divide and assessing the impact of Internet adoption on corruption reduction in the Economic Community of West African States (Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo). The study uses fixed and random effect panel data techniques covering 17 years (2003-2019), to exploit the times series nature of the relationship between the digital divide and its determinants. In addition, it aims to assess the impact of internet adoption along with other control variables on corruption. The estimation results show that per capita income, human capital, age, population density, government effectiveness, political stability, and the rule of law significantly affect the digital divide in ECOWAS. The findings reveal also that internet adoption affects positively the level of corruption control; the impact of an increase in internet users of 1% implies an increase in corruption control between 0.05% and 0.06%.

Keywords: corruption; digital divide; ECOWAS; internet adoption; panel data.

JEL classification: D73; O55; O38.

* OFPPT (Vocational education in Morocco); e-mail: *tsouli.driss@gmail.com*.

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1. INTRODUCTION

Corruption is a worldwide phenomenon that a majority of countries are still failing to tackle effectively (Transparency International, 2019). For instance, on 21 December 2001, the Economic Community of West African States (ECOWAS) signed protocol A/P3/12/01 21 on the fight against corruption in Dakar. Yet, many years later, and in 2019 Transparency International considered West Africa as the lowest-scoring region on the Corruption Perceptions Index (CPI). Except for Cape Verde which is ranked in the first quartile out of 180 countries, all West African countries[1] were and are still at the bottom of the index. This is explained by the fact that this region is truly very far from the international standards in all socio-economic indicators (Ejemeyovwi *et al.*, 2019). Thereby, it is natural to ask how these countries can improve their ranking in the CPI through these indicators.

A growing number of studies have considered corruption as one of the global issues for a long time, which is seriously affecting people, government, civil society, and media, as well as involving anyone from politicians and government officials to business people and citizens. Also, many studies highlighted that corruption is efficient in making other economic activities and social values inefficient. Corruption can weaken the efficiency of the economic system and result in higher poverty rates and income inequality (Gupta *et al.*, 2002; Park & Kim, 2020). In addition, corruption affects social values by lessening public trust and consequently being a hindrance to the legitimacy of institutions (Seligson, 2002; Swaner, 2017).

In this perspective, transparency may play a crucial role in enhancing citizens' trust in institutions by creating an environment of openness that allows people to participate in the decision-making process and monitor the performance of institutions (Grimmelikhuijsen, 2012; Burman *et al.*, 2016). Transparency can be reached by using Information and Communication Technologies (ICT) that are accessible and available to the majority of people to improve accountability (Lnenicka & Nikiforova, 2021).

The emergence of computers, and the rapid growth of the Internet and mobile phones, allow institutions to enhance their transparency. From this point, ICT has played two key roles. First, they mitigate the interaction between citizens and government officials and consequently slash the discretionary power of government officials (Elbahnasawy, 2014). Second, ICT makes easier the dissemination of information on corruption (Goel *et al.*, 2012). Nowadays, the speed of information dissemination is heavily reliant on the use of the Internet by citizens, businesses, and institutions. This was supported by the spread of several easy ways of sharing information in real-time (e.g., Social media networks).

However, the use of the internet and other tools of ICT in many countries are significantly linked to many obstacles such as the digital divide; lack of legal bases; lack of policy cycle management; lack of measurement and evaluation; lack of citizens' participation; and lack of trust and transparency (Savoldelli *et al.*, 2014). The digital divide is one of the most important obstacles (Gounopoulos *et al.*, 2020)**,** and it is qualified as a new face of inequality and disparity in the use of Information and Communication Technologies (Szeles, 2018; Elena-Bucea *et al.*, 2021). The consequence is only 18 percent of the population in Africa has internet access compared to 56.7 percent in the world (International Telecommunication Union, 2020).

The objective of this study is to contribute to the understanding of the role of ICT on corruption in 15 ECOWAS economies using panel data for the period 2003-2019, by analyzing factors impacting the digital divide and assessing the impact of internet adoption

on corruption reduction. For achieving this objective, two questions are addressed: first, what are the important determinants that significantly impact the digital divide in the ECOWAS? Second, does ICT affect corruption in these countries? This study contributes to the existing literature in two major ways: First, studies have concentrated on European, Asiatic, Latin American, and, sub-Saharan African countries, this study will therefore extend the results on the corruption-ICT nexus to the developing setting, especially ECOWAS that is prone to a high level of corruption. Second, previous studies had studied corruption-ICT without including determinants of the digital divide, this study assesses the impact of ICT on corruption reduction along with determinants of the digital divide. In this perspective, this research fills this gap by re-investigating which drivers of the digital divide impact e-government in the ECOWAS by integrating macroeconomic factors. In addition, this study explores the impact of ICT on corruption reduction in ECOWAS.

Despite the existence of several studies about the corruption-ICT nexus in Africa, there is a dearth of studies covering regional economic communities (RECs). So, it is crucial to focus on studies targeting regions such as ECOWAS, AMU, EAC, SADC, and so on.

This paper is organized as follows: Section 2 reviews related literature review. Section 3 reveals data and the empirical model. Section 4 presents results and discussions and Section 5 concludes with some policy implications.

2. LITERATURE REVIEW

2.1 Digital Divide and ICT

According to UNESCO[2]: "Digital divide refers to the distinction between those who have internet access and can make use of new services offered on the World Wide Web, and those who are excluded from these services". In the same way, the Organization for Economic Co-operation and Development (OECD) provides a more detailed definition of the digital divide: "The gap between individuals, households, businesses, and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities" (Van Panhuys *et al.*, 1968).

Despite the rapid evolution and the strong trend in digital indicators in the world, Africa is marginalized in terms of digital penetration and it has a higher digital divide around the globe. The majority of people who don't have access to digital channels such as the Internet, mobile telephony, and fixed phone are located in the African continent (Mignamissi & Djijo T, 2021). This is mainly explained by a lack of telecom infrastructure (Mutula, 2008; International Telecommunication Union, 2020).

Researchers exploring the digital divide by using different approaches and many dimensions have found that gender, age, education, income, location, population density, government effectiveness, political stability, and rule of law are the main causes of the digital divide (Table no. 1). Older, less educated, and poor people have would have more difficulties in access to digital channels than younger, educated, and rich people (van Deursen *et al.*, 2015; Botrić & Božić, 2021; Myovella *et al.*, 2021). Furthermore, a recent study conducted by Lembani *et al.* (2020), sheds light that students who lived in rural areas have more difficulties in open-distance learning than those who live in urban areas due to the problem of access to digital technologies. This is justified by the concentration of internet service providers in

urban areas and by the availability of public internet access in these areas than the rural areas (Okunola *et al.*, 2017). Yet other researchers, have pointed out that the digital divide is a consequence of a lack of the skills to use technology, called: digital skills (Gounopoulos *et al.*, 2020; Niyigena *et al.*, 2020; Maji & Laha, 2022). Moreover, other strands of literature have revealed other variables such as the cost of the internet, access to electricity, ethnicity, societal openness, civilian liberties, political rights governance, and R&D expenditure that explain the digital disparities (Chinn & Fairlie, 2006; J. B. Pick *et al.*, 2015; Krishnan *et al.*, 2017; Ma, 2018; Szeles, 2018; J. Pick *et al.*, 2021). According to Song *et al.* (2020), there are three levels of the digital divide: the first level is about ICT access, and it is measured by: computer penetration, mobile phone penetration, and internet access price. The second level is ICT use, which is measured by "Internet users per capita", broadband subscribers per capita, and time online. The third level is linked to ICT outcomes, it is measured by the E-commerce economy, online shopping benefits, online learning outcomes, and E-government. Concerning this study, the second level is adopted and consequently, the digital divide will be measured by the "Internet users per capita" indicator (Milner, 2006; F. Zhao *et al.*, 2014; Elena-Bucea *et al.*, 2021; Myovella *et al.*, 2021).

Table no. 1 - Some selected Studies that support the chosen determinants of the digital divide

Variables	Studies
GDP per capita	Bagchi (2005); Dasgupta *et al.* (2005); Chinn and Fairlie (2006); F. Zhao *et al.* (2014); Weiss *et al.* (2015); Nishijima *et al.* (2017); Pérez-Morote *et al.* (2020); Myovella *et al.* (2021)
Human capital index	Adam (2020); Pérez-Morote *et al.* (2020); Maji and Laha (2022)
Population age	Chinn and Fairlie (2006); F. Zhao *et al.* (2014); Nishijima *et al.* (2017); Pérez-Morote *et al.* (2020)
Rural population	Chinn and Fairlie (2006); Milner (2006); Nishijima *et al.* (2017); Pérez-Morote *et al.* (2020)
Population density	Nishijima *et al.* (2017); Botrić and Božić (2021)
Government effectiveness	Dasgupta *et al.* (2005); Wijers (2010); F. Zhao *et al.* (2014)
Political stability	Dasgupta *et al.* (2005); Wijers (2010); Adam (2020); Myovella *et al.* (2021)
Rule of law	Dasgupta *et al.* (2005); Chinn and Fairlie (2006); Wijers (2010); Weiss *et al.* (2015); J. Wang *et al.* (2019)

To sum up, studies about the digital divide have focused mainly on two categories of disparities: the domestic digital divide and the international digital divide (Maji & Laha, 2022). The domestic digital divide is about disparities at the micro-level (individual, state, district, and city), and the international digital divide is related to disparities among countries. This research fits with this second category, in the context of the ECOWAS for the reason that there is scanty literature on unearthing the role of socio-economic factors (along with other important factors) to explain the digital divide in this region.

2.2 ICT and corruption

As previously indicated, it is imperative to explore the underlying positive implications of ICT in the context of ECOWAS, particularly considering the disparities at the corruption level across the member nations. The literature on ICT and corruption draws a direct

association between various determinants such as economic, political, technological, societal, and cultural factors, amongst others. In this regard, the present section reviews ICT and the issues associated with corruption from a macroeconomic perspective. Empirical studies find both direct and indirect impacts of e-government on corruption reduction (Table no. 2). For instance, a study conducted by Adam (2020) investigated whether e-government facilities would alleviate corruption through the mediating role of ICT and institutional quality. The author used secondary data from various sources. The result shows that ICT and institutional quality play the role of mediators between e-government and corruption. Yet, the direct effect of ICT on corruption has not been found. Another study based on data from 133 countries by L. Wang *et al.* (2022) also proves a non-linear relationship between ICT and corruption. But, the ICT infrastructure moderates this relationship. Similarly, Park and Kim (2020) by using longitudinal data from 2003 to 2016 across 214 countries, found that the rule of law moderates the relationship between ICT and corruption. Focusing on 120 economies over four years, a recent study by Alsaad (2022), has found an indirect effect of ICT on corruption through the variable of the enforcement of the law.

Table no. 2 – Some selected studies that support the chosen variables in the corruption-internet adoption nexus

Variables	Studies
Control of corruption	Lio *et al.* (2011); X. Zhao and Xu (2015); Lee *et al.* (2018); Nam (2018); Androniceanu and Georgescu (2021); Darusalam *et al.* (2021); Ali *et al.* (2022)
Internet users	Lio *et al.* (2011); Lee *et al.* (2018); Darusalam *et al.* (2021); Setor *et al.* (2021)
Voice and accountability	X. Zhao and Xu (2015); Lee *et al.* (2018)
Political stability	X. Zhao and Xu (2015); Androniceanu and Georgescu (2021)
Government effectiveness	X. Zhao and Xu (2015); Nam (2018); Androniceanu and Georgescu (2021); Darusalam *et al.* (2021); Ali *et al.* (2022)
Rule of law	X. Zhao and Xu (2015); Lee *et al.* (2018); Nam (2018)
Human capital index	Lio *et al.* (2011); X. Zhao and Xu (2015); Darusalam *et al.* (2021); Ali *et al.* (2022)
E-participation index	Lee *et al.* (2018); Androniceanu and Georgescu (2021)
GDP per capita	Lio *et al.* (2011); X. Zhao and Xu (2015); Darusalam *et al.* (2021); Setor *et al.* (2021)
Population density	X. Zhao and Xu (2015); Lee *et al.* (2018)
Rural population	X. Zhao and Xu (2015); Adam (2020)

Other strands of literature explored the direct effect of ICT on corruption. In this context, a recent study conducted by Ali *et al.* (2022), provided regional evidence from four South Asian countries spanning the period 2003-2018. The study revealed that ICT has a significant positive impact on corruption reduction, along with press government effectiveness and education. Mouna *et al.* (2020), by investigating the impact of corruption on economic growth for a sample of 149 countries from 2012 to 2016, have found that corruption has a weak impact on economic growth for countries with a high level of technology adoption. Using panel data from 57 countries H. Zhao *et al.* (2021), found a weak and positive impact of e-government development and corruption but this impact changes according to cultural factors. Similarly, a study by Nam (2018), which covered 179 countries, extended the ICT-corruption nexus by

exploring factors that impact the level of corruption control by considering political, economic, and cultural differences. The empirical analysis suggests that cross-country disparities in political, economic, and cultural conditions affect the impact of e-government on corruption. Focusing on the ASEAN countries from 1984 to 2016, Darusalam *et al.* (2021) investigated whether ICT development influences the control of corruption. Results show that ICT alone cannot reduce corruption but it needs to be complemented by institutional measures and education. Another study by X. Zhao and Xu (2015), made similar research by examining whether e-government reduces corruption across 80 countries from 2003 to 2010. The findings reveal that a low level of corruption is correlated with e-government development as well as other factors such as government effectiveness, gender ratio, and government size. Androniceanu and Georgescu (2021) studied the relationship between e-government and corruption covering 27 European countries for the period 2010-2019. The result reveals that countries with a high level of ICT implementation have a low level of corruption. In light of the above studies, it is clearly expressed that ICT along with other factors reduces corruption.

This research adds some evidence to the literature in the context of ECOWAS by examining the theoretical links, and whether factors that drive internet adoption will contribute to reducing corruption.

3. DATA AND EMPIRICAL MODEL

Based on the literature review, this section presents an econometric model to examine the determinants of the digital divide, and the impact of internet adoption on the alleviation of corruption in ECOWAS.

3.1 Empirical model and estimation technique

For answering the main research questions in this paper, three regression techniques were run (Fixed-Effects, Random Effects, and Double Least Squares). First, is the test of factors impacting the digital divide in ECOWAS. “Internet users per capita” was used as a measurement of the digital divide. After testing the factors of the digital divide, the assessment of the impact of internet adoption in reducing corruption is performed. Internet adoption was also measured by “Internet users per capita” indicators. For the analysis, we used the statistical software STATA version 17.

Based on the multicollinearity test[3] (Table no. 4), two models are employed for modelling the determinants of the digital divide and the relationship between internet adoption and corruption. Due to the endogeneity problem of the OLS method, two techniques of estimation (Fixed effects and random effects). According to the literature, the fixed effects regression is chosen for two reasons: first, it is considered the ultimate way of analyzing countries with different data levels and time-series variation. Second, the fixed effect regression can improve the bias emerging from unobserved heterogeneity (Myovella *et al.*, 2021). The random-effects regression supposes exogeneity of independent variables, but the errors of independent variables may be correlated.

Concerning the econometric analysis, the fixed effect is selected, based on the Hausman specification test. If the p-value is less than 0.05, the null hypothesis is rejected and the fixed effect technique is needed for the analysis. However and according to Arellano and Bond (1991), the random effects and the fixed effects regressions are biased due to autocorrelation and

heteroscedasticity problems. In this perspective, and to avoid any potential problem of endogeneity in the results, the literature suggests the use of the instrumental variable method in particular the Fully Modified Ordinary Least Squares (FMOLS) and Generalized Moments Method (GMM) of Blundell and Bond (1998). However, GMM is recommended when the number of individuals is greater than the number of periods. In our case, the number of periods is high than the number of individuals, consequently, the FMOLS is employed as a robustness test.

The FMOLS allowed us to correct for heteroscedasticity, and endogeneity bias and, above all, to check whether the results are still valid when the regression techniques are changed (Yang *et al.*, 2017).

Based on the literature review the construction of the econometric model is presented below. For determining the crucial factors that influence the digital divide in ECOWAS, the following econometric model is employed:

$$lnINU_{it} = \alpha_0 + \beta_1 lnGDPC_{it} + \beta_2 lnHCI_{it} + \beta_3 lnPOA_{it} + \beta_4 lnRUP_{it} + \beta_5 lnPOD_{it} + \beta_6 VOA_{it} + \beta_7 GOE_{it} + \beta_8 POS_{it} + \beta_9 RUL_{it} + \alpha_i + e_{it}. \quad (1)$$

where lnINU = log of internet users, lnGDPC = log of per capita real GDP, lnHCI = log of human capital index, lnPOA = log of total population, lnRUP = log of rural population, lnPOD = log of population density, lnGEN = log of gender ratio, VOA= Voice and accountability, GOE = government effectiveness ,POS =political stability and absence of violence, RUL= rule of law, i = 1,2,3,… 255 country, t = 1,2,3,… 15 time period, α_i = the unobserved effects for i^{th} country observation, and e_{it}= the idiosyncratic error term for i^{th} country on the t^{th} year. We except that: per capita income, human capital index, population size, population density, gender ratio, voice and accountability, government effectiveness, political stability, and rule of law are positively associated with internet users, whereas the rural population is expected to have a negative relationship with internet users.

To analyze the impact of internet adoption on corruption in ECOWAS, the following econometric model is specified:

$$COR_{it} = \alpha_0 + ln\beta_1 lnINU_{it} + \beta_2 VOA_{it} + \beta_3 POS_{it} + \beta_4 GOE_{it} + \beta_5 RUL_{it} + \beta_6 lnHCI_{it} + \beta_7 lnEPI_{it} + \beta_8 lnGDPC_{it} + \beta_8 lnPOD_{it} + \beta_9 lnPOA_{it} + \beta_{10} lnRUP_{it} + \alpha_i + e_{it} \quad (2)$$

where COR = control of corruption, lnEPI = log of E-participation index, and the other specifications are similar to the econometric model (1). Here, internet users is expected to be positively associated with control of corruption because higher access to internet services helps the government to share information and to deliver better services to citizens and businesses. The other specifications are expected to have a positive relationship with the control of corruption to the above equations. Except for the rural population which is expected to have a negative impact on the control of corruption.

3.2 Data and variables

This research aims to investigate the relationship between E-government and Corruption. For this purpose, the empirical analysis uses a cross-sectional and longitudinal study on data spanning the period 2003–2019, collected for 15 ECOWAS member states[4]. By using the linear interpolation technique for dealing with missing data, these data become a

balanced panel since the countries in the sample have the same number of time-series observations. The values of both the dependent and independent variables were sourced from secondary sources. The variables selected for this study were selected based on previous studies and the availability of data. Table no. 3 shows the variables used in this empirical section, as well as their measurements and sources.

Table no. 3 – Variables, measurement, and data source

Variables	Measurement	Data source
E-participation Index (EPI)	It is focused on the use of online services to facilitate the provision of information by governments to citizens.	UN E-government knowledge-base
Human Capital Index (HCI)	It consists of four components: (i) adult literacy rate; (ii) the combined primary; secondary and tertiary gross enrolment ratio; (iii) expected years of schooling; and (iv) average years of schooling	
GDP per capita (GDPC)	It is gross domestic product divided by midyear population. Data are in current U.S. dollars.	World Development Indicators
Population Age (POA)	The total population between the ages of 15 to 64 is a percentage of the total population.	
Rural Population (RUP)	It refers to people living in rural areas. It is calculated as the difference between the total population and the urban population.	
Rule of Law (RUL)	It reflects the extent to which agents have abided by the rules of society (estimate ranges from − 2.5 (weak) to 2.5 (strong))	
Political stability and absence of violence (POS)	It measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism (estimate ranges from − 2.5 (weak) to 2.5 (strong))	
Voice and Accountability (VOA)	Perceptions of the extent to which a country's citizens can participate in selecting their government (estimate ranges from − 2.5 (weak) to 2.5 (strong))	
Internet Users (INU)	They are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, or digital TV.	
Control of Corruption (COR)	it captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption (estimate ranges from − 2.5 (high level of corruption) to 2.5 (low level of corruption))	
Population Density (POD)	It is a midyear population divided by land area in square kilometers.	
Government Effectiveness GOE	Perceptions of the quality of public services, and the degree of its independence from political pressures (estimate ranges from − 2.5 (weak) to 2.5 (strong))	

Table no. 4 – Multicollinearity test

	EPI	HCI	GDPC	POA	RUP	RUL	POS	VOA	INU	COR	POD	GOE
EPI	1.000											
HCI	-0.037	1.000										
GDPC	0.443***	0.426***	1.000									
POA	0.334***	0.687***	0..603***	1.000								
RUP	-0.236***	-0.661***	-0.639***	-0.775***	1.000							
RUL	0.273***	0.174***	0.464***	0.422***	-0.402***	1.000						
POS	0.117	0.328***	0.498***	0.378***	-0.362***	0.452***	1.000					
VOA	0.339***	0.150**	0.467***	0.478***	-0.343***	0.813***	0.504***	1.000				
INU	0.664***	0.173***	0.728***	0.510***	-0.604***	0.347***	0.209*	0.309***	1.000			
COR	0.298***	0.196***	0.505***	0.516***	-0.448***	0.907***	0.552***	0.783***	0.360***	1.000		
POD	0.198***	0.622***	0.483***	0.626***	-0.643***	0.146**	0.031	0.024	0.492***	0.158**	1.000	
GOE	0.239***	0.148**	0.535***	0.366***	-0.370***	0.882***	0.316***	0.742***	0.308***	0.852***	0.161***	1.00

Notes: ***, **, and * refer to significance at 1%, 5% and 10%, respectively.
Source: author compilation

4. RESULTS AND DISCUSSION

This section shows the empirical finding and discussions. First, it presents the results on the crucial factors that impact the digital divide in ECOWAS. Second, it reports the results on the influence of internet adoption on corruption reduction.

Table no. 5 presents the descriptive statistics of the data used for the econometric models. From this table, we can notice that the standard deviation compared to the mean is high for corruption, internet users, political stability, and voice and accountability variables. This indicates that it is inequality among ECOWAS at the level of corruption, internet adoption, political stability, and accountability. For other variables, we can observe that there is no disparity because the standard deviation is less than their mean values.

Table no. 5 – Descriptive statistics

	Obs.	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
EPI	255	0.14	0.14	0	0.63	1.32	4.05
HCI	255	0.38	0.15	0	0.78	0.17	2.92
GDPC	255	1050.88	788.50	243.08	3740.37	1.77	5.61
POA	255	53.55	3.46	47.18	66.89	1.29	6.42
RUP	255	58.13	11.39	33.80	83.79	0.40	3.15
RUL	255	-0.65	0.52	-1.64	0.65	0.43	2.75
POS	255	-0.53	0.79	-2.40	1.03	-0.43	2.47
VOA	255	-0.31	0.59	-1.46	0.979	0.20	2.42
INU	255	10.55	12.85	0.03	61.94	1.74	5.67
COR	255	-0.61	0.52	-1.55	0.95	1.12	4.44
POD	255	83.98	52.40	9.82	231.98	0.72	2.98
GOE	255	-0.79	0.45	-1.760	0.353	0.400	2.484

Source: author compilation

The Pesaran LM test reveals the presence of cross-sectional dependency, as the null hypothesis for all variables is rejected at the 1% level of significance (Table no. 6).

Table no. 6 – Cross-sectional dependence

	Pesaran LM
EPI	73.69***
HCI	48.62***
GDPC	72.40***
POA	74.08***
RUP	105.45***
RUL	19.48***
POS	19.43***
VOA	23.56***
INU	100.03***
COR	15.56***
POD	115.55***
GOE	8.16***

Source: author compilation

Moreover, the results reveal that variables HCI, RUL, POS, VOA, and GOE are stationary at a level. When the first difference is added, all the variables become stationary (Table no. 7). Hence, all the variables are incorporated in order I(1).

Table no. 7 – Panel unit root test Im, Pesaran, and Shin (CIPS)

Variables	Level		First difference		Order of integration
	Constant	Constant and trend	Constant	Constant and trend	
EPI	3.71	-1.74**	-7.13***	-4.49***	I (1)
HCI	-3.61***	-2.13**	-	-	I (0)
GDPC	-0.78	1.09	-9.11***	-6.99***	I (1)
POA	5.73	4.94	1.21	-3.06***	I (1)
RUP	13.39	7.97	-9.01	-6.06***	I (1)
RUL	-3.54***	-2.87***	-	-	I (0)
POS	-3.00***	-2.15***	-	-	I (0)
VOA	-1.25	-3.95***	-	-	I (0)
INU	26.05	17.04	4.52	-2.61***	I (1)
COR	-1.86**	-1.02	-8.65***	-6.24***	I (1)
POD	15.71	2.25	-4.16***	-11.78***	I (1)
GOE	-2.66***	-3.15***	-	-	I (0)

Notes: ***, **, and * refer to significance at 1%, 5% and 10%, respectively.
Source: author compilation

The results of the Kao (1999) cointegration test, which is conducted to test the association among the variables in the long run. The test has a null hypothesis of no cointegration. The results indicate that the null hypothesis is rejected at the 1% and 5% level of significance, revealing the long-run relationship among the variables for the four models of this study (Table no. 8).

Table no. 8 – Kao cointegration test

Models	**1**	**2**	**3**	**4**
T-statistic	-4.081***	-3.913***	-2.146**	-2.097**

Notes: ***, **, and * refer to significance at 1%, 5% and 10%, respectively.
Source: author compilation

4.1 Results on the determinants of the digital divide

The two models tested by fixed effect and FMOLS regressions indicate that per capita income, human capital, age, population density, government effectiveness, political stability, and the rule of law are the determinants of the digital divide in ECOWAS (Table no. 9). Per capita income has a significant and positive impact on internet use. This implies that high income allows people to have internet access. The impact is between 0.66% and 0.54%. This means that when per capita income grows by 1% enlarges users of the internet between 0.66% and 0.54%. This result is consistent with Botrić and Božić (2021); Myovella *et al.* (2021).

Table no. 9 – Determinants of the digital divide

Dependent variable: lnINU	FE		RE		FMOLS	
Independent variables	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
lnGDPC	0.663***	0.540***	1.460***	1.387***	0.803***	0.641***
lnHCI	-0.387***	-0.373***	-1.900***	-1.977***	-0.422**	-0.350*
lnPOA	9.542***	9.625***	4.875***	5.441***	11.766***	12.038***
lnRUP	2.011	1.804	-3.510	-3.688	2.711	2.860
lnPOD	6.961***	6.893***	0.863***	0.857***	6.712***	6.969***
VOA	0.151	-	0.506	-	-0.109	-
GOE	-0.200	-	-0.778***	-	-0.382	-
POS	0.062	-0.075***	-0.202***	-0.271**	0.075	-0.085
RUL	-	0.686***	-	0.318	-	0.651**
Cons	-78.305***	-76.607***	-19.643*	-20.102*	-	-
R-squared	0.910	0.915	0.818	0.816	0.937	0.939
No. of obs.	250	250	250	250	236	236
No. of groups	15	15	15	15	15	15
Prob.>F	0.000	0.000	0.000	0.000	-	-
Hausman test	441.97	289.96	-	-	-	-
Prob (Hausman test)	0.000	0.000	-	-	-	-

Notes: ***, **, and * refer to significance at 1%, 5%, and 10%, respectively.
Source: author compilation

Another finding is that the human capital index shows a significant negative impact on internet adoption, although the expected sign was positive. It can be explained by the low qualification of human capital in this region. This finding is not consistent with van Deursen *et al.* (2015); Botrić and Božić (2021); Myovella *et al.* (2021). Population age is another determinant of internet adoption. The influence of this variable is significant and positive. The coefficient is between 9.54% and 9.62%. This suggests that a rise of 1% in this population segment leads to expand the number of internet users between 9.54% and 9.62%. This enhances the argument that younger people use more internet than others. This result is similar to Elena-Bucea *et al.* (2021).

Population density is another factor that affects the digital divide in ECOWAS. The estimate shows a significant and positive impact on users of the internet. The interpretation is that people in dense areas use more internet services to save time commuting. this finding is similar to Botrić and Božić (2021). Government effectiveness and political stability are important to explain the digital divide. It is widely proven that the quality of government

policy, political stability, and no violence play a crucial role in the development of the internet across the world. However, our estimates indicate a negative effect of government effectiveness and political stability on internet adoption in ECOWAS. This suggests that internet users is affected by the low level of institutional quality and political stability in this region. The possible explanation is because of politicians who have a short-term vision, and focus their effort on investment with a rapid impact to win another mandate. While investment in telecom infrastructures needs huge budgets and their impact is not clear in the short term. This result is consistent with Myovella *et al.* (2021).

The impact of Rule of law is significant and positive on internet adoption. This shows that an increase of 1% affects the number of internet users by 0.68%. This implies that there is an improvement in the application of law equally to citizens and legal transparency. The possible explanation is that countries with high rule of law index are more interested in the digitalization of the justice system and people are using internet services to be engaged in this judicial system.

For the rural population, voice and accountability variables their impact on internet users is not significant statistically. The estimates following the FE are in contradiction with the FMOLS estimates.

4.2 Results on the impact of internet adoption on corruption

Table no. 10 presents the findings of the cross-section panel data models. Based on the Hausman test, model 1 is compiled with the fixed effect method while model 2 follows the random effect compilation. For the robustness check, we use the FMOLS method for avoiding the endogeneity problem of the FE and RE methods. The coefficient of internet users is significant and positive in both models. Hence, an enlargement in internet users in ECOWAS leads to a higher perception of corruption control. This suggests that an increase of 1% in internet users increases control of corruption by 0.05% and 0.06%. This weak impact is an indication of the poor level of telecom infrastructure and factors of the digital divide in ECOWAS countries. This finding is in line with the findings of Lio *et al.* (2011); X. Zhao and Xu (2015); Lee *et al.* (2018); Nam (2018); Androniceanu and Georgescu (2021); Darusalam *et al.* (2021); Setor *et al.* (2021); Ali *et al.* (2022). This result is robust with the FMOLS estimates.

The coefficient of voice and accountability is positively signed and achieves statistical significance at the 1% level. Invariably, a higher level of freedom of expression and involvement of citizens in governmental decisions leads to a high level of corruption control. An increase of 1% in voice and accountability stimulates corruption control by 0.22%. The estimate of government effectiveness has a positive sign and is significant at the 1% level. Thus, a higher perception of the quality of public services, as well as the degree of its independence from political pressures contributes significantly to increasing the perception of corruption control. A 1% rise in government effectiveness enhances corruption control by 0.48% and 0.53%. Rule of law shows a positive and significant impact on controlling corruption. This suggests that the intensification of law enforcement and the enhancement of the legal system increase the perception of corruption control. These findings are similar to X. Zhao and Xu (2015); Nam (2018); Androniceanu and Georgescu (2021); Darusalam *et al.* (2021); Ali *et al.* (2022). These results are robust with the FMOLS estimates.

Human capital is another variable that alleviates the level of corruption in the ECOWAS. The estimate is significant at 10% and it indicates that a rise of 1% in this index leads to an improvement in the control of corruption by 0.09%. This indicates that the educated public

can detect the violation of law and unethical practices, for this reason, education can be a powerful tool for tackling corruption in this region. This finding is consistent with Lio *et al.* (2011); X. Zhao and Xu (2015); Darusalam *et al.* (2021); Ali *et al.* (2022). For the robustness check, the FMOLS estimator shows also a positive and significant impact.

Other control variables such as political stability, E-participation index, per capita income, population density, and rural population are not significant statistically and the estimates are not robust with the FMOLS regression. Consequently, they are not impacting corruption in this study.

Table no. 10 – Impact of internet adoption on corruption

Dependent variable: COR	FE		RE		FMOLS	
Independent variables	Model 3	Model 4	Model 3	Model 4	Model 3	Model 4
lnINU	0.058***	0.078***	0.054**	0.061***	0.052*	0.087***
VOA		0.229***	-	0.227***	-	0.319***
POS	-0.016	-0.018	-0.017	-0.004	-0.018	-0.002
GOE	0.481***	0.503***	0.482***	0.539***	0.401***	0.443***
RUL	0.315***	-	0.359***	-	0.468***	-
lnHCI	0.064	0.083	0.056	0.092*	-0.136**	0.179***
lnEPI	-0.012	-0.021	-0.010	-0.025*	-0.031	-0.036
lnGDPC	-0.061	-0.031	-0.058	-0.033	-0.131	-0.080
lnPOD	-0.010	-0.206	0.068	-0.062	0.333	0.126
lnRUP	-0.206	-0.029	-0.363	-0.107	0.654	0.404
Constant	1.203	0.639	2.096*	0.650	-	-
R-squared	0.522	0.521	0.520	0.519	0.961	0.961
No. of obs.	225	225	225	225	194	194
No. of groups	15	15	15	15	15	15
Prob.>F	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test	385.10	-	-	7.53	-	-
Prob (Hausman test)	0.000	-	-	0.674	-	-

Notes: ***, **, and * refer to significance at 1%, 5%, and 10%, respectively.
Source: author compilation

5. CONCLUSIONS

The core aim of this study is to reinvestigate the role of ICT on corruption in 15 ECOWAS economies using panel data for the period 2003-2019, by analyzing factors impacting the digital divide and assessing the impact of internet adoption on corruption reduction. To answer some key questions regarding the role of ICT, the factors that significantly affect internet adoption were examined. Empirical results confirm the importance of per capita income, human capital, age, population density, government effectiveness, political stability, and rule of law affecting the digital divide in ECOWAS. Then the test of the impact of internet adoption on corruption for ECOWAS was performed. The results indicate a significant and positive impact of internet adoption on corruption reduction.

Based on the findings, this study suggests the following thoughts for policy consideration. First, economic factors, demographic factors, and institutional factors are determinants of the digital divide. Countries with a high-income per capita income, the

youngest population, population density, political stability, and rule of law tend to have more access to internet services, while those with low human capital index, government effectiveness, and political stability have lower access to internet services. For these countries, a good educational system, political stability, governance, and the quality of institutions lead to reducing the digital divide by providing more access for people to internet services.

Finally, the results show evidence of a positive impact of the internet on corruption alleviation. In this regard, ECOWAS's policymakers should enlarge internet access and ICT infrastructure to further accelerate corruption reduction. ICT infrastructures in ECOWAS contribute to make easier the availability of the Internet for the whole population and consequently improve their efforts to tackle all types of corruption. However, investing in ICT infrastructure is not enough, ECOWAS leaders should have political well by enhancing education and investing in institutions.

The limit of this study is related to the selection of one variable as a measure of internet adoption, future studies are invited to employ other measures such as social media users or the E-government index as a measure of ICT in this region. Moreover, for future research, a comparative and country-specific study among ECOWAS is needed to investigate the determinants of the digital divide and corruption-ICT nexus. Future studies can also investigate the impact of ICT infrastructures on corruption.

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ORCID

Tsouli Driss http://orcid.org/0000-0002-1400-4382

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Notes

[1] Since 2012, Senegal and Ivory Coast have made a significant improvement.

[2]https://unevoc.unesco.org/home/TVETipedia+Glossary/filt=all/id=704 (accessed: 16/10/2021)

[3]Correlations of above 0.8 or 0.9 are often interpreted as excessively collinear (Franke, 2010)

[4]ECOWAS are an area of more than 5 million km^2 and, they are a home of 349 million people whose major languages are English, French, and Portuguese with a GDP per capita (current international dollar) of $4618. They include :Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

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Investigating the Nexus Between Militarization and Inflation in Turkey

Olcay Çolak[*], Sevilay Ece Gümüş Özuyar [**], Duran Bülbül[***]

Abstract: The importance of military expenditure in terms of establishing national security constitutes the main excuse for public expenditures made by states in this field. Yet, a special importance should be attached to military expenditure in terms of ensuring the efficiency of the public sectors of developing countries and rational use of resources. In fact, there is no consensus about the effect of these types of expenditures on the economy in general or the trade-offs they cause. Therefore, their effects on major macroeconomic variables and efficiency in resource allocation, production, and distribution deserve to be comprehensively addressed. To this end, this study aims to investigate the long- term effect of militarization on inflation in Turkey. By incorporating the annual data from the period 1970 to 2020 and employing the combined approach to cointegration suggested by Bayer and Hanck (2013), the presence of long-term interplay between militarization and inflation can be analyzed. After detecting the presence of cointegration, the findings of the long run model reveal that inflation is spurred by military expenditure and arms imports besides the other determinants of inflation.

Keywords: Bayer-Hanck Cointegration Test; inflation; militarization; Turkish economy.

JEL classification: C32; E31; H41; H56.

[*] Uşak University, Faculty of Economics and Administrative Sciences, Department of Economics, Uşak/Turkey; e-mail: *olcay.colak@usak.edu.tr* (corresponding author).
[**] Necmettin Erbakan University Faculty of Political Sciences, Department of Public Finance, Konya/Turkey; e-mail: *sevilayece.gumusozuyar@erbakan.edu.tr*.
[***] Ankara Hacı Bayram Veli University Faculty of Economics and Administrative Sciences, Department of Public Finance, Ankara/Turkey; e-mail: *duranbulbul@hbv.edu.tr*.

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1. INTRODUCTION

The inflationary aspect of military services is one of the core topics in the terrain of defense economics. In one of the pioneering attempts, Schultze (1981) argues that there are two main mechanisms by which military outlays might potentially affect inflation. The first mechanism works through an aggregate demand channel. By accelerating government expenditures, military spending would induce inflationary pressures, which are associated with upswings in aggregated demand unless contractionary fiscal and monetary policy tools are enabled. The second mechanism is associated with the supply side, in which limitations on capacity utilization and cost increases associated with the defense industry (Nourzad, 1987; Sahu et al., 1995). According to Vitaliano (1984), these price rigidities mainly stem from the monopolistic and monopsonistic characteristics of the defense sector and the demand for high-skilled labor by the defense sector itself. Thus, output expansion in the defense sector would lead to price upswings, which might result in unanticipated inflationary pressures in the overall economy (Sahu et al., 1995). However, overall security of the country is a crucial issue in sustaining more stable macroeconomic conditions. That is why countries are inclined to militarize not only for political reasons but also in order to maintain a more stable economic environment. Nevertheless, rising militarization in terms of military outlays tends to have adverse effects on the economy. Besides the misallocation of resources, rising military expenditure can potentially put pressure on governments' budgets.

As one of the most crucial elements of macroeconomic stability, inflation plays a key role in the economy, particularly for developing countries. In this respect, the Turkish economy displays a good experimental laboratory for researchers and policymakers to the extent that inflation was one of the major issues for decades until the adoption of an inflation targeting regime after the financial crisis of 2001. Before achieving a relatively stable price level in the aftermath of the adoption of the inflation-targeting strategy, the structural changes in the economy inevitably lead to financial crashes, which mostly resulted in high inflation. One of the major reasons for the price instability stems from the excessive amount of budget deficits that occurred during the 1970s and the financial crashes in 1994 and 2001. Accordingly, these financial crashes had a distorting effect on the investment climate and adverse effects on the economy.

In the 1970s, Turkey experienced some major political concerns. For example, the outbreak of internal tensions and disputes over Cyprus resulted in an arms embargo on Turkey. Besides these political concerns, macroeconomic instabilities were also observed. In this context, one of the major macroeconomic concerns was the unanticipated increase in overall prices. That period was characterized by the implementation of the import-substitute development strategy, market failures, and price controls in the overall economy. The implementation of the import-substitute strategy is characterized by the extensive imports of raw materials and intermediate goods. However, this situation deteriorated the terms of trade with the emergence of oil price shock and thus accelerated the current account deficit. In addition, the five-year development plan's intensive implementation of public investment programs exacerbated the fiscal balances. With the presence of two oil price shocks, imbalances in aggregate supply and demand induced higher inflation rates (The Central Bank of Turkey, 2002). In the early years of the 1980s, Turkey embarked on an export-led development strategy and financial liberalization that was introduced by most of the developing countries. However, the presence of uncontrollable capital movements and implementation of expansionary monetary and fiscal policies under the fixed exchange rate

regime distorted the internal and external balances of the Turkish economy. The devastating effects of those inefficient economic policies lead to three consecutive financial crashes in 1994, 2000, and 2001 that resulted in the historically highest levels of inflation. To that end, price inflation, as measured by changes in the consumer price index, was around 60-65 percent in the second part of the 1980s. In the early 1990s, inflation rates increased to 70 percent on average, and in 1994 it reached 106.3 percent, the highest recorded. During the post-crisis period (after 1994), it ranged from around 80-90 percent on average (Cizre-Sakallioglu & Yeldan, 2000). In the aftermath of the financial crash in 2001, Turkey switched its monetary strategy from nominal exchange rate targeting to inflation targeting due to the failure of the disinflation program adopted in 1999 based on the crawling peg regime under the auspices of the International Monetary Fund (IMF) (Alici & Ucal, 2015). Based on the public declaration of specific target points or range of inflation and requiring the independence of the central bank and fiscal discipline, it was implemented implicitly over the period of 2002 to 2005, with explicit implementation of this policy by 2006. In this context, efficient and decisive implementation of this strategy (even implicitly) caused inflation to fall sharply to the single digit level in 2004, which had not been experienced since 1970 (Kara, 2018).

In the historical perspective, militarization is one of the most widely discussed issues with various aspects to consider, some of which are specific to Turkey. Turkey is the nation that formed the first regular army as a result of six thousand years of Turkish history, and the more recent wars that it fought as a newly established state can be pointed to as reasons for militarization. Furthermore, historical antagonism with its neighbors, in particular the tensions with Greece due to disputes over Cyprus and the continental shelf on the islands that are located off the Aegean Sea coast are often indicated as some of the major reasons that military spending in Turkey consistently increases. This rivalry in terms of militarization between Turkey and Greece has been the focus of many studies. However, the studies evaluating this issue in a comparative context are relatively scant. Among these, the most prominent ones are those by Georgiou et al. (1996) and Kollias and Makrydakis (1997). Georgiou et al. (1996) attempted to find the economic impacts of Greece and Turkey's military expenditures by employing diagnostic tests and the Granger causality test. Due to the tensions between these countries, the fact that both countries accelerate their defense expenditure against a possible military threat from the other raises the consideration of the results of this study. In light of this study, Kollias and Makrydakis (1997) conducted a similar study by focusing on the increase in military spending to the extent that it is associated with the arms race between the two countries.

Another reason generally given as a cause of militarization in Turkey is terrorism and terrorist activities. Efforts to prevent the activities of left-political oriented terrorist organizations, which were the most active terrorist groups, resulted in military coups and tight government regimes. This situation accelerated militarization in Turkey and led to an exponential increase in military spending. The Kurdistan Workers' Party (PKK) and its variations, which claim to be the Kurdish nationalist movement, replaced these organizations, which lost momentum in the 1980s. The pro-militarization attitude of the people was reinforced as the PKK still exists and continues its activities against the people. In addition to the resources spent on military operations, the purchase of weapons and ammunition, as well as R&D activities in this field are high cost items. Hence, when terrorism is a concern, the importance of militarization and spending is based on national security and defense.

Apart from the discussions regarding the militarization process, Turkey is one of the oldest members of the North Atlantic Treaty Organization (NATO), which acts as a major military and regional power with significant human and logistics resources around the world. In this context, Turkey allocates a significant share of its budgetary resources in the defense sector as a major ally of the NATO alliance. According to the Stockholm International Peace and Research Institute (SIPRI) (Stockholm International Peace and Research Institute, 2021), Turkey is the 16th largest military spender in the world with 17.7 billion dollars annually that corresponds to 2.8 % of its gross domestic product (GDP). With this record, Turkey is the seventh largest military spender across NATO (SIPRI, 2021).

Through the aforementioned arguments and facts, the main purpose of this present study is to investigate the long-run relationship between inflation and militarization that is captured by military expenditure, which stands out as the highest type of public expenditure, and arms imports, which could be a major component of external demand due to external dependency. In this context, the main hypothesis of this paper is constructed as follows:

H*$_0$: Military expenditure and arms imports have a long-run positive influence on inflation.*

H*$_1$: Military expenditure and arms imports do not have any significant long-run influence on inflation.*

It should also be noted that the economic impact of militarization have been studied widely in terms of economic growth in the empirical literature. However, inflationary aspects of militarization are relatively less studied terrain in the empirical literature. Specifically, there are a few empirical papers that deal with the interplay between militarization and inflation for Turkey (Dritsakis, 2004; Özsoy, 2008; Özsoy & Ipek, 2010; İpek, 2014; Karakurt *et al.*, 2018). Hence, this paper aims to contribute existing literature by dealing the nexus between militarization and inflation for Turkish economy which asserts a good case to the extent that inflation is a major structural macroeconomic concern in historical perspective. On the other hand, Turkey is one of the oldest allies of NATO and devotes significant portion of budgetary sources into national defense due to geopolitical risks and tensions between neighbors. Furthermore, this paper would contribute to the empirical literature by employing a novel method that is pioneered by Bayer and Hanck (2013). In this respect, together with the other potential determinants of inflation the long term interplay between militarization and inflation will be investigated by employing combined cointegration tests that is developed by Bayer and Hanck (2013) and pretty novel approach in the terrain of defense economics. In line with these arguments, the layout of the present study is as follows: The next section is devoted to relevant theoretical and empirical literature on the interplay between inflation and militarization. The third part presents the model, data set, and methodology regarding the empirical treatment. The fourth part discloses the estimation results of empirical analysis, and discussion of the empirical results is given in the fifth part. Finally, the last section concludes the study with some policy recommendations.

2. LITERATURE REVIEW

Even though the economic impacts of military expenditure have been widely discussed in terms of economic growth, the relationship between inflation and military expenditure is an area that has also attracted the interests of scholars, and therefore a large literature has been formed

so far within the framework of theoretical and empirical models. In line with the theoretical background presented above, the empirical literature is fundamentally built on two main pillars. The first pillar claims the existence of a positive relationship between military expenditure and inflation. Furthermore, in terms of causality analysis, those studies are in support of unidirectional causality running either from military expenditure to inflation or the reverse (Reich, 1972; Dumas, 1977; Smith, 1977; Melman, 1978; Gansler, 1980; Calleo, 1981; Capra, 1981; DeGrasse, 1983; Starr *et al.*, 1984; Nourzad, 1987; Chan & Davis, 1991; Gi Baek, 1991; Deger & Sen, 1995). Kaufman (1972), Dumas (1977) and Melman (1978) argue that military spending causes inflation by increasing demand without creating any increase in supply. At the same time, Melman (1978) claims that the firms that are the army contractors cause the cost increase by showing the costs to the army to be higher than they are, and this situation increases the prices in the civilian sector due to an additional increase in demand. Hamilton (1977), Melman (1986) and Stein (1980) draw attention to the relationship between war and inflation, emphasizing that inflation is affected by the increase of military spending during the war period. Similarly, DeGrasse (1983) argues that military spending deeply affects the economy through acquisitions in wartime. In fact, the findings of many studies on the existence of the relationship between war, military spending, and inflation point to similar situations. Based on the analysis made by researchers such as Melman (1986) and Kinsella (1990), inflationary pressures are mainly observed due to the serious increases in defense expenditure during the extraordinary periods, i.e., warfare. However, when the same analyses are carried out in peacetime, neither study draws a similar judgment compared to the general literature (Musgrave & Musgrave, 1980). As argued above, the direction of causality might run from inflation to military outlays. In this context, Gi Baek (1991) identifies that a rising inflation rate affected defense spending in the United States of America (USA) between 1956 and 1989. In a more recent paper, Asilogullari (2020) scrutinize the causal nexus between defense expenditure and inflation for 25 NATO countries over the period of 1990 to 2018. By performing the panel bootstrap causality test, they find a unidirectional causality running from inflation to defense expenditure in the USA, Czechia (Czech Republic), Estonia, Croatia, England, and Latvia.

Along with these views, there are also opinions on the first pillar, arguing that although military spending increases inflation, this increase is not much different from that caused by other public expenditures. Like other types of public expenditures, rises in military spending might generate an inflationary effect by pushing up the aggregate demand as it is not offset by tax increases or restrictive monetary actions (Melman, 1970; Hamilton, 1977; Stein, 1980; Schultze, 1981; Looney, 1989; Sandler & Hartley, 1990). Heo (1998) expresses that it is also unreasonable to expect an inflationary effect in a situation where the governments create money to finance military spending. In addition, Schultze (1981) and Nourzad (1987) add that an increase in military expenditures may not cause an inflationary effect in a situation where the economy is not under full employment whereas Starr et al. (1984) argue that the effect of rising military expenditure on the balance of payments is an alternative way to prevent inflation. There are limited studies with findings that advocate a bidirectional relationship between inflation and military expenditures, rather than one-way, in the first pillar mentioned. Two are those by Dunne et al. (2002) and Azam (2020). Dunne et al. (2002) draw attention to this bidirectional feeding mechanism in the analysis made based on economic growth with military spending in small-industrialized countries. Although there is no bidirectional causality between defense expenditure and inflation in the study conducted by Azam (2020),

the existence of this relationship between the current account balance and defense expenditure has been revealed with significant statistical results.

The second pillar consists of the studies that have not found a consistent relationship between inflation and military expenditure. Stekler (1979), Domke et al. (1983), Starr et al. (1984), Vitaliano (1984), Payne (1990), Payne and Ross (1992), Sahu et al. (1995), Grier and Tullock (1989) are among such studies. Stekler (1979) highlights the presence of no correlation between defense spending and inflation for the US between 1972 and 1977. Domke et al. (1983) do not find any pattern in the short term in their analysis of England, USA, France, and Germany between 1948 and 1978; they find a strong relationship in the long term. The authors claim that the reason for this long-term relationship was the post-war reconstruction works. This state of affairs also resembles the studies on the first pillar that mention the fact that defense expenditure in post-war periods creates growth and inflation. Starr et al. (1984) specifically state that the interplay between military spending and inflation is valid for Britain and the United States during the period 1956-1979, and that there is a valid relationship between military spending and inflation for France and Germany in the same period. Payne (1990) investigates the relationship between military spending and inflation using the Granger causality test for the United States and finds no significant relationship. Sahu et al. (1995) use the Gordon model of inflation proposed by Vitaliano (1984) in their work with quarterly data between 1960 and 1989. They claim that neither defense expenditures nor other public expenditures had a statistically significant effect on inflation.

In a similar vein, recent studies have been shaped in terms of the aforementioned pillars. Terhal (2001), Fordham (2003), Cuaresma and Reitschuler (2004), Bose et al. (2007), Hung-Pin et al. (2016) and Xu et al. (2018) all investigated the relationship between defense spending and inflation. Terhal (2001) emphasizes the inflationary pressure that stemmed from military spending over the period between 1960 and 1970 for India. Bose et al. (2007) determine the effect of defense spending on other public spending triggering and increasing demand for 30 developing countries in the 1970s and 1980s. According to Cuaresma and Reitschuler (2004), since defense spending is not as productive as other types of public spending, it generates more inflationary pressures compared to other types of public spending. For the USA, Fordham (2003) determines that an increase in defense expenditures causes higher increases in inflation. Another study that achieved similar results for developed countries is that of Hung-Pin et al. (2016). Hung-Pin et al. (2016) evaluate the relationship between military spending and inflation over the co-holistic and causality tests for China, Japan, South Korea, and Taiwan from 1995 to 2010 and reached different results according to the countries they researched. Although there is a statistically strong relationship between military spending and inflation in all countries, it has been observed that an increase in military spending creates low inflation in China and Japan, but high inflation in Taiwan. Xu et al. (2018) examine the nexus between defense expenditures, inflation, and economic growth for China between 1953 and 2014 by employing the wavelet analysis and found that although there is a strong relationship between defense expenditure and inflation, an increase in the former duration induced a raise in the latter especially in the short run and during warfare.

Unlike those studies, some studies suggest a relatively weak or negative relationship between inflation and military spending rather than a strong one. In one of the earlier attempts, Olaniyi (1993) analyzes the impact of Nigeria's defense spending on basic macroeconomic indicators by employing the ordinary least squares (OLS) method and found a dampening effect on inflation. Based on the monetary endogenous growth model,Tzeng et al. (2008) conclude that

the relationship between defense spending and inflation is not clear, but ambiguous. In parallel, Aiyedogbon et al. (2012) conduct vector autoregressive (VAR) methodology and the Granger causality test for the period between 1980 and 2010 and highlight the lack of a long-term relationship or causality between military expenditure and inflation. Lin (2012) deals with the nexus between defense expenditure and inflation within the framework of the Endogenous Growth Model in analyzing government spending allocation with the assumption of a rising defense spending share of overall public spending. It is strikingly argued that an increase in the share of defense spending tends to lower the inflation rate and raise the economic growth rate to the extent that defense spending is financed by raising the monetary emissions, and the overall public spending is financed by collecting income tax revenue. Furthermore, it is asserted that if the government's desire is to achieve maximum social welfare and minimum inflation, the share of the defense spending should be increased as well.

The economic impacts of militarization in Turkey have been widely examined in the context of economic growth as well as its trade-offs, which include the opportunity cost with other public services. However, less attention has been given to the relationship between militarization and inflation. It should be highlighted that in line with most of the studies in the empirical literature, there is no consensus regarding the effect of militarization on inflation within the context of Turkey in terms of the aforementioned two pillars. The main reason for the disagreement comes from the sample selection and the methodologies that construct the framework of the empirical analyses. Accordingly, non-existence of a significant relationship between military spending and inflation is one of the most commonly observed findings in the empirical literature. For instance, Dritsakis (2004) evaluates the relationship between military spending and inflation for Greece and Turkey by employing VAR methodology and Granger causality tests in a comparative context. The findings of the study indicate neither a long-run relationship nor causality between military spending and inflation for those countries. Özsoy (2008) also derives analogous findings between defense expenditure, inflation, and other macroeconomic variables over the period of 1970 to 2004 for Turkey by performing the Johansen cointegration test, the Granger causality test, and impulse-response analysis. In a similar vein, Özsoy and Ipek (2010) examine the relationship between inflation and military expenditure for four countries including Turkey between the years 1980 and 2006 and find no causality between military expenditure and inflation.

İpek (2014) and more recently Karakurt et al. (2018) examine the relationship between inflation and military spending by considering the presence of structural breaks and incorporating relatively long time-series. By performing Maki (2012) and autoregressive distributed lag (ARDL) approaches to cointegration tests and the Toda-Yamato causality test for the period of 1980 to 2012, İpek (2014) finds no long-run relationship and unidirectional causality that is running from military spending to inflation. However, Karakurt et al. (2018) conducts the Maki (2012) cointegration test and Toda-Yamamoto causality tests and reveals not only the presence of a long-run relationship but also the existence of unidirectional causality from defense expenditure to inflation for the period between 1966 and 2016. In a more recent study, Asilogullari (2020) examines the clarity of the relationship between military spending and inflation by employing the autoregressive distributed lag (ARDL) approach to cointegration over the period of 1960 to 2017. She concludes that a one percent rise in military spending induces inflation to rise by 1.29 percent in the long run. This result is not clearly set forth in any work previously done on Turkey. On the other hand, Dudzevičiūté and Šimelyté (2022) detect opposite findings and derive only short-term relation

for Turkey. By assessing the NATO countries in terms of military burden, they point out the significant effect of inflation on military burden for Turkey. Finally, in a most current study, Caldara et al. (2023), determine that geopolitical risks have inflationary effects and these effects are more intense especially for emerging countries. Nonetheless, the proof within the scope of the study that military expenditure is not a geo-political risk factor does not state much for Turkey, which is a part of emerging seven countries, in the relationship between inflation and military expenditure. Hence, failing either to reach a common consensus or to figure out a plausible outcome about the relationship between inflation and militarization for Turkey is an indication of the need for studies in this field to clarify the issue. For this reason, the main aim of this study has been shaped with this need in mind.

3. MODEL, DATA, AND EMPIRICAL STRATEGY

We focus on the following two baseline specifications to investigate the long-run nexus between militarization and inflation in Turkey by incorporating the annual data that spans the period of 1970 to 2020:

$$\text{Model 1: } CPI=\int(ME,GOV,EX,M2,OIL) \quad (1)$$

$$\text{Model 2: } CPI=\int(ARM,GOV,EX,M2,OIL) \quad (2)$$

where consumer price index (CPI) is the proxy for annual inflation in each model. Since this paper particularly addresses the long-run nexus between militarization and inflation, we include two measures to proxy militarization in each specification. In this respect, militarization is captured by military expenditure (ME) and arms imports (ARM), respectively.

Besides the proxies of militarization, some potential determinants of inflation are also considered for the investigation. In this respect, as an important component of aggregate demand, we include general government expenditures to highlight the role of fiscal policy shocks and investigate the presence of demand-pull inflation. However, as Sahu et al. (1995) suggest, we incorporate the approach by which non-military government spending (GOV) is obtained by subtracting the total military expenditure from the total general government expenditure. In order to identify the exchange rate pass through effect on inflation, we also consider the role of the exchange rate (EX), to examine the idea that instability of the exchange rate might affect inflation via international trade and balance of payments mechanisms. The monetary aspect of inflation is widely confirmed by many classical economists. According to the classical approach, uncontrolled monetary growth inevitably spurs inflation even in the short run. To this end, we endeavor to examine the role of monetary expansion on inflation; we include a broader money terminology, which is represented by M2 money supply (M2). Besides the demand forces, the effect of supply shocks on inflation are also considered. As another major type of inflation, cost-push inflation is often observed in economies which are mainly dependent on the import of natural resources and adversely affected by the increases of the prices of those resources. Hence, we capture the effect of supply shocks, including the crude oil price (OIL).

As argued in the introduction, we postulate that the proxies of militarization are expected to affect inflation positively. In addition, the rest of the government outlays might have a positive influence on inflation by deteriorating the fiscal balances. On the other hand,

volatility in the exchange rate might distort the terms of trade against the domestic economy. Thus, a rising exchange rate might result in higher inflation, which might validate the phenomenon of the exchange rate pass-through hypothesis for a domestic economy. Since there is a widespread theoretical consensus regarding inflation as a monetary phenomenon, we also expect that a rising money supply would lead to higher inflation rates. Since inflation is also influenced by the imbalances in aggregate supply, we would expect that oil prices might positively affect inflation. It should be noted that except for the crude oil price, all relevant data were compiled from the World Development Indicators (WDI) database of the World Bank and were transformed into their natural logarithmic forms. To this end, Table no. 1 presents the abbreviations, detailed definitions, and data sources regarding the variables that are used in the empirical analysis.

Table no. 1 – Variable Definitions

Variables	Definition and Data Source
CPI	Consumer Price Index (2010=100), World Bank, WDI
ME	Military Expenditure (current local currency), World Bank, WDI
ARM	Arms Imports (SIPRI Trend Indicator Value, million US $), World Bank, WDI
GOV	Non-Military Government Spending (current local currency), World Bank, WDI
OIL	Brent Type Crude Oil Price (US $/bbl), World Bank, Commodity Price Data
EX	Official exchange rate (local currency per US $, period average), World Bank,
M2	Broad Money (current local currency), World Bank, WDI

Note: All variables are expressed in natural logarithmic form.

Table no. 2 briefly displays the descriptive statistics. Compared to the other variables, M2 money supply (M2) and non-military government expenditure (GOV) assert more volatility due to having the highest standard deviations as the differences between maximum values and minimum values are relatively higher. Moreover, variance between maximum and minimum values for crude oil price (OIL) and arms imports (ARM) are relatively lower, with the standard deviations of both variables displaying the lowest values.

In dealing with the long-run interaction amidst most of the macroeconomic variables, the cointegration approach is widely employed in the empirical analyses. As conventional wisdom, a stationary check of the series is a necessary step before conducting the cointegration analysis. To this end, we employ Phillips-Perron (PP) and Generalized Least Squared-Dickey-Fuller (DF-GLS) tests. As argued by Sohag et al. (2019), while DF-GLS performs efficiently in the case of a sample span of time, the PP test accounts for the serial correlation in the series.

Table no. 2 – Descriptive Statistics

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
CPI	51	-0.737	5.292	-9.245	5.573
ME	51	18.377	5.748	8.763	25.533
ARM	51	20.47	0.656	18.269	21.692
GOV	51	19.349	6.181	9.575	27.189
OIL	51	3.215	1.026	0.19	4.718
EX	51	-4.087	4.791	-11.417	1.947
M2	51	20.732	6.257	10.704	28.856

Source: authors' estimations. Note: All values expressed in natural logarithmic form.

Apart from most of the studies in the empirical terrain, we aim to detect the cointegration relationship by drawing upon a novel approach pioneered by Bayer and Hanck (2013). The novelty of the methodology introduced by Bayer and Hanck (2013) stems from the integration of the linear combinations of the residual-based approach by Engle and Granger (1987), the system-based approach by Johansen (1988), and error correction based approaches by Boswijk (1994) and Banerjee et al. (1998). However, most of those methods could generate biased results due to size and power issues. Thus, Bayer and Hanck (2013) developed a new approach to cointegration methodology in which linear combination of the abovementioned methodologies was done to achieve results that are more efficient. To this end, Bayer and Hanck (2013) derive the following p-values for each individual cointegration test by using Fisher's formulation:

$$EG - J = -2\left[\ln(p_{EG}) + \ln(p_j)\right] \tag{3}$$

$$EG - J - B - BDM = -2\left[\ln(p_{EG}) + \ln(p_j) + \ln(p_B) + \ln(p_{BDM})\right] \tag{4}$$

where p_{EG}, p_J, p_B, and p_{BDM} denote the p-values of each individual cointegration test, namely Engle and Granger (1987), Johansen (1988), Boswijk (1994), and Banerjee et al. (1998).

In order to estimate the long-run elasticities through the baseline specification, this study employs the fully modified ordinary least squares (FMOLS) and dynamic ordinary least squares (DOLS) methods. Developed by Phillips and Hansen (1990), the FMOLS estimator is asymptotically unbiased and wipes out serial correlation and endogeneity by employing the semi-parametric corrections. Phillips and Hansen (1990) consider the following linear model to obtain the FMOLS estimator:

$$y_t = \beta_0 + \beta_i X_t + u_{1t} \tag{5}$$

where X_t includes the set of drift parameters and regressors and follows a first difference process, i.e., I (1) in this way:

$$\Delta X_t = \omega + u_{2t} \tag{6}$$

where ω is a $k \times 1$ vector of drift parameters. The estimated parameters of residuals in Equations 5 and 6 are represented by $\widehat{u_{1t}}$ and $\widehat{u_{2t}}$, which are used to compute the long-run covariance matrices $\widehat{\Omega}$ and $\widehat{\Lambda}$. Hence, the FMOLS estimator is given by the following equation:

$$\hat{\beta} = (W'W)^{-1}\left(W'\hat{y}^* - nD\hat{Z}\right) \tag{7}$$

where $\hat{y}^* = (\hat{y}_1^*, \hat{y}_2^*, \ldots, \hat{y}_n^*)$, W=$(\tau_n, X)$, $\hat{Z} = \Delta_{21}' - \Delta_{22}'\widehat{\Omega}_{22}^{-1}\widehat{\Omega}_{21}$, and D is the $(k+1) \times k$ matrix of drift parameters.

For the sake of the robustness of the results, we also perform the dynamic OLS (DOLS) method. Based on the augmentation of Equation 6 by the inclusion of lags and leads, Stock and Stock and Watson (1993) obtain the following OLS estimator:

$$\widehat{\delta_{OLS}} = \left[\left(\sum_t z_t z_t'\right)\otimes I_{kt}\right]^{-1}\left[\sum_t (z_t \otimes I_{kt})(\Delta^{d-l+1} y_t^l)\right] \tag{8}$$

where d denotes the maximum integration order, l denotes the number of lags, and Δ^d is the difference operator. Thus, $\Delta^{d-l+1} y_t^l = (z_t' \otimes I_{kt})\delta + \vartheta_t^l$. It should be noted that the regressors

z_t are assumed to be uncorrelated with the errors ϑ_t^l and follows the I (1) process as well. In accordance with the baseline specifications and empirical strategy, in the next sections we will elaborate on the empirical results.

4. EMPIRICAL RESULTS

Since most of the macroeconomic variables potentially include trends, integration order of the variables becomes the core issue before conducting the further analysis because the presence of unit root in the series potentially causes spurious results. Thus, before proceeding to the main empirical analysis, we commence by investigating the unit root properties of the variables by employing PP and DF-GLS tests. Table no. 3 reports the results of the unit root tests. It is apparent that all variables are non-stationary at level but become stationary after first differencing, i.e., the variables are integrated at I (1).

Table no. 3 – Unit Root Tests

Variables	PP Test	DF-GLS Test	Outcome
CPI	0.371	-2.012	
ΔCPI	-6.911*	-4.784*	I (1)
ME	0.194	-1.349	
ΔME	-8.833*	-5.238*	I (1)
ARM	-0.241	-1.757	
ΔARM	-9.032*	-4.334*	I (1)
GOV	0.103	-1.815	
ΔGOV	-7.512*	-4.497*	I (1)
OIL	-2.736	-1.957	
ΔOIL	-6.246*	-3.742**	I (1)
EX	-0.534	-1.957	
ΔEX	-3.261***	-4.577*	I (1)
M2	0.160	-2.449	
ΔM2	-10.770*	-3.943*	I (1)

Notes: *, ** and *** denote the significance levels at 1 %, 5% and 10 % respectively.
Source: authors' estimations.

Having declared that all the variables are integrated at I (1), we proceed to determine whether long-run or cointegration nexus among the variables exist. Pioneered by Bayer and Hanck (2013), we performed combined cointegration tests and the corresponding results are reported in Table no. 4, which involves EG-J and EG-J-B-BDM tests. For each model specification, the results of the combined cointegration tests firmly attest to the presence of a cointegration relationship to the extent that Fisher statistics for EG-J and EG-J-B-BDM tests exceed the critical values at 1%, 5%, and 10% significance levels. Therefore, we reject the null hypothesis of no cointegration and decide that our model specifications indicate the presence of long-run interplay among the variables.

After detecting the presence of a cointegration relationship, the next step is devoted to exploration of the long-run elasticities. In this respect, we performed FMOLS and DOLS estimators, and their corresponding results are presented in Table no. 5 in which the top segment is devoted to FMOLS estimates and the bottom segment is devoted to DOLS estimates.

Table no. 4 – Bayer and Hanck (2013) Cointegration Test

Specification	Fisher Statistics		Cointegration
	EG-J	EG-J-B-BDM	
Model 1	56.549*	60.099*	Yes
Model 2	57.797*	116.446*	Yes
	Critical Values		
	EG-J	EG-J-B-BDM	
1 %	15.66	30.11	
5 %	10.44	20.17	
10 %	8.27	15.98	

Source: authors' estimations
Notes: * denotes the significance level at 1 %

Table no. 5 – FMOLS and DOLS Estimates

Panel A: FMOLS Estimates						
Regressors	**Model 1**			**Model 2**		
	Coefficient	**Std. Error**	**t-statistics**	**Coefficient**	**Std. Error**	**t-statistics**
ME	0.144**	0.056	2.557			
ARM				0.037**	0.015	2.449
GOV	0.242*	0.053	4.569	0.307*	0.043	7.042
OIL	0.151*	0.023	6.364	0.197*	0.018	10.640
EX	0.313*	0.067	4.618	0.454*	0.049	9.234
M2	0.325*	0.088	3.694	0.273**	0.076	3.584
Panel B: DOLS Estimates						
Regressors	**Model 1**			**Model 2**		
	Coefficient	**Std. Error**	**t-statistics**	**Coefficient**	**Std. Error**	**t-statistics**
ME	0.156**	0.068	2.300			
ARM				0.097***	0.049	1.972
GOV	0.248*	0.065	3.795	0.520*	0.089	5.832
OIL	0.134*	0.028	4.657	0.300*	0.039	7.597
EX	0.325*	0.083	3.87	0.810*	0.079	10.231
M2	0.296*	0.109	2.715	0.320*	0.125	2.547

Source: authors' estimations.
Notes: *, ** and *** denote the significance levels at 1 %, 5% and 10 % respectively.

The estimation results of both methods reveal that inflation is positively influenced by militarization. However, the inflationary aspect of militarization led by total military expenditure (ME) is relatively more dominant over arms imports (ARM). Specifically, a 1% rise in military expenditure (ME) accelerates inflation by 0.144 and 0.156 whereas a 1% rise in arms imports (ARM) increases inflation by 0.037 and 0.097, respectively to each estimator. In line with the expectations, the non-military component of government expenditure (GOV) has an inflationary effect. Strikingly, this effect is more pronounced compared to the effect induced by military expenditure. In this context, a unit rise in GOV spurs inflation by 0.242 and 0.307 for the FMOLS estimator whereas for the DOLS estimator a unit rise in GOV spurs inflation by 0.248 and 0.520, respectively.

The long-run elasticities of the rest of the explanatory variables have the expected signs through the theoretical expectations. Accordingly, the potential adverse supply effect on inflation is captured by the inclusion of the oil prices, and the results highlight the validity of

the inflation accelerating effect of the oil prices. The results of FMOLS estimation indicate that a unit increase in OIL induces an increase in inflation by 0.151 and 0.197 whereas the DOLS estimator yields an increase by 0.134 and 0.300, respectively. The coefficients of the exchange rate (EX) are positive and support the prevalence of the exchange rate pass-through hypothesis in Turkey. Hence, a unit increase in EX accelerates inflation by 0.313 and 0.454 for the FMOLS estimations while for the DOLS estimations a unit increase in EX accelerates inflation by 0.325 and 0.810, respectively. Finally, the results confirm the view that inflation is a monetary phenomenon in Turkey. According to the FMOLS estimations, a 1% increase in M2 increases inflation by 0.325 and 0.273 while a 1% increase in M2 increases inflation by 0.296 and 0.320 for the DOLS estimations.

5. DISCUSSION

Having revealed the presence of a cointegration relationship, the estimation results of the long-run models firmly attest to the findings which have been revealed by many studies in the empirical literature (Reich, 1972; Dumas, 1977; Smith, 1977; Melman, 1978; Gansler, 1980; Calleo, 1981; Capra, 1981; DeGrasse, 1983; Starr *et al.*, 1984; Nourzad, 1987; Chan & Davis, 1991; Gi Baek, 1991; Deger & Sen, 1995). In a similar vein, the findings of the recent studies on Turkey by Karakurt et al. (2018) and Asilogullari (2020), who address the presence of a cointegration relationship with structural breaks between military expenditure and inflation, are in line with the findings as outlined above. Strikingly, the positive effect of military expenditure on inflation is slightly higher than on the arms imports even though the military burden has slowed down in recent decades. One of the possible reasons for this fact is the recent developments in the defense sector in Turkey. Even though Turkey is one of the major arms importers in the global context, with the recent developments in the domestic arms industry and the emergence of public-private partnerships in the arms industry, the relative significance of arms imports has diminished in recent years since the demand for armament has been met by the domestic suppliers. Yet, the findings also indicate that non-military components of government outlays tend to accelerate inflation. Besides the inflation accelerating effect, these types of expenditures would exacerbate the budget deficits and raise the tendency to borrow to the extent that efficient private investment projects would be crowded out. Thus, with the emergence of the crowding-out effect, rising government expenditure may likely retard the economic growth in the long run.

In addition, the findings are also in favor of our expectations regarding the rest of the explanatory variables that we draw upon for theoretical considerations. In this context, the findings highlight the validity of the exchange rate pass-through hypothesis. Although there are very few scholars who have tested this relationship in the long term, it is similar to Domke et al. (1983) and Karakurt et al. (2018)'s studies in terms of the direction and strength of the relationship. The study makes an important contribution to the literature in terms of making this analysis and presenting its findings regarding the long run. In this context, a rising exchange rate might affect inflation by means of two mechanisms. First, depreciation of national currency would lead domestic goods to become cheaper, and thus rising demand for domestic goods would generate demand-pull inflation. Second, a rising exchange rate would yield higher prices for imported goods. Since intermediate goods have a relatively higher share in the imports, rising cost of imported intermediate goods could potentially increase the cost of domestic goods, which in turn causes higher inflation. Another possible source of the

inflation might come from the potential monetary policy shocks, and the results indicate the validity of the monetary aspect of inflation within the context of Turkey. The monetary expansion inevitably stimulates the total expenditure, in particular private domestic investment expenditure, which in turn leads to more inflationary pressures in the economy. Finally, the results also confirm the prevalence of cost-push inflation due to a potential rise in crude-oil prices.

6. CONCLUSIONS

As one of the crucial elements of macroeconomic stability, sustaining price stability is one of the major goals for policymakers. In addition, inflation might be the potential source of the uncertainty and might negatively affect the decisions of individual agents due to its anticipated and unanticipated costs. It should be emphasized that macroeconomic stability and economic development can be achieved by satisfying both internal and external security of the country. Hence, the demand for national defense becomes one of the major priorities of the governments to sustain border security, mitigating the destabilizing effects of geo-political risks and combatting all types of terrorism besides achieving a stable economic environment and investment climate.

In this context, this paper aims to examine the long-run interplay between inflation, military expenditure, and arms imports with the other possible determinants of inflation by incorporating the annual long-term series data from the period 1970 to 2020. In order to determine the long-run relationship between the inflation, militarization, and other potential determinants of inflation, as a novel approach in the terrain of defense economics, the combined cointegration methodology proposed by Bayer and Hanck (2013) was performed, and the results confirmed the presence of a cointegration relationship among the variables. For the investigation of the direction and magnitude of the long-run relationship, we employed the FMOLS and DOLS estimators, and the findings of both techniques revealed that together with non-military components of government spending, military outlays and arms imports are positively associated with inflation in the long run.

Our findings also reveal that inflation is also affected by the fluctuations in oil prices and exchange rates. Given the fact that Turkey's economy is purely dependent on energy imports, the effect generated by the fluctuations of the oil prices has been one of the most vital reasons for the chronic inflation problem. Therefore, policy makers should also consider the policy measures that alleviate the import dependency on energy. The findings also emphasize that changes in exchange rates have an accentuating effect on inflation. Accordingly, the depreciation of the national currency tends to raise the export demands and inflation as the domestic goods become relatively cheaper than the foreign goods. In addition, the broad money supply is also likely to have an inflation accelerating effect. In this respect, monetary policy should be implemented to sustain the price stability in the long run. It is also important for controlling the fluctuations of the exchange rate since the frequent implementation of the expansionary monetary policies might potentially lead to the depreciation of the national currency and exacerbate the current account balance and price stability as well.

Even though price stability has historically been one of the most crucial issues relating to the Turkish economy, our findings reflect that demand and supply components also accompany the military outlays and arms imports in affecting the inflation. The past evidence also demonstrates that inflation emerges at the expense of fiscal and monetary discipline. In

this respect, policymakers should stick to fiscal discipline and diminish the inefficient outlays to sustain price stability and macroeconomic stability in the long run. In addition to these long-run objectives, scarce resources should be channeled into the efficient investment projects to the extent that new productive capacity of the economy could be enhanced. However, this situation may raise the issue of a trade-off between national security and price stability due to fragile economic and fiscal structure. In order to control for the possible risks that are attached to this trade-off, some policy measures can be taken. First, the dependency on imports and foreign resources should be curtailed because the dependency on imports and foreign resources to meet the demand for armament might exacerbate the current account balance and budget deficits that have been the basic structural problems for the Turkish economy from a historical perspective. Secondly, military burden on the government's budget could be curtailed by enabling a more competitive structure in the defense sector and promoting the public-private partnerships which support the research and development (R&D) projects to wipe out the current and potential risks that threaten Turkey. Third, despite the presence of ongoing geo-political risks and tensions in neighboring countries and fighting against terrorism, together with the above policy measures, fiscal and monetary discipline should be sustained to achieve price stability goal in the long run.

ORCID

Olcay Çolak http://orcid.org/0000-0002-0794-8449
Sevilay Ece Gümüş Özuyar http://orcid.org/0000-0002-1957-3648
Duran Bülbül https://orcid.org/0000-0002-3890-2304

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The Effectiveness of the Huber's Weight on Dispersion and Tuning Constant: A Simulation Study

Intan Martina Md Ghani*, Hanafi A. Rahim**

Abstract: Dispersion measurement and tuning constants are critical aspects of a model's robustness and efficiency. However, in the presence of outliers, the standard deviation is not a reliable measure of dispersion in Huber's weight. This research aimed to assess the efficacy of the Huber weight function in terms of dispersion measurement and tuning constant. The simulation study was conducted on a hybrid of the autoregressive (AR) model and the generalized autoregressive conditional heteroscedasticity (GARCH) model with 10% and 20% additive outlier contamination. In the simulation analysis, three dispersion measurements were compared: median absolute deviation (MAD), interquartile range (IQR), and IQR/3, with two tuning constant values (1.345 and 1.5). The numerical simulation results showed that during contamination with 10% and 20% additive outliers, the IQR/3 outperformed the MAD and IQR. Our findings also showed that IQR/3 is a potentially more robust dispersion measurement in Huber's weight. The tuning constant of 1.5 revealed a decrease in resistance to outliers and increased efficiency. The proposed IQR/3 model with a constant tuning value (h) of 1.5 outperformed the AR(1)-GARCH(1,2) model while minimising the effect of additive outliers.

Keywords: dispersion; tuning constant; Huber; generalized autoregressive conditional heteroscedasticity; additive outliers.

JEL classification: C15; C52; C53.

* Universiti Malaysia Terengganu, Malaysia; e-mail: *intanmartina23@gmail.com* (corresponding author).
** Universiti Malaysia Terengganu, Malaysia; e-mail: *hanafi@umt.edu.my*.

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1. INTRODUCTION

M-estimator is a common approach used in the robust method. It has been discovered that M-estimators are more computationally efficient, as described in the Barrow *et al.* (2020) study. The majority of researchers used M-estimator in a variety of fields, including finance and econometrics (Fan *et al.*, 2019), geodesy and surveying (Osada *et al.*, 2018), business survey (Dehnel, 2016), hydroelectric power (Erdoğan, 2012), mechanical systems (Pennacchi, 2008), infrared spectroscopic application (Pell, 2000) and biological experimentation (Elsaied & Fried, 2016). Some researchers verified M-estimator via simulation experiment to improve their study (Erdoğan, 2012; Elsaied & Fried, 2016; Ghazali *et al.*, 2017; Ertaş, 2018; Polat, 2020). There are several robust methods, such as least absolute deviation (LAD) (Edgeworth, 1887), M-estimator (Huber, 1964), R-estimator (Jaeckel, 1972), least median of squares (LMS) (Rousseeuw, 1984), least trimmed squares (LTS) (Rousseeuw, 1984), S-estimator (Rousseeuw & Yohai, 1984), and MM-estimator (Yohai, 1987). Since they could provide some protection against outliers, both LAD-estimator and M-estimator are popular alternatives in the context of robust estimation of time series models (Barrow *et al.*, 2020). However, M-estimator is preferred because it is simple and straightforward (Osada *et al.*, 2018). Thus, many remarkable results had reported the M-estimator's potential, mainly Huber's function.

Huber's M-estimator has three functions: objective, influence, and weight. The weight function is a fundamental component of a particular implementation of the M-estimation, reweighting observations affected by outliers throughout the iteration process (Osada *et al.*, 2018). The Huber's weight function has been widely investigated (Pell, 2000; Dehnel, 2016; Ghazali *et al.*, 2017; Osada *et al.*, 2018; Polat, 2020; Wada, 2020). Huber's weight function residual was typically standardised using mean and standard deviation as the central tendency and dispersion, respectively. In the presence of outliers, however, both measures are non-robust (Hedayat & Su, 2012), have overestimated values (Dehnel, 2016), and are extremely sensitive to outliers (Park & Leeds, 2016). Furthermore, Hedayat and Su (2012) found that a wide range of tuning constant and dispersion measure options makes it challenging to try and convince people, particularly non-statisticians. Hence, there may be another robust dispersion measurement and tuning constant that can be considered to examine the effectiveness of the econometric model in the presence of outliers.

Moreover, the model's effectiveness is related to its robustness and efficiency. The MAD is a measurement of robust dispersion. According to Rousseeuw and Croux (1993), the median and MAD are simple and easy to compute but extremely useful. Aside from MAD, the IQR was proposed as a robust dispersion in the simulation study by Park and Cho (2003). However, the literature review reveals that Huber's weight is dependent on the MAD as a dispersion measurement with the default tuning constant. Therefore, this research aimed to examine the efficiency of Huber weights while taking dispersion measurement and tuning constant into account. The AR and GARCH models were used to validate the robust dispersion measurement in the Huber weight function. Consequently, IQR/3 was proposed as an alternative to the robust dispersion measures (MAD and IQR). Finally, the efficiency of the Huber weight was then compared in terms of the proposed tuning constant value (1.5) versus the default tuning constant value (1.345).

The sections that follow are divided into different sections. The AR (c), GARCH (m,n) model, M-estimator, tuning constant, and performance measurement are all briefly defined in

Section 2. Section 3 described the process in the simulation study in detail. Section 4 contains the results and discussion based on the simulation analysis, while Section 5 concludes the findings.

2. MATERIALS AND METHODS

This section addresses the hybrid of econometric models: AR and GARCH. The AR(c) can be expressed using notation as presented by Box *et al.* (2016):

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \cdots + \alpha_c Y_{t-c} + \varepsilon_t \quad (1)$$

with α_0 represents a coefficient term, α_c is the AR component coefficient of order c, and ε_t is the white noise at time t. The c order is non-negative integers.

Let P_t represent a random sample of size, T, with $t = 1, \dots, T$. Considering the GARCH (m, n) model developed by Bollerslev (1986), the equations can be written as follows:

$$r_t = Y_t + \varepsilon_t \quad (2)$$

$$\varepsilon_t = \sigma_t X_t, \; X_t \sim N(0,1) \quad (3)$$

$$\sigma_t^2 = \phi_0 + \phi_1 \sigma_{t-1}^2 + \cdots + \phi_m \sigma_{t-m}^2 + \varphi_1 \varepsilon_{t-1}^2 + \cdots + \varphi_n \varepsilon_{t-n}^2 \quad (4)$$

with r_t is the return series $(\ln(P_t/P_{t-1}))$, Y_t is a conditional mean, ε_t is a residual term at time t, X_t is the residual standardised, σ_t^2 is the conditional variance at time t, ϕ_0 is the constant coefficient, σ_{t-1}^2 is the previous variance currently predicted, and ε_{t-1}^2 is the new details on volatility observed at the earlier moment under these conditions: $\phi_0 > 0, \phi_1, \dots, \phi_m \geq 0$, and $\varphi_1, \dots, \varphi_n \geq 0$.

The additive outliers (AO) affect a single observation since only the T^{th} observation period is affected (Chang *et al.*, 1988; Chan, 1992; Chen & Liu, 1993a; Balke & Fomby, 1994; Caroni & Karioti, 2004; Charles, 2008; Hotta & Tsay, 2012; Kamranfar *et al.*, 2017; Urooj & Asghar, 2017). These outliers could be due to an error in documentation caused by other external factors such as human error or machine malfunction (Lee & Van Hui, 1993; Franses & Van Dijk, 2000; Basu & Meckesheimer, 2007; Urooj & Asghar, 2017). Additionally, the AO specifies an extraneous/exogenous corrective (Urooj & Asghar, 2017) and a gross error model (Hillmer, 1984; Chang *et al.*, 1988).

Through Eq. (4), the model GARCH (m, n) can be written as an AR moving average for ε_t^2 as described by Bollerslev (1986):

$$\varepsilon_t^2 = \phi_0 + \sum_{p=1}^{c} (\phi_p + \varphi_p) \varepsilon_{t-p}^2 + \gamma_t - \sum_{q=1}^{n} \phi_q \gamma_{t-q}^2 \quad (5)$$

with $c = max\{m, n\}$ and $\gamma_t = \varepsilon_t^2 - \sigma_t^2; t = 1,2, \dots, n$, where ε_t^2 is the outlier free time-series while γ_t is the outlier-free residuals. Next, Eq. (5) can be designed as:

$$\varepsilon_t^2 = \frac{\phi_0}{1 - \varphi(D) - \phi(D)} + \frac{1 - \phi(D)}{1 - \varphi(D) - \phi(D)} \gamma_t = \frac{\eta}{1 - \varphi(D) - \phi(D)} + \eta^{-1}(D) \gamma_t \quad (6)$$

with $\varphi(D) = \sum_{q=1}^{n} \varphi_q D^q, \phi(D) = \sum_{p=1}^{m} \phi_p D^p$ and $\eta(D) = \frac{1 - \varphi_q(D) - \phi_p(D)}{1 - \phi_p(D)}$.

Once AO is apparent in the part of the GARCH model, the Equation could be transformed into Eq. (7), as shown by Chen and Liu (1993b).

$$e_t^2 = \omega_{\text{IO}}\xi_{\text{AO}}(D)I_t(T) + \varepsilon_t^2 \tag{7}$$

From Eq. (7), it is possible to view this as a regression model for ε_t^2 and to reform as:

$$e_t^2 = \omega_{\text{AO}}x_t + \varepsilon_t^2 \tag{8}$$

where:

e_t^2 is an observed series ε_t^2,

ω_{AO} is the magnitude effect of AO, which is $\omega_{\text{AO}}(T) = \chi_T$,

$\xi_{\text{AO}}(D)$ is the dynamic pattern of AO effect, which is $\xi_{\text{AO}}(D) = 1$,

$I_t(T)$ is the predictor function that can clarify AO's impact as $I_t(T) = \begin{cases} 1 & , t = T \\ 0 & , \text{otherwise} \end{cases}$

(T is the point where AO occurred).

2.1 M-estimator

Huber (1964) developed the M-estimator, a generalisation of the maximum likelihood estimator, as an alternative to minimising the objective function.

$$\min \sum_{i=1}^{n} \rho(\varpi_i) \tag{9}$$

From Eq. (9), ϖ_i is the i-th residual and ρ is a symmetric function with a specific minimum value of zero. It is important to note that the residuals must be standardised. Let:

$$\varpi_i = \frac{x_i - f(\mu)}{g(\sigma)} \tag{10}$$

where $f(\mu)$ is any central tendency measurement function, such as mean, median, or mode. Meanwhile, $g(\sigma)$ is any dispersion measurement function, such as standard deviation, variance, MAD, range, or IQR. The following equations must be solved to simplify Eq. (9),

$$\sum_{i=1}^{n} \psi\left(\frac{x_i - f(\mu)}{g(\sigma)}\right) = 0 \tag{11}$$

$$\sum_{i=1}^{n} \psi(\varpi_i) = 0 \tag{12}$$

whereby $\psi(\varpi_i)$ is the influence function derived from the objective function's first derivative concerning residuals. $\psi(\varpi_i)$ can be calculated using Eq. (13).

$$\psi(\varpi_i) = \frac{\partial \rho(\varpi_i)}{\partial \varpi_i} \tag{13}$$

Next, the weight function is defined as:

$$w(\varpi_i) = \frac{\psi(\varpi_i)}{\varpi_i} \tag{14}$$

where $w(\varpi_i)$ is the derivative of the $\psi(\varpi_i)$.

Now, we decided to minimise the Huber objective function, hence:

$$\rho(\varpi_{\mathrm{H}}) = \begin{cases} \dfrac{\varpi_{\mathrm{H}}^2}{2} & \text{, for } |\varpi_{\mathrm{H}}| \le h \\ h|\varpi_{\mathrm{H}}| - \dfrac{(h)^2}{2} & \text{, for } |\varpi_{\mathrm{H}}| > h \end{cases} \tag{15}$$

With the first derivative, the $\rho(\varpi_H)$ becomes $\psi(\varpi_{\mathrm{H}})$,

$$\psi(\varpi_{\mathrm{H}}) = \begin{cases} \varpi_{\mathrm{H}} & \text{, for } |\varpi_{\mathrm{H}}| \le h \\ h\big(sgn(\varpi_{\mathrm{H}})\big) & \text{, for } |\varpi_{\mathrm{H}}| > h \end{cases} \tag{16}$$

From Eq. (16), the weight function can be expressed as:

$$w(\varpi_{\mathrm{H}}) = \begin{cases} 1 & \text{, for } |\varpi_{\mathrm{H}}| \le h \\ \dfrac{h}{|\varpi_{\mathrm{H}}|} & \text{, for } |\varpi_{\mathrm{H}}| > h \end{cases} \tag{17}$$

where h is a tuning constant with a value of 1.345 that produce 95% efficiency for normally distributed, ε_t.

2.2 The Robust Huber's Weight of Dispersion

Since the outliers could affect the mean and standard deviation as the central tendency and dispersion, respectively, therefore, Hampel (1974) proposed the MAD as a more robust estimate than the sample standard deviation. Chen and Liu (1993b) also examined the MAD approach to achieve a better estimate and considered it an appropriate option (Simpson & Montgomery, 1998) and more robust dispersion (Leys *et al.*, 2013; Ruppert & Matteson, 2015).

Therefore, from Eq. (17), the robust Huber's weight can be expressed in two ways: $w(\varpi_{\mathrm{MAD}})$ and $w\big(\varpi_{\mathrm{IQR}}\big)$.

$$w(\varpi_{\mathrm{MAD}}) = \begin{cases} 1 & \text{, for } |\varpi_{\mathrm{MAD}}| \le h \\ \dfrac{h}{|\varpi_{\mathrm{MAD}}|} & \text{, for } |\varpi_{\mathrm{MAD}}| > h \end{cases} \tag{18}$$

with:

$$\varpi_{\text{MAD}} = \frac{x_i - \text{median}}{\frac{\text{MAD}}{0.6745}} \tag{19}$$

and:

$$w(\varpi_{\text{IQR}}) = \begin{cases} 1 & , \text{ for } |\varpi_{\text{IQR}}| \leq h \\ \dfrac{h}{|\varpi_{\text{IQR}}|} & , \text{ for } |\varpi_{\text{IQR}}| > h \end{cases} \tag{20}$$

with:

$$\varpi_{\text{IQR}} = \frac{x_i - \text{median}}{\text{IQR}} \tag{21}$$

The h value for the robust Huber's weight in Eq. (18) and Eq. (20) is 1.345, resulting in a 95% efficiency for normally distributed, ε_t.

2.3 The Proposed Huber's Weight of Dispersion

Carnero *et al.* (2012) reported that even if the actual procedure for dealing with outliers comes after the estimate phase, outliers can be detected and corrected before the GARCH parameters are estimated. Subsequently, Eq. (10) is modified to:

$$\varpi_{\text{I}} = \frac{x_i - \text{median}}{\text{IQR}/3} \tag{22}$$

where ϖ_{I} is the contamination data.

Therefore, the proposed Huber's weight can be written as:

$$w(\varpi_{\text{I}}) = \begin{cases} 1 & , \text{ for } |\varpi_{\text{I}}| \leq h \\ \dfrac{h}{|\varpi_{\text{I}}|} & , \text{ for } |\varpi_{\text{I}}| > h \end{cases} \tag{23}$$

where proposed Huber's weight in Eq. (23) has a h value of 1.5, resulting in 99.99% efficiency for normally distributed, ε_t.

2.4 Review of h

The weighting function in M-estimator has h that affects its robustness and efficiency (Holland & Welsch, 1977; Huber, 1981; Wang *et al.*, 2007; Elsaied & Fried, 2016; Gajowniczek & Zabkowski, 2017; Li *et al.*, 2021). A higher h-value improves efficiency but reduces robustness to outliers, whereas a lower h-value reduces efficiency but increases robustness to outliers (Elsaied & Fried, 2016; Li *et al.*, 2021). Cummins and Andrews (1995) also observed that a higher value of h reduces robustness to outliers, which is undesirable. However, it reduces the risk of penalising 'good' data, which is helpful. While decreasing the value of h increases robustness to outliers, it also increases the risk of underweighting 'good' data, resulting in information loss.

Generally, the default value of h for Huber weight is 1.345, which produce 95% efficiency for normally distributed. In their study, Cummins and Andrews (1995) reported that the default values of h provided the best efficiency. Holland and Welsch (1977) and Simpson and Montgomery (1998) attempted to calculate the h value in their studies. However, Huber (1981) suggested that the best Huber weight value was at $h = 1.5$, which is between 1 and 2. Therefore, some researchers had adjusted or modified the h value to improve the performance of a specific weight function (Mbamalu *et al.*, 1995). The various of Huber's h values are summarized in Table no. 1.

Table no. 1 – Adjusted h value of Huber weight.

Tuning constant value, h	Sources
1.2	Cantoni and Ronchetti (2001)
1.2107	Pennacchi (2008)
1.25	Street *et al.* (1988); Chi (1994)
1.5	Wang *et al.* (2007); Gajowniczek and Zabkowski (2017)

2.5 Measure of Performance

The performance of the dispersion measurement in Huber weight for AR(1)-GARCH(1,2) model were compared using two goodness-of-fit measures, such as mean square error (MSE) and root mean square error (RMSE).

$$\text{MSE} = \frac{1}{T}\sum_{t=T_1}^{T}(\sigma_t^2 - \hat{\sigma}_t^2)^2 \qquad \text{RMSE} = \sqrt{\frac{1}{T}\sum_{t=T_1}^{T}(\sigma_t^2 - \hat{\sigma}_t^2)^2}$$

Based on the MSE and RMSE measures, T is the total number of observations, T_1 is the initial observation in the evaluation period, σ_t^2 is the actual conditional variance at time t, and $\hat{\sigma}_t^2$ is the predicted conditional variance at time t. A smaller MSE and RMSE under contamination are required for accurate dispersion measurement.

3. A SIMULATION STUDY

We designed simulations to examine the performance of the AR(1)-GARCH(1,2) model in the presence of AO by combining Huber weight function with the following factors:

a) Percentage of AO contamination, P_{AO} = {0%, 10%, 20%}
b) Dispersion measurement: (MAD, IQR and IQR/3)
c) Tuning constant, $h = \{1.345, 1.5\}$

One thousand simulation iterations of three-time series length, $T = \{500,1000,5000\}$ were generated using R Core Team (2020) software version 3.6.3. The AR(1)-GARCH(1,2) model was considered in the simulation study, which was adapted from Ghani and Rahim (2018) study. The motivation of selection percentages of AO contamination (P_{AO} = 10% and 20%) was also investigated by Muler and Yohai (2008) and Wang *et al.* (2007) in their research. Previously, researchers used $T = \{500, 1000, 5000\}$ during their simulation

processes (Grané & Veiga, 2010; Carnero *et al.*, 2012). Therefore, the process of simulation studies was conducted as follows:

1. The AR(1)-GARCH(1,2) model using the *fGarch* package (Wuertz *et al.*, 2020) with parameter values were specified as:
$\{\alpha_0 = 0.043, \alpha_1 = -0.312, \phi_0 = 0.011, \phi_1 = 0.913, \varphi_1 = 0.224, \varphi_2 = -0.136\}$.
2. Data were randomly simulated at the beginning of $T = 500$ with a mean and standard deviation of 0 and 1, respectively.
3. AO contamination was 10% of the series. The location of AO was identified by calculating the magnitude with 16σ.
4. The Huber's weight was derived using three different dispersion measurements (MAD, IQR, and IQR/3) with $h = 1.345$ based on the absolute 10% of AO contamination.
5. The new data was obtained by applying Huber's weight.
6. Steps (3) to (5) were repeated before increasing AO contamination to 20%.
7. Coefficients of the AR(1)-GARCH(1,2) model for three situations were estimated using the *garchFit* function in Gaussian error distribution.
8. The performance of the AR(1)-GARCH(1,2) model for three cases was evaluated.
9. Steps (1) to (8) were repeated for different time series lengths, $T = 1000, T = 5000$. All-time series lengths were carried out using 1000 replications.
10. Steps (1) to (9) were repeated by changing $h = 1.5$.

4. RESULTS AND DISCUSSIONS

In this section, the performances of the AR(1)-GARCH(1,2) model using different dispersion measurements and h in the Huber weight function will be discussed based on simulation study.

4.1 Simulation Results

This section will discuss how the proposed dispersion measurement outperformed the MAD and IQR presented by Park and Cho (2003) when using AO contamination of 10% and 20% for $T = 500,\ 1000,\ 5000$. Again, in this simulation, two concerns were addressed: dispersion measurement and h.

4.2 Dispersion Measurement

Table no. 2 depicts the performance of non-Huber weight and dispersion measurements of 0%, 10%, and 20% AO contamination based on MSE. The MSE result for $T = 500$ reported a 54.4922 increase compared to 10% AO contamination (26.5450). IQR/3 reported a minimum MSE value of 0.3753 for $T = 500$ during contaminated 10% AO, a drop of 98.6% when compared to the non-weighting value (26.5450). The results were followed by a 96.2% drop in MAD and a 95.1% drop in IQR.

The MSE for the IQR/3 in the 20% contamination of AO reported a minimum value of 0.4306, followed by MAD and IQR, which were 1.2855 and 1.8402, respectively. Compared to the non-weighting measurements, all three-dispersion measurements decreased by 99.2%, 97.6%, and 96.6%, respectively (54.4922). A similar situation occurred when T=1000 and 5000.

Table no. 2 – MSE for non-Huber weight and dispersion measurement

T	P_{AO} (%)	NW	MAD	IQR	IQR/3	ΔMAD	ΔIQR	ΔIQR/3
500	0	0.91910						
	10	26.5450	0.9974	1.3061	0.3753	- 96.2	- 95.1	- 98.6
	20	54.4922	1.2855	1.8402	0.4306	- 97.6	- 96.6	- 99.2
1000	0	0.91910						
	10	23.5924	0.9612	1.2472	0.3346	- 95.9	- 94.7	- 98.6
	20	52.9005	1.3382	1.8595	0.4390	- 97.5	- 96.5	- 99.2
5000	0	1.00160						
	10	25.4275	1.0434	1.3575	0.3839	- 95.9	- 94.7	- 98.5
	20	49.5896	1.4176	2.0162	0.4871	- 97.1	- 95.9	- 99.0

Note: *T* = time series length, P_{AO} = percentage contamination of AO, NW = non-weighting, ΔMAD = percentage change of MAD, ΔIQR = percentage change of IQR, ΔIQR/3 = percentage change of IQR/3.

Table no. 3 presents the performance of non-Huber weight and dispersion measurement with RMSEs of 0% (without contamination), 10%, and 20% AO contamination. The RMSE value for T=500 increased 43.3% during 20% AO contamination to 7.3819 compared to the 10% AO contamination (5.1522). When T=500 and PAO = 10%, the RMSE values for MAD, IQR, and IQR/3 were 0.9987, 1.1429, and 0.6126, respectively. The IQR/3 had the greatest percentage reduction in RMSE at 88.1%, followed by MAD (80.6%) and IQR (77.8%).

As PAO was increased to 20%, IQR/3 reported a minimum of RMSE of 0.6562, a drop of 91.1% when compared to the non-weighting (7.3819). The MAD and IQR, on the other hand, fell by 84.6% and 81.6%, respectively. When the time series length was increased to 1000 and 5000, a similar situation occurred.

Table no. 3 – RMSE for dispersion measurement in Huber weight.

T	P_{AO} (%)	NW	MAD	IQR	IQR/3	ΔMAD	ΔIQR	ΔIQR/3
500	0	0.9587						
	10	5.1522	0.9987	1.1429	0.6126	- 80.6	- 77.8	- 88.1
	20	7.3819	1.1338	1.3566	0.6562	- 84.6	- 81.6	- 91.1
1000	0	0.9587						
	10	4.8572	0.9804	1.1168	0.5785	- 79.8	- 77.0	- 88.1
	20	7.2733	1.1568	1.3636	0.6626	- 84.1	- 81.3	- 90.9
5000	0	1.0008						
	10	5.0426	1.0215	1.1651	0.6196	- 79.7	- 76.9	- 87.7
	20	7.0420	1.1906	1.4199	0.6979	- 83.1	- 79.8	- 90.1

Note: *T* = time series length, P_{AO} = percentage contamination of AO, NW = non-weighting, ΔMAD = percentage change of MAD, ΔIQR = percentage change of IQR, ΔIQR/3 = percentage change of IQR/3.

The MAD results for the MSE and RMSE were more robust than the IQR at the P_{AO} = 10% and 20%. Tables no. 2 and no. 3 show that the percentage decrement for MAD is more significant than that for IQR. It has been reported that the MAD is an excellent choice for measuring dispersion (Rousseeuw & Croux, 1993; Simpson & Montgomery, 1998). This is supported by a study done by Park and Cho (2003), which discovered that MAD could be identified as a robust dispersion measurement under a normal distribution with contaminated data. However, our results showed that the IQR/3 outperformed the MAD and IQR during contamination with 10% and 20% AO.

4.3 Tuning Constant, h

The performance of the three-dispersion measurement based on MSE between $h = 1.345$ and $h = 1.5$ is shown in Table no. 4. At T=500, P_{AO} = 10%, and $h = 1.345$, the IQR/3 showed the lowest MSE value compared to MAD and IQR. The MSE value for IQR/3, MAD, and IQR was 0.3173, 0.8968, and 1.1878, respectively, decreased by 98.8%, 96.6%, and 95.5% compared to the non-weighting value (26.5450) in Table no. 2. The MSE value for the three-dispersion measurement was lower when $h = 1.345$ rather than $h = 1.5$, as per this data. For P_{AO} = 20%, $h = 1.345$, the minimum MSE value was IQR/3, which had the highest percentage decrement of 99.3%, followed by MAD (97.9%) and IQR (97.0%). When the time series length was increased to 1000 and 5000, a similar situation occurred.

Table no. 4 – MSE and percentage change (in parentheses) for dispersion measurement with $h = \{1.345, 1.5\}$

T	P_{AO}	$h = 1.345$			$h = 1.5$		
		MAD	**IQR**	**IQR/3**	**MAD**	**IQR**	**IQR/3**
500	10%	0.8968 (- 96.6)	1.1878 (- 95.5)	0.3173 (- 98.8)	0.9974 (- 96.2)	1.3061 (- 95.1)	0.3753 (- 98.6)
500	20%	1.1212 (- 97.9)	1.6078 (- 97.0)	0.3641 (- 99.3)	1.2855 (- 97.6)	1.8402 (- 96.6)	0.4306 (- 99.2)
1000	10%	0.8570 (- 96.4)	1.1326 (- 95.2)	0.2829 (- 98.8)	0.9612 (- 95.9)	1.2472 (- 94.7)	0.3346 (- 98.6)
1000	20%	1.1751 (- 97.8)	1.6375 (- 96.9)	0.3711 (- 99.3)	1.3382 (- 97.5)	1.8595 (- 96.5)	0.4390 (- 99.2)
5000	10%	0.9352 (- 96.3)	1.2375 (- 95.1)	0.3242 (- 98.7)	1.0434 (- 95.9)	1.3575 (- 94.7)	0.3839 (- 98.5)
5000	20%	1.2467 (- 97.5)	1.7674 (- 96.4)	0.4113 (- 99.2)	1.4176 (- 97.1)	2.0162 (- 95.9)	0.4871 (- 99.0)

Note: T = time series length, P_{AO} = percentage contamination of AO, the values in parentheses represents the percentage change.

Table no. 5 – RMSE and percentage change (in parentheses) for dispersion measurement with $h = \{1.345, 1.5\}$

T	P_{AO}	$h = 1.345$			$h = 1.5$		
		MAD	**IQR**	**IQR/3**	**MAD**	**IQR**	**IQR/3**
500	10%	0.9470 (- 81.6)	1.0899 (- 78.8)	0.5633 (- 89.1)	0.9987 (- 80.6)	1.1429 (- 77.8)	0.6126 (- 88.1)
500	20%	1.0589 (- 85.7)	1.2680 (- 82.8)	0.6034 (- 91.8)	1.1338 (- 84.6)	1.3566 (- 81.6)	0.6562 (- 91.1)
1000	10%	0.9257 (- 80.9)	1.0643 (- 78.1)	0.5319 (- 89.1)	0.9804 (- 79.8)	1.1168 (- 77.0)	0.5785 (- 88.1)
1000	20%	1.0840 (- 85.1)	1.2796 (- 82.4)	0.6092 (- 91.6)	1.1568 (- 84.1)	1.3636 (- 81.3)	0.6626 (- 90.9)
5000	10%	0.9671 (- 80.8)	1.1124 (- 77.9)	0.5694 (- 88.7)	1.0215 (- 79.7)	1.1651 (76.9)	0.6196 (- 87.7)
5000	20%	1.1165 (- 84.1)	1.3294 (- 81.1)	0.6413 (- 90.9)	1.1906 (- 83.1)	1.4199 (- 79.8)	0.6979 (- 90.1)

Note: T = time series length, P_{AO} = percentage contamination of AO, the values in parentheses represents the percentage change.

Table no. 5 shows the RMSE performance of the three-dispersion measurement between $h = 1.345$ and $h = 1.5$. IQR/3 reported a minimum RMSE value of 0.5633 for $T = 500$, P_{AO} = 10%, and $h = 1.345$, a drop of 89.1% compared to the non-weighting (5.1522). This was followed by a drop in MAD and IQR of 81.6% and 78.8%, respectively. At $T = 500$, P_{AO} = 20%, and $h = 1.345$, the MSE for the IQR/3 was 0.6034, followed by the MAD and IQR, which were 1.0589 and 1.2680, respectively. Compared to the non-weighting measurements, all three-dispersion measurements decreased by 91.8%, 85.75%, and 82.8%, respectively (7.3819). A similar situation occurred when $T = 1000$ and 5000.

This study found that as the proposed tuning constant $(h = 1.5)$ increased in comparison to the default $(h = 1.345)$, the MSE (in Table no. 4) and RMSE (in Table no. 5) for MAD, IQR, and IQR/3 also increased. The findings in Tables no. 4 and no. 5 proved that as the constant tuning increased, the amount of resistance to outliers decreased and efficiency increased (Cummins & Andrews, 1995; Elsaied & Fried, 2016). The current finding also supported Cummins and Andrews (1995) study, which found that increasing h is better since it reduces the risk of correcting "good" data. Our findings revealed that the IQR/3 outperformed MAD and IQR during AO contamination (P_{AO} = 10%, 20%) with $h = \{1.345, 1.5\}$.

5. CONCLUSIONS

This study aimed to examine and compare the efficiency of Huber weights by taking dispersion measurement and tuning constant into account. The following conclusions can be drawn from the computed results:

1) The simulation results concluded that the proposed dispersion measurement IQR/3 in the Huber weight function performed better than MAD and IQR during 10% and 20% AO contamination.

2) The findings demonstrated that the IQR/3 becomes more robust as the percentage of AO contamination and time series length increase.

3) $h = 1.5$ outperformed the default value $(h = 1.345)$, resulting in less resistance to outliers and greater efficiency.

The current study makes several contributions. First, we propose a method for detecting outliers before the estimation process. Second, the precision of IQR/3 as a dispersion measurement and the tuning constant $(h = 1.5)$ in the Huber weight function can help to reduce the effect of an additive outlier. Finally, the proposed Huber's dispersion weight is quick and straightforward to apply, making it an appealing tool for academic and/or practitioner communities

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ORCID

Intan Martina Md Ghani http://orcid.org/0000-0002-1212-6175
Hanafi A. Rahim https://orcid.org/0000-0002-9367-5423

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Globalization and Per Capita Income Growth in Emerging Economies

Ubong Edem Effiong*

Abstract: In this study, the efficacy of globalization in influencing income growth within the Sub-Saharan Africa (SSA) from 1982 to 2020 is being examined. The "Konjunkturforschungsstelle Globalization Index" (KOFGI) was used to measure globalization at the overall, economic, social, and political level, while income growth was captured using the growth rate of gross national income per capita. The data employed in the analysis were gotten from World Bank and KOFGI database. The analysis follows a sequential order of unit root test based on the augmented Dickey-Fuller, autoregressive distributed lag (ARDL) bounds test for cointegration, and error correction model. The unit root test revealed that the order of integration of the variables were mixed at levels and first difference. The bounds test showcased that all the dimensions of globalization exhibited long-run association with income growth. The short-run result indicated that globalization wielded a negative and significant effect on income growth. A unit percent increase in globalization put forth a 1.3818% decrease in income growth. In the long-run, globalization however exerted a positive but insignificant sway on income growth in the SSA. The implication of this is that though globalization poses a short-run negative impact on income growth, the SSA can move along the learning curve to derive some long-term benefits that emanate from global interactions. It becomes pertinent for the SSA to see globalization as a long-term avenue for propelling income growth, bearing in mind that the short-run negative effect can be corrected periodically as the economy moves along the learning curve of globalization.

Keywords: globalization; inequality; gross national income; Sub-Saharan Africa; KOF.

JEL classification: C82; D30; F02; F62; F63; F69; O55; N37.

* Department of Economics, University of Uyo, Nigeria; e-mail: *ubongeffiong3@gmail.com*.

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1. INTRODUCTION

The Sub-Saharan Africa has been open to international borders which influences its economic, social, cultural, and political activities. Such openness can have some implications on her macroeconomic variables like income, inequality, employment, and external balance. This has caused some researchers to investigate into how globalization can effect macroeconomic variables. This brought up diverse themes by different scholars who attempted to examine the effect of globalization on growth (see Dreher, 2003; Stiglitz, 2004; Samimi & Jenatabadi, 2014; Atan & Effiong, 2020; Effiong, 2021); effect of globalization on inequality (see Miller, 2001; Dreher, 2006; Goldberg & Pavcnik, 2007; Bergh & Nilsson, 2011; Atif *et al.*, 2012; Han *et al.*, 2012; Jaumotte *et al.*, 2013; Jin, 2014); effect of globalization on income distribution (Milanovic, 2002; Zhou *et al.*, 2011) and effect of globalization on industrialization (Kaya, 2010); and effect of globalization on unemployment (Moore & Ranjan, 2005; Mitra & Ranjan, 2010; Janiak, 2013; Adamu *et al.*, 2018; Altiner *et al.*, 2018; Atan & Effiong, 2020; Effiong *et al.*, 2020).

Globalization is a contentious issue. Globalization, interpreted as free trade, is internationally advantageous in raising national incomes, in line with classical and neoclassical literature on trade benefits. The discussion is centred on distributional consequences. The Stolper-Samuelson theorem, applied in a Heckscher-Ohlin framework, indicates that freer trade benefits relatively ample factors while hurting relatively scarce factors –Stolper and Samuelson (1941) cited in Potrafke (2014). Other income distribution impacts result from outsourcing, non-traded goods, and the trading of inputs.

Globalization has social justice implications because of economic distribution. Owing to increased rivalry between individuals, corporations, governments, and nations, critics of globalization have blamed it for permeable social security systems, poverty, social inequality, and shrinking government size and scope (Stiglitz, 2004; Heine & Thakur, 2011). Globalization's 'benefits include the halt of the "Cold War" and fast economic growth in some Asian countries (Potrafke, 2014). However, in developed nations, the financial crunch that was instigated in 2007 and growing economic disparity fuelled criticism of capitalism and globalization.

Globalization is a multidimensional idea that encompasses economic, social, and political implications beyond trade openness and capital flows. The Kearney/Foreign Policy Magazine globalization index, the CSGR Globalization index (Lockwood & Redoano, 2005) or the Global Index (Raab *et al.*, 2008), and the Maastricht Globalization Index (Martens & Zywietz, 2006; Martens & Raza, 2009; Figge & Martens, 2014) are examples of comprehensive indexes that encompass economic, social, and political dimensions. The KOF globalization index is used quite often among all the globalization index (Dreher & Gaston, 2006; Dreher *et al.*, 2008). The KOF index defines globalization consistent with Clark (2000) as "the process of establishing multicontinental networks of linkages among players, interceded by a variety of flows such as people, information and ideas, capital, and products" (Potrafke, 2014).

Globalization diverges from 'internationalization', 'liberalization', 'universalization' or 'Westernization' by defining globalization as "the spread of trans-planetary or supra-territorial relations amid people". Internationalization refers to "a growth in cross-national commerce and interdependencies"; "the process of reducing legally imposed barriers on the flow of resources between countries is known as liberalization"; "the process of disseminating

diverse things and experiences to individuals in all inhabited places of the globe is known as universalization"; while Westernization is defined as "a sort of universalization in which Western societies' social frameworks are diffused across the globe" (Scholte, 2008; Caselli, 2013; Gygli *et al.*, 2019). These concepts are meticulously interconnected and calls for a clear distinguish among them. It is worthy of note that "when using a pluralistic and multiscale definition of globalization, no differentiation between the aforementioned concepts is required" (Figge & Martens, 2014).

In line with the *KOF globalization index*, as earlier developed by Dreher (2006) captures globalization into three – *economic, social, and political dimensions*. The economic dimension encapsulates actual flows (trade, FDI, portfolio investment, and income outflows to overseas residents), and trade restrictions (concealed import blockades, average tariff rate, taxes on transnational trade, and capital account kerbs). The social dimension comprises data on personal contact (telephone traffic, transfers, transnational tourism, overseas residents, transnational letters), data on information movements (internet users, television, trade in newspapers), and data on cultural propinquity (number of McDonald´s restaurants, number of IKEA, trade in books). The political globalization index takes account of embassies in countries, membership in international organizations, participation in U.N. Security Council Missions, and international treaties (Gygli *et al.*, 2019). The overall index is made up of the three sub-indices. A principal component analysis is used to weight the sub-indices. The variance of the variables utilized is computed using all available data for each individual variable in the main component analysis. The bigger the variation of a single variable, the greater the variable's weight (see KOF Swiss Economic Institute, 2021, for detailed method of computation).

The trend in globalization within the Sub-Saharan Africa has maintained a rising trend over the years. In the 1970s, the index of globalization averaged 29.46% and increasing from 27.79% in 1970 to 30.89% in 1979; and growing at the rate of 11.16% between the two periods. The 1980s witnessed a steady rise in globalization as the index rose from 31.41% in 1980 to 32.66% in 1989, growing at the rate of 3.98% between the two period and averaging 32.23% in the 1980s. The 1990s diverged from the steady increase in the 1980s by reflecting a rising globalization trend. The index rose from 33.15% in 1990 to 39.43% in 1999 with a growth rate of 18.94% and averaging 36.15% within the 1990s. In the 2000s, 200 to 2009, the rising trend in the 1990s was intensified as the index amplified from 40.20% in 2000 to 46.73 in 2009, averaging 43.38% and growing at a rate of 7.72% between the two periods. Subsequent years, 2010 to 2020 was still marked with increasing globalization trend from 47.52% to 50.12% for the respective periods; averaging 49.36% with a 5.47% growth rate.
At the income level, greater oscillations were recorded within the income growth in the SSA. With a positive growth rate throughout the 1970s and an average growth rate of 15.43%, the region plunged into periods of negative income growth rates in the 1980s with an average of 5.12% being recorded. The situation worsened in the 1990s as the average income growth rate further plunged to 3.02% having a period of negative growth rate up to four different years. Significant improvements were recorded in 2000 to 2009 where the region recorded an average of 12.29% income growth rate. starting from 2010 and ending in 2020, the region recorded an income growth rate of 17.42% in 2010 but this oscillated and plunged to a negative growth rate to the tune of -5.21%; and recording an average growth rate of 3.59% within the period. Figure no. 1 presents this movement in the two variables over time.

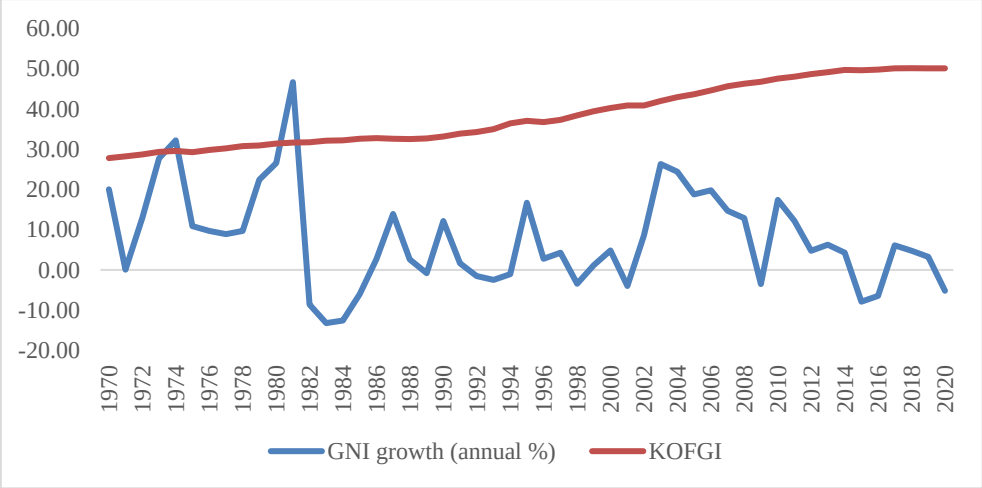

Figure no. 1 – Trend of GNI growth and Globalization in SSA, 1970 - 2020

Given the volatile trend in the income growth within the SSA and the rising trend in globalization, could it be that globalization has influenced income growth through the channel of the 'Stolper-Samuelson' theorem? It therefore becomes an imperative to investigate this empirically. The core aim of this study is to ascertain the influence of globalization on the growth of income within the Sub-Saharan African region. The specific objectives include:

a) To examine the effect of globalization on the growth of gross national income per capita,

b) To analyse the influence of economic globalization on the growth of gross national income per capita,

c) To investigate the sway of social globalization on the growth of gross national income per capita, and

d) To examine the effect of political globalization on the growth of gross national income per capita.

The paper is segmented into five major headings. The introduction which is section 1 is accompanied with the review of related literature in Section 2. Section 3 clearly defined the methodology of the research; while Section 4 presents the empirical findings. Then, Section 5 adumbrates the conclusion and recommendations of the study based on findings.

2. REVIEW OF RELATED LITERATURE

The pass through mechanism through which globalization can influence macroeconomic variables has been clearly defined in the literature. One of it is the 'Stolper-Samuelson' theorem emanating from the 'Heckscher-Ohlin' model (Jaumotte *et al.*, 2013). It states that "in a two-country two-factor structure, amplified trade openness (through tariff reduction) in a developing country where low-skilled labour is ample would upshot an increase in the wages of the low-skilled workers and a reduction in the compensation of the high-skilled workers, leading to a decline in income inequality" (Stolper & Samuelson, 1941).

When import tariffs are cut, the price of the (importable) high-skill intensive product drops, as does the compensation of the scarce high-skilled workforces, whereas the price of the (exportable) low-skill intensive good, for which the country has relatively abundant factors, rises, as does the reimbursement of low-skill workforces. In a sophisticated economy where high-skill components are plentiful, the opposite would hold true, with more openness leading to increased inequality.

The repercussions of the 'Stolper-Samuelson' theorem, particularly the enhancing effects of trade liberalization on income inequality in developing countries, have been intensively researched but have yet to be validated in large-scale investigations (Jaumotte *et al.*, 2013). Winters *et al.* (2004) present an outstanding review of the research and show that "there can be no clear general conclusion regarding the link between trade liberalization and poverty." Despite this proviso, the report substantially supports the theoretical presupposition that trade liberalization will alleviate poverty and provides little evidence for the argument that trade liberalization will increase inequality.

The growth in skill premium between skilled and unskilled employees observed in most emerging nations has been a special problem. This has resulted in a number of changes to the 'Heckscher-Ohlin' model, plus the addition of multiple countries, allowing poor (rich) countries to import low-skill (high-skill) intensive goods from other poor (rich) countries; the introduction of a continuum of goods, implying that "what is low skill-intensive in an advanced economy will be relatively highly skill-intensive in a less developed country" (Feenstra & Hanson, 1996); and the addition of intangible goods. Nonetheless, these additions have posed new difficulties for empirical testing.

Consequent upon these defies, a dissimilar literature has appeared arguing that "the 'Heckscher-Ohlin' model is fickle with contemporary inequality practise globally, not just in terms of inequality snowballing in developing countries, but also across multiple other dimensions – perhaps, factor reallocation appears to transpire principally within rather than across sectors" (Berman *et al.*, 1994); cum infinitesimal variations in the prices of unskilled labour (Lawrence & Slaughter, 1993). Modern theoretical and empirical research attempt to the reconsideration of the impacts of trade on inequality in the setting of heterogeneous enterprises and yield insights that differ significantly from those delivered by the 'Heckscher-Ohlin' model (Yeaple, 2005; Verhoogen, 2008; Egger & Kreickemeier, 2009).

Further empirical studies have been conducted at numerous levels. Milanovic (2002) investigated how globalization affects income distribution using data from the household budget survey, along with the sway of openness and FDI on the relative income shares of the low and high deciles. The study discovered some evidence that at extremely low average income levels, openness benefits the wealthy. As income levels surge, around the level of Colombia, Chile, or the Czech Republic, the situation changes, and the relative income of the poor and middle class grows in comparison to the affluent. Consequently, the effect of openness on a country's income distribution is determined by the country's prior income level.

Dreher (2003) offers a globalization index that considers the three dimensions: economic, social, and political. The aggregate index of globalization, plus sub-indices built to quantify the single components, are experimentally examined using panel data for 123 economies from 1970 to 2000. The findings suggest that globalization improves growth, but not to the amount required to significantly decrease poverty. Actual economic flows cum limits in industrialized nations are the variables most strongly linked to growth. Information flows, while less powerfully, also support growth, but political integration has little effect.

Dreher and Gaston (2006) were concerned with determining how globalization can influence income inequality in OECD and LDCs for 1970 through 2000 using panel data analysis. By dissecting globalization to the three dimensions of economic, social, and political, the economic factor of globalisation has increased industrial pay disparity in industrialized nations. To a lesser extent, the political and social components of globalisation appear to have contributed to rising pay disparity. In divergence, they discovered that globalisation had a minor influence on inequality in less developed nations. Grounded on the evidence, the conclusion that globalisation had no discernible influence on income inequality – at least as assessed by Gini coefficients – appears to be generally unarguable.

Kaya (2010) examined the impact of the most recent wave of economic globalization on manufacturing jobs in developing nations, utilizing data from 64 developing countries from 1980 to 2003. The findings demonstrated that manufacturing employment rose in the majority of emerging nations. First, consistent with this study, the degree of economic development as defined by GDP per capita is the most vital factor impacting the amount of manufacturing employment. Second, economic globalization has an impact on manufacturing jobs in emerging nations, mostly via trade. Consistent with the findings, the most recent wave of economic globalization has backed the enlargement of manufacturing employment in developing nations, however it is not the most important factor defining the size of manufacturing employment in these countries.

Bergh and Nilsson (2011) used GMM to investigate the relationship between globalization and within-country income disparity. They included various control variables and controlled for potential endogeneity. The research offered strong econometric analysis using a large panel data sample of 80 countries, spanning through 1970 to 2005. The KOF index, in particular, was used to quantify globalization, while the 'Fraser Institute's Economic Freedom Index' was used to evaluate economic disparity within countries. They found that economic freedom changes appear to enhance inequality mostly in the North, whereas social globalization is more relevant in the South. It has also been discovered that monetary, legal, and political globalization do not promote inequality.

Zhou *et al.* (2011) explored the influence of globalization on the distribution of income inequality in 60 industrialized, transitional, and developing nations. The Kearney index and the principal component index were employed as globalization indexes. It has been said that globalization may either reduce or increase economic inequality, and the majority of empirical data is disputed and inconclusive.

Atif *et al.* (2012) examined the influence of globalization on income inequality by estimating static and dynamic models for 68 developing countries' panel data from 1990 to 2010. Consistent with the findings, increased globalisation in developing nations leads to increased income disparity. However, several limitations in this research lead to the conclusion that possibly a basic, all-encompassing link does not exist in the issue. Reasonably, the influence of globalisation on income distribution may differ among nations, conditional upon the structures and institutions in place.

Han *et al.* (2012) used data from the Chinese Urban Household Survey from 1988 to 2008 to assess the influence of globalization on pay disparity. They investigate whether regions more open to globalization suffered greater changes in pay inequality than less-exposed regions in the aftermath of two trade liberalization shocks, Deng Xiaoping's Southern Tour in 1992 and China's entrance to the World Trade Organization (WTO) in 2001. At odds with the 'Heckscher–Ohlin' model's expectations, they discovered that WTO membership

was strongly related with growing pay disparity. They also show that both trade liberalizations increased within-region inequality by rising educational returns (returns to high school after 1992 and returns to college after 2001).

Jaumotte *et al.* (2013) investigated the link amid the rapid rate of trade and financial globalization and the growth in income disparity seen in most nations over the last two decades. Using collected panel data of 51 nations from 1981 to 2003, the research produced findings that suggest a stronger influence of technical advancement on inequality than globalization. The narrow total sway of globalization echoes a dual opposing tendencies: although trade globalization is linked with lower inequality, financial globalization - particularly foreign direct investment - is related with higher inequality.

Samimi and Jenatabadi (2014) evaluated the impact of economic globalization on Organization of Islamic Cooperation (OIC) countries' economic growth from 1980 to 2008. In addition, the study looked at the impact of complementing policies on the growth effect of globalization. It also looked at whether the growth effect of globalization is affected by a country's income level. The study presented evidence that economic globalization has a statistically significant influence on economic growth in OIC nations by employing the generalized method of moments (GMM) estimator within the framework of a dynamic panel data methodology. In keeping with the findings, this favourable effect is amplified in nations with better-educated employees and well-developed financial institutions.

Using the Pendroni cointegration test and the panel fully modified OLS, Ying *et al.* (2014) examined the effect of short-run dynamics and long-run equilibrium links flanked by globalization and the rise of the Association of Southeast Asian Nations (ASEAN) between 1970 and 2008. (FMOLS). The Pedroni cointegration test exposed a robust unified link amid globalization and economic growth, whereas the FMOLS shown that the elasticity of economic growth with reference to globalization is 1.48, indicating that globalization has a positive and noteworthy effect on economic growth. Furthermore, the study found that social globalization has a deleterious and considerable impact on economic growth, although political globalization has a negligible impact.

Kilic (2015) investigated the impact of globalization's three elements – economic, social, and political – on the economic growth of 74 developing nations from 1981 to 2011. The fixed effects least squares dummy variable panel regression and the Granger Causality test developed by Dumitrescu and Hurlin (2012) were used in this investigation. Consistent with the findings of this study, economic and political globalization have a favourable influence on economic growth, however social globalization has a detrimental impact on economic growth. Furthermore, the article revealed a bidirectional causative association between political and social globalization and economic growth, whereas social globalization and economic growth have a one-way causal relationship.

Majidi (2017) considered the effect of the three measurements of globalization on economic growth in one hundred developing countries from 1970 through 2014. The outcomes disclosed that political globalization wielded an undesirable and substantial influence on economic growth in upper middle income countries; while economic and social globalization had an inconsequential weight on economic growth. Further, the influence of overall and political globalization on economic growth in lower middle income countries is positive and substantial but economic cum social globalization have no noteworthy effect.

Hasan (2019) considered the waves of globalization on economic growth of South Asian countries from 1971 through 2014. The study used Pooled Mean Group (PMG) panel

cointegration model. The outcome designated that overall globalization, economic globalization, and political globalization stimulate economic growth in the long-run. However, the dimensions of globalization have no short-run momentous weight.

Atan and Effiong (2020) investigated the impact of globalization on economic growth in 25 African nations from 1991 to 2017. The Konjunkturforschungsstelle (KOF) indicator of globalization was used in this study. The panel unit root test, cointegration test, ARDL vector error correction mechanism (VECM), and Granger Causality test were used in the study. It was discovered that globalization has a favourable and considerable long-run influence on economic growth but a negative and small short-run effect. The Dumitrescu Hurlin Panel Causality Tests demonstrated a bidirectional association between globalization and African economic growth. The paper's policy implication is that African countries should recognize the long-term prominence of globalization as a potent force driving a modern economy; thus, coherent policies should be developed and geared toward managing the excesses of globalization in order to keep up with the ever-changing world.

Recently, Effiong (2021) focused on detecting the short-run and long-run sway of globalization (KOF globalization index) on economic development of Nigeria. The use of error correction mechanism, variance decomposition, and impulse response function, time series data from 1970 to 2017 were analysed. It was realized that economic globalization wielded a deleterious and momentous effect on economic development; while both political and social globalization exercised no substantial short-run effect. In the long run, economic globalization put forth a destructive and noteworthy effect on development; political globalization wielded a desirable and noteworthy effect on development; while social globalization wielded a deleterious and substantial effect on development.

Given the empirical studies conducted so far, majority of the studies focused outside the Sub-Saharan Africa from 1982 through 2020. Also, they are concerned with economic growth and income inequality. This paper fills this gap by considering whether globalization has been influencing income growth within Sub-Saharan Africa. In achieving this, the paper utilizes the autoregressive distributed lag approach since it can easily aid in the estimation of the short-run and long-run effect. The index of globalization to be used is the KOF globalization index earlier developed by Dreher (2006) while income growth is measured as the growth rate of gross national income per capita. The choice of this is to aid us to see how the effect of globalization tickles down to an individual in the Sub-Saharan Africa.

3. METHODOLOGY

3.1 The Model

Ascertaining the influence of globalization on any macroeconomic variable will require the construction of an index of globalization. In this study, globalization is the independent variable while income growth (growth rate of gross national income per capita) is the dependent variable. Our index of globalization utilized in this study is the one developed by Dreher (2006) which dissects globalization into economic, political, and social dimensions. Our model is constructed to capture the individual effect of the three dimensions and the overall effect of globalization on income growth. This lead to the construction of four different models by adapting the model of Dreher and Gaston (2006) as portrayed below.

Model I: To ascertain the influence of economic globalization on income growth

$$GNIPC = f(EKOFGI, GDSAV, GFCF, INDVA, POPG)- \quad (1)$$

Model II: To ascertain the influence of social globalization on income growth

$$GNIPC = f(SKOFGI, GDSAV, GFCF, INDVA, POPG) \quad (2)$$

Model III: To ascertain the influence of political globalization on income growth

$$GNIPC = f(PKOFGI, GDSAV, GFCF, INDVA, POPG) \quad (3)$$

Model IV: To ascertain the influence of overall globalization on income growth

$$GNIPC = f(KOFGI, GDSAV, GFCF, INDVA, POPG) \quad (4)$$

where:

GNIPC = Gross National Income Per Capita (% annual growth rates)
KOFGI = Konjunkturforschungsstelle (KOF) Globalization Index
EKOFGI = KOF Economic Globalization Index
SKOFGI = KOF Social Globalization Index
PKOFGI = KOF Political Globalization Index
GDSAV = Gross Domestic Savings (% of GDP)
GFCF = Gross Fixed Capital Formation (% of GDP)
INDVA = Industry Value Added (% of GDP)
POPG = Population (Annual Growth Rates)

Equation (1) to Equation (4) are then transformed into their estimable form and are presented as follows:

$$GNIPC = \delta_0 + \delta_1 EKOFGI + \delta_2 GDSAV + \delta_3 GFCF + \delta_4 INDVA + \delta_5 POPG + \mu_1 \quad (5)$$

$$GNIPC = \alpha_0 + \alpha_1 SKOFGI + \alpha_2 GDSAV + \alpha_3 GFCF + \alpha_4 INDVA + \alpha_5 POPG + \mu_2 \quad (6)$$

$$GNIPC = \beta_0 + \beta_1 PKOFGI + \beta_2 GDSAV + \beta_3 GFCF + \beta_4 INDVA + \beta_5 POPG + \mu_3 \quad (7)$$

$$GNIPC = \pi_0 + \pi_1 KOFGI + \pi_2 GDSAV + \pi_3 GFCF + \pi_4 INDVA + \pi_5 POPG + \mu_4 \quad (8)$$

The variables are as earlier defined; δ_0, α_0, β_0, and π_0 are the constants which are expected not to be equal to zero; and δ_1 to δ_5, α_1 to α_5, β_1 to β_5, and π_1 to π_5 are the parameters to be estimated. In regards to the effect of globalization, the expected sign are as follows: $\delta_1 > 0$; $\alpha_1 > 0$; $\beta_1 > 0$ or < 0; and π_1 = unknown (Dreher, 2006).

3.2 Nature and Sources of Data

The data utilized is time series by nature starting from 1982 and ending in 2020. This time frame is only for the data used for econometric analysis. Meanwhile, some data starts

from 1970 while others starts from 1990. These once were mainly used to discuss some stylized facts. The data on gross national income were gotten from World Bank (2021) publication on "World Development Indicators", while data on globalization were derived from KOF Swiss Economic Institute (2021) as earlier developed by Dreher (2006) and expanded by Gygli *et al.* (2019) They dissect globalization into economic, social and political dimensions. The indicators ranges from 0 to 100 showing the magnitude to which an economy is globalized.

3.3 Analytical Technique

In the data analysis, the paper adopts the sequential order of analysis since we are using time series variables. At first, a test for the existence of unit root among the time series variables using the augmented Dickey-Fuller (ADF) unit root test under the constant and trend assumption is executed. The test equation is specified thus;

$$\Delta X_t = \alpha_0 + \delta t + \alpha_1 X_{t-1} + \sum_{i=0}^{K} \gamma_i \Delta X_{t-I} + \varepsilon_t \quad (9)$$

where X is the time series variable to be subjected to unit root test; α_0 is the constant; δ is the coefficient that captures the trend (t) assumption; k is the optimal lag length; i is the number of periods; Δ is the difference operator; the summation component captures the augmented component; and ε_t is the error term. The test is to allow us detect the order of integration of the variables for the reason of deciding the appropriate econometric approach to be used for further analysis. The null hypothesis is that there is unit root, expressed as α_1 =1. The rejection of the null hypothesis requires that the ADF statistic be more negative than the 5% critical tau (τ) statistic.

Next, the paper adopts the Bounds test for levels relationship. The test is used in the place of the conventional Engel-Granger cointegration test. The Bounds test is used when the time series variables are stationary at levels and first difference. The existence of cointegration spurred us into the final stage which entails the estimation of both the short-run dynamics and the long-run equilibrium estimates under the autoregressive distributed lag (ARDL) error correction mechanism (ECM). The model for the estimation of the ARDL short-run ECM is specified thus:

$$X_t = \varphi_0 + \sum_{i=1}^{p} \varphi_i \Delta X_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta Y_{t-i} + \sum_{i=0}^{n} \vartheta_i \Delta Z_{t-i} + \emptyset ECM_{t-1} + \varepsilon_t \quad (10)$$

The variable X_t is income growth; Y_t is the different indices of globalization; Z_t are the vector set of control variables (gross domestic savings, industrial value added, gross fixed capital formation, and population growth); $\emptyset$ captures the speed of adjustment; ECM is the error correction mechanism; and ε_t is the error term. For the model to correct short-run disequilibrium, the error correction term, $\emptyset$, is expected to be negative and statistically significant.

4. EMPIRICAL FINDINGS

4.1 Stylized Facts

The stylized facts relevant in this study is the growth in income along with the globalization trends in the Sub-Saharan Africa (SSA). These variables are captured accordingly, and their pattern discussed over stated period.

4.1.1 Stylized Facts on Income Growth in Sub-Saharan Africa

The growth in gross national income within the SSA displayed some interesting dynamics in the 1970s, up to the 2000s. These changes are reflected in Table no. 1 where the GNI at current US dollar and its growth rate from 1970 to 2020 is captured.

Table no. 1 – Gross national income (GNI) and its growth in the SSA

Year	GNI growth (annual %)	GNI (current US$ billion)	Year	GNI growth (annual %)	GNI (current US$ billion)
1970	20.02	58,598.80	**1996**	2.78	371,805.27
1971	0.05	58,625.86	**1997**	4.25	387,622.26
1972	13.00	66,246.06	**1998**	-3.47	374,170.78
1973	27.76	84,635.94	**1999**	1.20	378,658.13
1974	32.22	111,901.59	**2000**	4.86	397,049.52
1975	10.87	124,063.91	**2001**	-3.98	381,227.99
1976	9.66	136,054.01	**2002**	8.62	414,075.28
1977	8.86	148,102.97	**2003**	26.32	523,061.71
1978	9.71	162,479.19	**2004**	24.44	650,890.06
1979	22.39	198,858.70	**2005**	18.78	773,146.21
1980	26.58	251,720.32	**2006**	19.75	925,851.98
1981	46.66	369,177.38	**2007**	14.73	1,062,269.13
1982	-8.59	337,458.85	**2008**	12.89	1,199,206.74
1983	-13.22	292,861.46	**2009**	-3.52	1,156,996.36
1984	-12.58	256,016.97	**2010**	17.42	1,358,506.92
1985	-5.98	240,699.46	**2011**	12.17	1,523,842.00
1986	2.65	247,087.88	**2012**	4.78	1,596,661.54
1987	13.87	281,356.20	**2013**	6.25	1,696,382.61
1988	2.59	288,629.92	**2014**	4.30	1,769,287.14
1989	-0.81	286,305.72	**2015**	-7.87	1,630,068.96
1990	12.13	321,040.51	**2016**	-6.42	1,525,403.67
1991	1.65	326,325.41	**2017**	6.07	1,618,017.38
1992	-1.50	321,435.26	**2018**	4.72	1,694,440.65
1993	-2.50	313,389.02	**2019**	3.28	1,750,081.43
1994	-1.08	310,013.15	**2020**	-5.21	1,658,883.46
1995	16.69	361,744.38			

Source: World Bank (2021)

In the 1970s, the SSA recorded a positive growth in GNI throughout the period, averaging 15.45% with the highest growth rate of 32.22% recorded in 1974. This positive growth continued till the early 1980s where the region recorded a huge growth rate of 46.66% in 1981. Thereafter, the region plunged to a negative growth rate in GNI for four consecutive

years (1982 to 1985) with an average growth rate of -10.90%. subsequently, a recovering was recorded for three consecutive years (1986 to 1988) where the region recorded a positive growth rate of GNI to the tune of 6.37% on the average before plunging back to a negative growth rate of -0.81% in 1989. The early period of the 1990s (1990 and 1991) was marked with improvements, though this was wiped out for three consecutive years of negative GNI growth (-1.50% in 1992; -2.50% in 1993; and -1.08% 1994). This was followed by a positive growth rates of 4.29% from 1995 through 1999 though with a negative growth rate of -3.47% as at 1998.

In the 2000s, the SSA recorded a positive growth in GNI from 2000 through 2014 with exception of 2001 and 2009 where the region recorded a negative growth rate of -3.98% and -3.52% respectively. Within this period, the growth rate of GNI averaged 11.19% with the highest growth rate of 26.32% recorded in 2003. From 2015 to 2020, there has been greater volatility in the growth rate of GNI within the SSA, marked with three years of negative growth (20015, 2016, and 2020) and three consecutive years of positive growth rates (2017, 2018, and 2019). Within this period, GNI growth averaged -0.90% which is quite low and reflects a deteriorating income growth within the SSA in recent years.

To narrow down on the how much of the income could be attributed to each individual in the SSA, the GNI per capita is utilized. Table no. 2 reflects the value of the GNI per capita at 2015 constant US$ along with its growth rate for 1982 to 2020.

Table no. 2 – GNI per capita and its growth rates in the SSA

Year	GNI per capita (constant 2015 US$)	GNI per capita growth (annual %)	Year	GNI per capita (constant 2015 US$)	GNI per capita growth (annual %)
1982	1,304.77	-2.85	**2002**	1,197.04	4.96
1983	1,221.26	-6.40	**2003**	1,221.13	2.01
1984	1,213.86	-0.61	**2004**	1,268.65	3.89
1985	1,195.10	-1.55	**2005**	1,309.07	3.19
1986	1,174.83	-1.70	**2006**	1,382.01	5.57
1987	1,171.04	-0.32	**2007**	1,416.43	2.49
1988	1,201.83	2.63	**2008**	1,446.36	2.11
1989	1,186.96	-1.24	**2009**	1,456.65	0.71
1990	1,187.53	0.05	**2010**	1,486.82	2.07
1991	1,163.41	-2.03	**2011**	1,509.12	1.50
1992	1,140.06	-2.01	**2012**	1,532.26	1.53
1993	1,105.80	-3.00	**2013**	1,569.30	2.42
1994	1,096.08	-0.88	**2014**	1,625.23	3.56
1995	1,100.72	0.42	**2015**	1,637.51	0.76
1996	1,124.83	2.19	**2016**	1,621.26	-0.99
1997	1,133.01	0.73	**2017**	1,608.29	-0.80
1998	1,129.32	-0.33	**2018**	1,598.81	-0.59
1999	1,125.64	-0.33	**2019**	1,605.61	0.43
2000	1,110.14	-1.38	**2020**	1,537.35	-4.25
2001	1,140.44	2.73			

Source: World Bank (2021)

With the dynamics in population growth within the SSA growing at an average of 2.76% (see Figure no. 2), it is worthy to note that such growth in population will affect how much of the GNI goes to each individual if such population growth in not matched with increasing GNI.

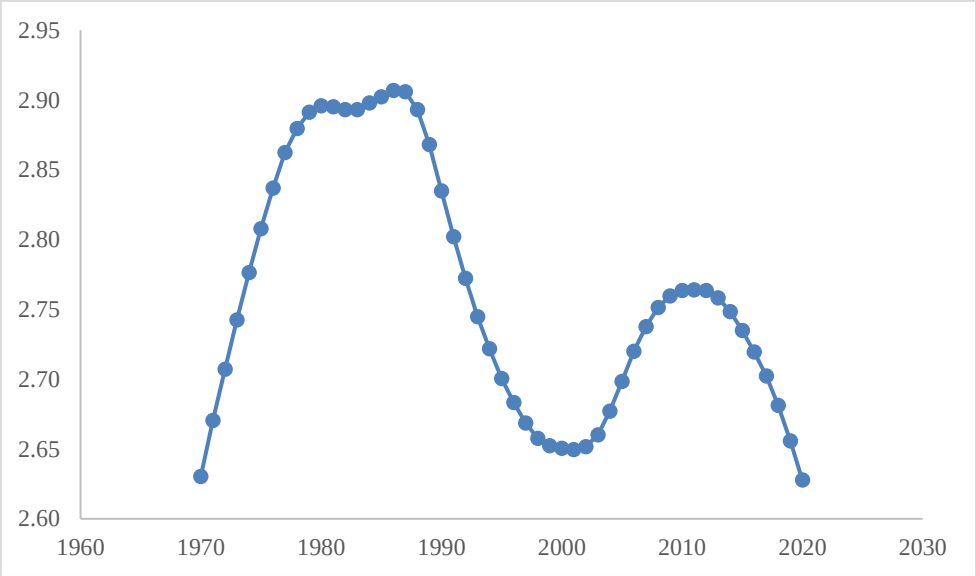

Figure no. 2 – Population growth rates in the Sub-Saharan Africa (1970 – 2020)

The GNI per capita (constant 2015 US$) declined from US$1,304.77 in 1982 to US$1,187.53 in 1990 and recording an average negative growth rate of -1.33%. This negative growth rate was quite pronounced as the SSA recorded a negative growth rate for six consecutive years (1982 – 1987) before a recovery to a tune of 2.63% in 1988 which was reversed in 1989 to a negative growth rate of -1.24% and then a positive growth of just 0.05% in 1990.

Further decline was recorded in the 1990s as the GNI per capita (constant 2015 US$) declined from US$1,187.53 in 1990 to US$1,110.14 in 2000, with an average growth rate of -0.66% from 1991 to 2000. This period was marked with drastic decline in GNI per capita since it recorded negative growth rates for seven years out of the ten years' period. Meanwhile, the SSA experienced greater improvements in the GNI per capita growth from 2001 till 2015 as the region recorded a positive growth rate throughout the 15 years to a tune of 2.63% on the average. This was followed by a negative growth rate for three consecutive years (2016 – 2018) to a tune of -0.79% on the average; and then a recovery set in in as at 2019 where a growth rate of 0.43% was recorded, before a subsequent decline to -4.25% in 2020. This negative growth in recent years reflects the declining standard of living in the Sub-Saharan Africa.

Using purchasing power parity (PPP) both at the constant and current prices, the GNI per capita revealed tremendous improvements over the years. Table no. 3 captures this behaviour.

Table no. 3 – GNI per capita purchasing power parity (PPP), (1990 – 2020)

Year	GNI per capita, PPP (constant 2017 international $)	GNI per capita, PPP (current international $)	Year	GNI per capita, PPP (constant 2017 international $)	GNI per capita, PPP (current international $)
1990	2,770.06	1,695.59	**2006**	3,238.49	2,746.92
1991	2,715.01	1,728.69	**2007**	3,318.85	2,890.00
1992	2,665.01	1,686.73	**2008**	3,384.49	3,007.39
1993	2,589.52	1,684.94	**2009**	3,393.49	3,043.97
1994	2,569.33	1,700.90	**2010**	3,458.15	3,154.53
1995	2,586.08	1,776.91	**2011**	3,506.99	3,273.51
1996	2,646.35	1,834.37	**2012**	3,543.35	3,287.20
1997	2,671.98	1,898.95	**2013**	3,622.89	3,449.83
1998	2,667.78	1,912.24	**2014**	3,756.17	3,656.28
1999	2,660.76	1,938.19	**2015**	3,789.84	3,667.43
2000	2,630.45	1,967.50	**2016**	3,769.85	3,713.24
2001	2,700.16	2,053.91	**2017**	3,749.20	3,751.78
2002	2,818.81	2,159.83	**2018**	3,735.98	3,832.02
2003	2,876.04	2,230.05	**2019**	3,754.82	3,917.52
2004	2,982.26	2,374.44	**2020**	3,599.15	3,795.43
2005	3,075.11	2,533.80			

Source: World Bank (2021)

At the 2017 constant international price (in $), the GNI per capita PPP exhibited a decline from $2,770.06 in 1990 to $2,660.76 in 1999; averaging $2,654.19 and reflecting a negative growth rate of -3.95% from 1990 to 1999. Meanwhile, the declining trend continued till 2001 to a tune of $2,700.16 before a tremendous increase being recorded thereafter. It increased from $2,630.45 in 2000 to $3,789.84 in 2015, averaging $3,255.97 and growing at a rate of 44.08% between the stated years. This was followed with a decline in the PPP from $3,789.84 in 2015 to $3,599.15 in 2020 reflecting a negative growth of -5.03% between the stated period, and averaging $3,721.80 between 2016 and 2020.

At the current international price (in $), the GNI per capita at PPP rose from $1,695.59 in 1990 to $1,938.19 in 1999 averaging $1,785.75 with a growth rate of 14.31%. This was followed with a continuous increase to a tune of $3,043.97 in 2009, growing at a rate of 54.71% between 2000 and 2009. Subsequent increase was recorded between 2010 and 2020 where the GNI per capita PPP at current international price averaged $3,590.80 and growing between the same period at a rate of 20.32% within the same period.

4.1.2 Stylized Facts on the Level of Globalization in Sub-Saharan Africa

In consistent with Dreher (2006), Potrafke (2015) and Gygli *et al.* (2019) the Konjunkturforschungsstelle (KOF) globalization index is disaggregated into three – economic, social, and political. Table no. 4 captures the behaviour of these indices from 1982 to 2020.

Table no. 4 – Index of globalization within the Sub-Saharan Africa, 1982 – 2020

Year	KOF Globalization Index	KOF Economic Globalization Index	KOF Social Globalization Index	KOF Political Globalization Index
1982	31.71	34.76	24.04	35.73
1983	32.13	35.11	24.06	36.55
1984	32.21	35.66	24.07	36.88
1985	32.62	36.48	23.98	37.36
1986	32.78	35.93	24.00	38.31
1987	32.62	36.12	24.12	37.56
1988	32.50	36.05	24.16	37.20
1989	32.66	36.43	24.19	37.29
1990	33.15	36.71	25.14	37.49
1991	33.85	36.35	25.27	39.74
1992	34.27	36.97	25.76	39.91
1993	34.97	38.10	25.72	41.04
1994	36.42	40.78	25.62	42.73
1995	37.06	41.20	25.91	43.94
1996	36.76	39.77	26.67	43.77
1997	37.26	40.02	27.08	44.60
1998	38.38	40.82	27.54	46.67
1999	39.43	41.34	28.66	48.23
2000	40.20	43.12	29.14	48.37
2001	40.88	43.41	30.17	49.06
2002	40.85	43.29	31.21	48.14
2003	41.94	43.13	32.46	50.30
2004	42.96	43.07	33.65	52.20
2005	43.68	43.50	34.63	52.99
2006	44.57	43.51	36.12	54.23
2007	45.66	44.35	37.32	55.46
2008	46.29	43.61	39.15	56.24
2009	46.73	43.48	40.56	56.33
2010	47.52	44.85	41.63	56.34
2011	48.04	45.59	42.73	56.10
2012	48.67	45.58	43.71	57.01
2013	49.16	45.87	44.55	57.36
2014	49.69	45.85	44.85	58.61
2015	49.65	44.95	45.08	59.15
2016	49.79	45.01	45.09	59.46
2017	50.10	45.04	45.16	59.98
2018	50.13	45.52	45.08	59.72
2019	50.11	45.28	45.12	59.85
2020	50.12	45.40	45.10	59.78

Source: KOF Swiss Economic Institute (2021)

The level of globalization has been maintaining a rising trend given the need for global interactions among different economies of the world. This is also reflected in the globalization trends in the SSA. The SSA witnessed a rising globalization as reflected in KOF globalization index from 31.71% in 1982 to 33.15% in 1990. This was followed by a 40.20% and 47.52% in 2000 and 2010 respectively. This rising trend continued steadily reaching an all-time high of 50.13% in 2018. Other dimensions of globalization follow similar trends as observed in their rising values over the years. Figure no. 3 reflects on the rising trends of globalization at the economic (EKOFGI), social (SKOFGI), and political (PKOFGI) dimensions along with the overall globalization level (KOFGI).

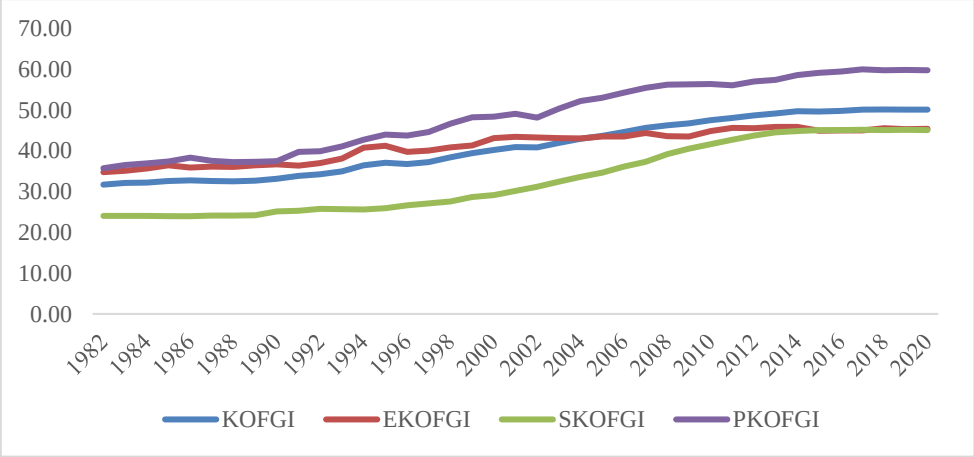

Figure no. 3 – Globalization trends in the Sub-Saharan Africa, 1982 - 2020

In line with Figure no. 3 which is derived from Table no. 4, political globalization index is observed to have a leading rising trend over the years while social globalization index has been the least until recently where it seems to measure up with economic globalization index. Economic globalization index rose from 34.76% in 1982 to 36.71% and 43.12% for 1990 and 2000 respectively. This was followed by a further increase to 44.85% and 45.52% for 2010 and 2018 respectively. Political globalization index seems to be the fastest growing index as it rose sharply from 35.73% in 1982 to 48.37% in 2000 before surging to 56.34% and 59.98 for 2010 and 2017 respectively. Social globalization index has been slow in the 1980s and 1990s standing at 24.04% in 1982 and rising steadily to 29.14% in 2000. The increase persisted to 41.63% in 2010 45.08% in 2018.

Whether this rising trend has had any significant influence on the income growth of the Sub-Saharan Africa will be determined using further econometric analysis.

4.2 Descriptive Statistics

The descriptive attributes of our variables of interest are in Table no. 5 where the table captures both the measures of central tendency and the measures of dispersion.

Table no. 5 – Descriptive characteristics of the variables

	EKOFGI	KOFGI	PKOFGI	SKOFGI	GNIPC
Mean	41.33	40.96	48.51	33.04	0.38
Maximum	45.87	50.13	59.98	45.16	5.57
Minimum	34.76	31.71	35.73	23.98	-6.4
Standard Deviation	3.81	6.79	8.62	8.40	2.49
Skewness	-0.43	0.05	-0.10	0.37	-0.25
Kurtosis	1.63	1.46	1.48	1.47	3.21
Jarque-Bera (J-B)	4.27	3.85	3.81	4.67	0.48
Probability	(0.12)	(0.15)	(0.15)	(0.10)	(0.79)
Observations	39	39	39	39	39

Source: author's computation

As captured in Table no. 5, economic globalization index, overall globalization index, political globalization index, and social globalization index averaged 41.33%, 40.96%, 48.51% and 33.04% respectively. Their respective standard deviation was 3.81%, 6.79%, 8.62%, and 8.40%. This gives their coefficient of variation to be 9.22%, 16.58%, 17.77%, and 25.42%. This reflects that social globalization index has the highest degree of variability over the study period. In regards to income growth, the growth rate of GNI per capita averaged 0.38% with a standard deviation of 2.49%; thus giving a coefficient of variability amounting to 655.26% indicating a very high degree of variability over the years. All the variables of interest are normally distributed since their J-B statistic are not statistically significant at the 5% level.

4.3 Unit Root Test

Given the fact that the paper deals with time series variables, the test for the stationarity of the series is sacrosanct. This is done using the Augmented Dickey-Fuller (ADF) test for unit root. The test is conducted using the constant and linear trend assumption, with the lag length being automatically selected using the Schwarz Information Criterion (SIC). Table no. 6 presents the result if the unit root test at level and first difference. For the null hypothesis of no unit root to be accepted, the ADF statistic must be negative and greater than the 5% critical tau statistic in absolute term (more negative).

Table no. 6 – The ADF unit root test result

Variables	ADF statistic at Level	Probability	ADF Statistic at First Difference	Probability	Order of Integration
GNIPC	-2.6652 [-3.5331]	0.2559	-8.9078 [-3.5366]	0.0000**	I(1)
KOFGI	-1.1525 [-3.5331]	0.9060	-9.9085 [-3.5366]	0.0000**	I(1)
EKOFGI	-1.5428 [-3.5331]	0.7965	-4.3136 [-3.5485]	0.0086**	I(1)
SKOFGI	-2.5991 [-3.5403]	0.2829	-10.2392 [-3.5485]	0.0000**	I(1)
PKOFGI	-1.1946 [-3.5331]	0.9774	-5.0633 [-3.5366]	0.0011**	I(1)
GDSAV	-1.3806 [-3.5578]	0.8475	-6.4469 [-3.5366]	0.0000**	I(1)
GFCF	-11.7711 [-3.5331]	0.0000**			I(0)
INDVA	-3.7311 [-3.5331]	0.0322**			I(0)
POPG	-3.4583 [-3.5443]	0.0600	-7.1596 [-3.5366]	0.0000**	I(1)

Note: ** denotes significance at 5% level, and 5% critical values are in the square bracket.
Source: author's computation

In Table no. 6, GNIPC only became stationary after first differencing as the ADF statistic (-8.9078) is more negative than the 5% critical value (-3.5366) and the probability of rejecting the null of no unit root is low. Intrinsically, GNIPC is stationary at first difference and it is an I(1) series. Similarly, KOFGI, EKOFGI, SKOFGI, PKOFGI, GDSAV, and POPG only became stationary after first difference. thus, they are also an I(1) time series variables. The variables

that were stationary at level were industrial value added (INDVA) and gross fixed capital formation (GFCF) since at their level, their ADF statistic were more negative than the 5% critical value. Thus, they are both an I(0) time series variables. It is worthy of note that some variables are stationary at levels while others at first difference. This diverse order of integration zero down to the use of the Autoregressive Distributed Lag (ARDL) approach in the analysis. This process will start from first detecting the existence of levels relationship (cointegration) among the variables in the model.

4.4 Bounds Test for Cointegration

As identified earlier, the bonds test for cointegration will aid us to determine if any form of long-run relationship exist among the variables given their diverse order of integration. This is done for the four models specified in this study. The test requires that the F-statistic must be greater than the I(0) and I(1) bounds values at the 5% level for cointegration to exist.

Table no. 7 – Bounds test result for Model I (Economic Globalization)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	4.8245	10%	2.08	3.00
Number of Parameters (k)	5	5%	2.39	3.38
		1%	3.06	4.15

Source: author's computation

The result of Model I reflected in Table no. 7 indicates that the F-statistic (4.8245) is greater than the 5% critical I(0) value of 2.39 and I(1) value of 3.38. the null hypothesis of "no levels relationship" is disallowed. This validates the existence of levels relationship between income growth and economic globalization.

Table no. 8 – Bounds test result for Model II (Social Globalization)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	3.8062	10%	2.08	3.00
Number of Parameters (k)	5	5%	2.39	3.38
		1%	3.06	4.15

Source: author's computation

In Model II, the result as showcased in Table no. 8 reveals that the F-statistic vale of 3.8062 is greater than both the I(0) value of 2.39 and I(1) value of 3.38 at the 5% level. the null hypothesis of "no levels relationship" is overruled. Hence, cointegration exist and there exist a long-run relationship amid income growth and social globalization.

Table no. 9 – Bounds test result for Model III (Political Globalization)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	4.7924	10%	2.08	3.00
k	5	5%	2.39	3.38
		1%	3.06	4.15

Source: author's computation

The test for a long-run relationship between income growth and political globalization is evidenced in the result in Table no. 9 where the F-statistic (4.7924) is outside the I(0) and I(1) bounds value at the 5% level. We reject the null hypothesis of "no levels relationship" and conclude that cointegration exists amid the two variables.

Table no. 10 – Bounds test result for Model IV (Overall Globalization)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	5.4252	10%	2.08	3.00
k	5	5%	2.39	3.38
		1%	3.06	4.15

Source: author's computation

For the overall globalization index which is captured by the KOF globalization index, the result in Table no. 10 is a proof that cointegration exist since the F-statistic value of 5.4252 lies outside the I(0) and I(1) bound at the 5% level of significance. The null hypothesis is therefore rejected and evidence of cointegration flanked by globalization and income growth is being validated.

Given that all the index of globalization reported the existence of a long-run relationship with income growth, our analysis proceeds to determining both the short-run and long-run effect of globalization on income growth within the Sub-Saharan Africa.

4.5 ARDL Short-Run Error Correction Mechanism (ECM)

The short-run error correction model is estimated to capture the short-run dynamic effect of globalization on income growth within the SSA along with determining how such short-run distortions are corrected to establish long-run equilibrium. This is done in respect to the four models so specified in the study.

Table no. 11 – ARDL short-run error correction mechanism result for Model I

Dependent Variable: Income Growth (GNIPC)
Selected Model: ARDL(1, 0, 1, 2, 2, 1)

Variable	Coefficient	Standard Error	t-Statistic	Probability
D(GFCF)	-0.3229	0.1158	-2.7885	0.0102**
D(INDVA)	0.2277	0.1952	1.1661	0.2550
D(INDVA(-1))	-0.4798	0.2304	-2.0829	0.0481**
D(POPG)	-58.9357	51.2319	-1.1504	0.2613
D(POPG(-1))	148.0296	57.9807	2.5531	0.0175**
D(EKOFGI)	-0.9425	0.3766	-2.5031	0.0195**
ECM_{t-1}	-1.1855	0.1825	-6.4973	0.0000***
R-squared	0.6508	Durbin-Watson stat		1.6637
Adjusted R-squared	0.5809	S.E. of regression		1.4095

*Note: ** and *** captures significance at 5% and 1% level correspondingly.*
Source: author's computation

For Model I where the paper captures the effect of economic globalization (EKOFGI) on income growth, controlled with some other variables, the short-run dynamic effect of

GFCF put forth a deleterious and momentous effect GNIPC at the 5% level of significance. A unit percent change in GFCF reduces income growth by 0.3229% on the average in the short-run. Industrial value added (INDVA) wields a positive but insignificant short-run effect on income growth in the SSA. Such insignificant effect could be linked to the declining industrial production within the region coupled with heavy importation of manufactured goods. Meanwhile, the one-period lag in INDVA exercises a deleterious and significant effect on income growth by reducing income growth by 0.4798% on the average. Population growth put forth an undesirable but insignificant effect on income growth. Such negative effect implies that the population is not effectively utilized for creation of wealth given the pronounced unemployment rate in the region. Meanwhile, the one-period lag in population growth wields a positive and substantial effect on income growth in the SSA by increasing income growth by 148.03% on the average. This encapsulates that past population values were efficiently utilized as can be linked to the rising primary product exports before the discovery of oil in the region.

Economic globalization is observed to wield a negative and significant short-run effect on income growth in the SSA. This can be linked to the fact that globalization and trade liberalization has been pointed out to be driving force of inequality (Bergh & Nilsson, 2011); and that trade liberalization can weaken and destroy good jobs (Davis & Harrigan, 2010); and technological transfers can facilitate job destruction as enunciated by Schumpeter. As such, a one percent change in economic globalization reduces income growth by 0.9425% on the average.

The coefficient of the error correction term (ECM_{t-1}) is negative and statistically significant as required, implying that the model adjusts to long-run equilibrium. From the coefficient, 118.55% of the short-run distortions in income growth is corrected on a yearly basis. This is a reflection that it takes less than one year for equilibrium to be fully reinstated in the long-run. The r-squared is an indication that economic globalization with other explanatory variables account for 65.08% of the overall distortions in income growth in the short-run. the Durbin-Watson statistic of 1.6637 (which is approximately 2) validates the absence of serial correlation in the model.

Table no. 12 – ARDL short-run error correction mechanism result for Model II

Dependent Variable: Gross National Income Growth Per Capita (GNIPC)
Selected Model: ARDL(1, 3, 1, 0, 1, 2)

Variable	Coefficient	Standard Error	t-Statistic	Probability
D(GDSAV)	-0.0383	0.1094	-0.3497	0.7299
D(GDSAV(-1))	-0.0440	0.1099	-0.4004	0.6927
D(GDSAV(-2))	0.2251	0.0797	2.8239	0.0099**
D(GFCF)	-0.0794	0.2176	-0.3649	0.7187
D(POPG)	100.2160	20.0191	5.0060	0.0001***
D(SKOFGI)	0.8562	0.6505	1.3162	0.2016
D(SKOFGI(-1))	-1.6018	0.6279	-2.5511	0.0182**
ECM_{t-1}	-0.7715	0.1325	-5.8232	0.0000***
R-squared	0.6384	Durbin-Watson stat		2.0151
Adjusted R-squared	0.5481	S.E. of regression		1.3293

*Note: ** and *** captures significance at 5% and 1% level correspondingly.*
Source: author's computation

In Model II, gross domestic savings (GDSAV) along with its one-period lag exerts a negative but insignificant effect on income growth in SSA. However, its two-period lag wielded a positive and significant effect on income growth by increasing income growth by 0.2251% on the average. This is an indication that the present savings do not support investment for growth and wealth creation, while the previous period's savings were sufficient enough to drive wealth creation and increase income growth in the SSA. Gross fixed capital formation is noted to have a negative but insignificant short-run effect on income growth in the SSA while population growth wielded a positive and significant effect. A unit percent increase in population growth wielded a 100.22% increase in income growth. Social globalization put forth a positive but insignificant short-run effect on income growth; pointing out that social globalization is desirable but its sway in driving income growth is limited. Meanwhile, its one-period lag generated a negative and significant effect on income growth, reducing income growth by 1.6018% on the average.

The error correction term is negative and is statistically significant consistent with prerequisite, entailing that 77.15% of the short-run alterations in income growth is rectified in a yearly basis for equilibrium to be fully refurbished in the long-run. the r-squared indicates that social globalization along with other control variables account for about 63.84% of the overall discrepancies in income growth. The model is devoid of serial correlation since the Durbin-Watson statistic is approximately 2.0.

Table no. 13 – ARDL short-run error correction mechanism result for Model III

Dependent Variable: Gross National Income Growth Per Capita (GNIPC)
Selected Model: ARDL(1, 3, 1, 0, 1, 1)

Variable	Coefficient	Standard Error	t-Statistic	Probability
D(GDSAV)	-0.0771	0.1105	-0.6977	0.4924
D(GDSAV(-1))	-0.0276	0.1120	-0.2466	0.8074
D(GDSAV(-2))	0.2188	0.0808	2.7088	0.0125**
D(GFCF)	0.2040	0.2192	0.9307	0.3617
D(POPG)	103.4044	19.5712	5.2835	0.0000***
D(PKOFGI)	-0.4708	0.2303	-2.0438	0.0526*
ECM_{t-1}	-0.8466	0.1302	-6.5037	0.0000***
R-squared	0.6192	Durbin-Watson stat		2.1251
Adjusted R-squared	0.5404	S.E. of regression		1.3405

*Note: *, ** and *** captures significance at 10%, 5%, and 1% level correspondingly.*
Source: author's computation

The result for Model III as adumbrated in Table no. 13 indicates that gross domestic savings with its one-period lag put forth a negative but insignificant effect on income growth. Meanwhile, its two-period lag wielded a positive and substantial effect on income growth by increasing income growth by 0.2188% on the average. This behaviour can be linked to the case that a greater proportion of present savings in the SSA could utilized for consumption rather for the creation of more wealth, as opposed to the previous years' savings. Gross fixed capital formation is also noted to put forth a positive though insignificant effect on income growth in the SSA. Population growth wielded a positive and substantial short-run effect on income growth at the 5% level. Intrinsically, a unit percent change in population growth changes income growth by 103.40% on the average. This point to the importance of human capital in fostering growth and wealth creation; which has a direct link to enriching the citizens

through access to gainful employment. Political globalization wielded a negative and significant effect on income growth in the SSA. Such negative effect could be attributed to adoption of wrong political policies and ideas from other countries which could not have bearings within the SSA. A unit percent increase in political globalization reduces income growth by 0.4708% on the average.

The coefficient of the error correction term is negative and statistically significant at the 5% level. it follows from the coefficient that 84.66% of the total discrepancies in income growth is corrected every year for the restoration of long-term equilibrium. The r-squared signifies that political globalization along with other explanatory variables accounts for 61.92% of the total variations in income growth within the SSA for the study period.

Table no. 14 – ARDL short-run error correction mechanism result for Model IV

Dependent Variable: Gross National Income Growth Per Capita (GNIPC)
Selected Model: ARDL(1, 1, 3, 1, 0, 1)

Variable	Coefficient	Standard Error	t-Statistic	Probability
D(KOFGI)	-1.3818	0.3938	-3.5087	0.0019**
D(GDSAV)	-0.0429	0.1068	-0.4016	0.6917
D(GDSAV(-1))	-0.0588	0.1074	-0.5472	0.5895
D(GDSAV(-2))	0.1935	0.0776	2.4937	0.0203**
D(GFCF)	0.0928	0.2109	0.4401	0.6640
D(POPG)	107.0657	18.8552	5.6783	0.0000***
ECM_{t-1}	-0.9065	0.1310	-6.9198	0.0000***
R-squared	0.6409	Durbin-Watson stat		2.2038
Adjusted R-squared	0.5666	S.E. of regression		1.3017

*Note: ** and *** captures significance at 5% and 1% level correspondingly.*
Source: author's computation

In the overall result to ascertain the influence of globalization on income growth in the SSA, it is observed that globalization put forth a negative and significant short-run effect on income growth at the 5% level. A one percent increase in globalization wields a 1.3818% decrease in income growth. This negates the believe that "globalization suggests exciting business opportunities, efficiency gains from trade, more rapid growth of knowledge and innovation, and the transfer of such knowledge to developing countries facilitating faster growth, or the prospect of a world too interdependent to engage in war …" Todaro and Smith (2011) cited in Effiong Effiong (2021). This points out that globalization is not favourable for income growth within the SSA. As truly positioned by Yunus (2008), a Nobel laureate in 2008, "global trade is like a hundred-lane highway traversing the world. If it is a free-for-all highway, with no stop lights, speed limits, size restrictions, or even the lane markers; its surface will be taken over by the giant trucks from the world's most powerful economies" (Effiong, 2021); and that globalization and trade liberalization have been viewed to be a driving force in generating inequality in a country (Effiong *et al.*, 2020).

Gross domestic savings and its one-period lag exerted a negative but insignificant effect on income growth; while its two-period lag generated a positive and substantial effect by increasing income growth by 0.1935% on the average. Gross fixed capital formation wielded a positive but insignificant effect while population growth put forth a desirable and momentous effect on income growth. A unit percent increase in income growth is followed with a 107.07% increase in income growth on the average.

The error correction term reflects that on a yearly basis, 90.68% of the short-run inconsistencies in income growth is corrected so that a long-term equilibrium is reinstated. The r-squared is an indication that globalization along with other control variables account for 64.09% of the total discrepancies in income growth within the SSA in the short-run. The Durbin-Watson statistic of 2.20 validates absence of serial correlation in the model.

4.6 Long-Run Estimates

Since our bounds test revealed evidence of long-run relationship, the long-run estimates of the models are presented in Table no. 15.

Table no. 15 – Long-Run Result for Model I to Model IV

Dependent Variable: Gross National Income Growth Per Capita (GNIPC)

Variables	Model I	Model II	Model III	Model IV
Economic Globalization	0.2957 (0.0520)*			
Social Globalization		0.0553 (0.3281)		
Political Globalization			0.0823 (0.2024)	
Globalization Index				0.0958 (0.2136)
Gross Domestic Savings	0.5091 (0.0106)**	0.5599 (0.0071)**	0.5355 (0.0092)***	0.5461 (0.0079)**
Gross Fixed Capital Formation	-0.5076 (0.0013)***	-0.5586 (0.0007)***	-0.5406 (0.0009)***	-0.5481 (0.0008)***
Industrial Value Added	-0.3096 (0.3568)	-0.4571 (0.1997)	-0.3742 (0.3042)	-0.3986 (0.2647)
Population Growth	-2.5799 (0.6866)	-8.0738 (0.1839)	-5.8832 (0.3455)	-6.6068 (0.2807)
Constant	3.3177 (0.8911)	32.9409 (0.0753)*	22.5859 (0.2911)	25.2497 (0.2159)
R-Squared	0.4625	0.4138	0.4257	0.4243
Adjusted R-Squared	0.3810	0.3249	0.3387	0.3371
F-Statistic	5.6780	4.6582	4.8922	4.8644
Probability of F-Statistic	0.0007***	0.0025***	0.0019***	0.0019***
Durbin-Watson Statistic	1.6742	1.5721	1.6061	1.5984

*Note: *, ** and *** captures significance at 10%, 5% and 1% level correspondingly.*
Source: author's computation

For Model I, economic globalization is noted to wield a positive and significant long-run effect on income growth in the SSA at the 10% level of significance. The coefficient reflects that a unit percent increase in economic globalization will cause a 0.2987% increase in income on the average. Also, gross domestic savings put forth a positive and significant long-run effect on income growth – which indicates the role of savings in wealth creation and long term income growth. Gross fixed capital formation wielded a negative and significant long-run effect on income growth at the 1% level of significance. In that regards, a unit percent change in GFCF changes income growth in the opposite direction by 0.5076% on the average. This indicates that

the SSA's capital base is not sufficient to drive income growth. however, industrial value added and population growth put forth a negative but insignificant effect on income growth in the long-run. The overall model is statistically significant in explaining long-term income growth since the F-statistic is significant at the 1% level; the model explains 46.25% of the long-run variations in income growth; and the model is devoid of serial correlation.

For Model II, social globalization put forth a positive but insignificant effect on income growth which is similar to its short-run effect. Gross domestic savings wielded a positive and significant effect on long-term income growth while GFCF put forth a negative and significant effect. a unit percent increase in gross domestic savings increase long-term income growth by 0.5599% while a unit percent change in GFCF changes income growth in the opposite direction by 0.5586% on the average. Industrial value added and population growth wielded a negative though insignificant effect on income growth in the long-run. The significance of the F-statistic at 1% level indicates that the overall model is statistically significant; and the Durbin-Watson statistic of 1.57 imply that the model is devoid of serial correlation. The social globalization with other explanatory variables jointly explain 41.38% of the total variation in income growth in the long-run.

Consistent with Model III, political globalization also put forth a positive but insignificant long-run effect on income growth. Meanwhile, gross domestic savings exercised a positive and significant effect while gross fixed capital formation wielded a negative and significant effect. a unit percent increase in gross domestic savings increases income growth by 0.5355% which a unit percent change in GFCF changes income growth in the reverse order by 0.5406% on the average. Both industrial value added and population growth still maintained a negative but insignificant long-term effect on income growth in the Sub-Saharan Africa. The overall model is significant as reported by the significance of the F-statistic; free from serial correlation; and political globalization along with other explanatory variables jointly explains 42.57% of the total variation in income growth.

Lastly, it is observed that globalization (in general) wielded a positive but insignificant long-term sway on income growth. Gross domestic savings still account for a positive and significant effect while gross fixed capita; formation generated a negative and significant effect. a unit percent increase in gross domestic savings increases income growth by 0.5461% on the average; while a unit percent change in gross fixed capital formation changes income growth by 0.5481% on the average in a reverse order. Other variables exhibited a negative but insignificant effect. The model is generally significant since the F-statistic is significant and free from serial correlation since the Durbin-Watson statistic is 2.0 approximately. Globalization with other explanatory variables jointly explains 42.43% of the total variation in income growth in the long-run.

4.7 Major Findings

Given the analysis, the following are the major findings of the study:

a) Globalization generated a negative and significant short-run effect on income growth but such effect becomes positive but insignificant in the long-run.

b) Economic globalization generated a negative and significant short-run effect on income growth but such effect becomes positive and significant in the long-run.

c) Political globalization wielded a negative and significant short-run effect on income growth but its effect becomes positive but insignificant in the long-run.

d) Social globalization exerted a positive but insignificant short-run effect on income growth both in the short-run and in the long-run.

e) Gross domestic savings exerts a positive and significant effect on income growth in the short-run and in the long-run. This implies that developing and encouraging savings behaviour will aid in increasing income growth through wealth creation.

Such short-run negative effects of globalization on income growth portrays that globalization may not bring the immediate positive effect that is desired in the Sub-Saharan Africa. However, by moving along the learning curve of globalization and adopting suitable macroeconomic policies in the process, globalization is likely to bring forth the desired positive effect in the long-run.

5. CONCLUSION AND RECOMMENDATION

The issue of globalization has been addressed in various dimensions in the literature, focusing mostly on economic growth and income inequality. In this paper, the case of the Sub-Saharan Africa is considered where the paper explores how the concept influences income growth within the region from 1982 to 2020. The augmented Dickey-Fuller unit root test to ascertain the order of integration of our time series variables is used; the bounds test for cointegration to ascertain the existence of long-run equilibrium relationship; and the error correction model to capture how the short-run distortions are adjusted for the attainment of long-run equilibrium. The paper splits globalization into economic, social, and political dimensions and as well specified and estimated four models to capture their individual and aggregate effect on income growth within the SSA in both the short-run and in the long-run. At the individual level, the short-run result portrayed that economic globalization, political globalization, and one-period lag of social globalization wielded a negative and significant effect on income growth. Meanwhile, social globalization put forth a positive but insignificant effect on income growth. At the aggregate level, globalization is noticed to put forth a negative and significant short-run effect on income growth within the SSA. This points to the fact that increased globalization plunged income growth in the SSA in the short-run. Consequently, rising globalization will cause income growth to decline drastically in the short-run. In the long, all the dimensions of globalization (economic, social, and political) including the aggregate globalization wielded a positive effect on income growth. Meanwhile, only economic globalization wielded a significant influence. This points to the fact that though globalization may not be desirable in the short-run due to structural rigidities, it is quiet desirable in the long-run to drive income growth especially at the economic level.

Other key variables include gross domestic savings, gross fixed capital formation, industrial value added, and population growth. The short-run effect of gross domestic savings with its one-period lag is recorded to be negative but insignificant; while its two-period lag wielded a positive and significant effect on income growth. Both population growth and gross fixed capital formation put forth a positive and significant short-run effect on income growth of the Sub-Saharan Africa. This points out that increasing these variables will aid in increasing the income level of the SSA. In the long-run, gross domestic savings wielded a positive and significant influence on income growth. This point out the fact that savings will stimulate wealth creation which hitherto causes income to grow at a higher level. Population growth and industrial value added wielded a negative but insignificant long-run effect; while gross fixed capital formation wielded a negative and significant effect.

Going by the explanatory power of the models, economic globalization, social globalization, and political globalization along with control variables explained 65.08%, 63.84%, and 61.92% of the total variations in income growth in the short-run respectively. This points to the fact that economic globalization has a greater sway in influencing income growth in the Sub-Saharan Africa. This is because economic globalization cuts across trade liberalization, foreign direct investment, financial globalization, among others, which has greater positive externalities on modern economy. In the long-run, economic globalization, social globalization, and political globalization explained 46.25%, 41.38%, and 42.57% of the total variation in income growth respectively. Still, economic globalization still dominates as it holds a greater sway in influencing income growth within the region.

Given the findings of the study, this paper concludes that globalization is a crucial variable that pose a serious influence on the growth of the income within the Sub-Saharan Africa. Consequently, the promotion of economic globalization is of core importance in stimulating long-term income growth. This should be done bearing in mind that it has some short-run negative influence. However, it is worthy of note that the long-term benefit of economic globalization outweighs the short-run negative effect which can be corrected periodically as the economy moves along the learning curve of globalization.

ORCID

Ubong Edem Effiong https://orcid.org/0000-0003-4677-1268

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Interconnections between Minister Cabinets in Greece. A Bicentennial Study with Implications on Economy

Dimitrios Kydros[*], **Persefoni Polychronidou**[**]

Abstract: In this paper we deal with a network analysis of interconnected cabinets in Greece for an extended time period. In parallel, we present a small review of the economic crises that have occurred in Greece over this period. More particularly, we used historical sources to locate all different Greek governments and all economic crises starting from the 1821 Greek revolution to the present days. We also formed a two-mode (also known as affiliation) network of ministers and cabinets and subsequently created a network of interconnected cabinets. We used dedicated software to visualize this network and used Social Network Analytical procedures in order to calculate its properties. Finally, in an attempt to investigate possible relations between network metrics and economic crises, we note and discuss an interesting observation between a specific metrics and such major economic events. In our paper, we firstly introduce the context and present our research questions. We then present the relevant literature, mainly discussing the extent to which Social Network Analysis has been used to investigate patterns of behaviors in politics. We then proceed to presenting and applying our methodology on network creation, visualization and metrics computations. The following section discusses the longitudinal evolution of our network and the relation between its clustering coefficient and the emergence of economic crises. We then finalize our paper with some conclusions.

Keywords: social network analysis; governments in Greece; economic crises; clustering coefficient; political networks; longitudinal networks; macroeconomics; Kondratieff waves.

JEL classification: D72; D73; D85.

[*] Department of Economic Sciences, International Hellenic University, Serres, Greece; e-mail: *dkydros@ihu.gr* (corresponding author).
[**] Department of Economic Sciences, International Hellenic University, Serres, Greece; e-mail: *polychr@ihu.gr*.

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1. INTRODUCTION

In 2021, Greece celebrated its bicentennial liberation from the Ottoman Empire, after the Greek War of Independence (1821). During these last two centuries, the Greek state has matured politically (after passing through a series of different political periods) and expanded geographically (with the latest expansion taking place in 1912-1913). It has also suffered a series of dramatic Historical events (local and global wars) and also a number of (major and minor) economic crises, the latest one starting from 2008. Actually, about eight to ten major economic events have been recorded during this period (Tsoulfidis & Zouboulakis, 2016), including four (or five including the 2nd World War) defaults (see Table no. 1). Notably, in two hundred years of Greek independence, for almost 50% of the time Greece is under a type of financial control imposed by creditors.

Table no. 1 – Major economic incidents in Greece

Time	Type	Default
1827	Loans not paid	Yes
1843	Temporary stop of paying loans	Yes
1860	Temporary rest of paying loans	
1893	Major default	Yes
1921 - 1930	Partly stop paying loans	
1932	Temporary stop in paying loans	Yes
1942-1943	Stop of paying loans (war)	Yes
1953	Major drachma devaluation	
1973 - 1978	Oil crisis	
1985	Close to default	
2009 -	Close to default, salvation (!) by the Troika	

Viewing this period from a different perspective, that is, the political – parliament – government one, Greece exhibits a very rich modern political history. Ever since 1821, a number of 386 different formations of ministerial cabinets have been formed and served, almost two for every year of independence passed (Kydros, 2021). This large number of different cabinets does not actually mean a similar number of general elections; rather, in one parliament period, different formations (restructuring or reformation) of cabinets is common. However, as seen in the relevant literature (Sotiropoulos & Bourikos, 2002), the actual absolute number of different ministers is rather small, being 1955 different persons. This means that during the whole modern political government history, ministers are selected from a rather small 'ministerial elite'. This fact in turn means that in many cabinets, ministers are interconnected, in the sense that they serve together in different government formations.

Having the above two observations in mind, in this paper we venture to investigate possible relations between ministerial elites and their participation in different cabinets with major economic events (crises) in the Greek modern state. A relevant literature discussion is held in Section 2. In Section 3, we first create a network of interconnected cabinets (i.e., cabinets that share the same ministers) and discuss its structural properties, using different views (local and global ones). In Section 4, we place this network on a longitudinal scale and discuss some important relations between network metrics and relevant economic incidents. This paper concludes with some final remarks in Section 5. Overall, we try to cope with the following Research Questions (RQs):

***RQ1**: What is the structure of the cabinets' network in Greece? Does it belong to any categories of networks found elsewhere in real-life networks?*

***RQ2**: Is there any relation between the cabinets' network and important economic events (such as crises)?*

***RQ3**: If RQ2 has a positive answer, what type of phenomenon actually triggers this relation? Is it the economic crisis or the structure of the network at this particular time-frame?*

As a final point in this introduction, it must be noted that in this paper we do not actually deal with typical economic theories on crises. We rather try to locate patterns from the view of social network analysis in politics, since economy and politics are closely interconnected.

2. RELEVANT LITERATURE

Network Analysis (or Social Network Analysis – SNA or even Network Science) investigates the relations between individual actors. These actors may represent actual living and interacting persons (we then talk about social networks) or other entities, such as countries, computers, animals, companies, etc. According to Wellman (1988), network analysis is not statistics in the traditional way of thinking, where one investigates attributes of individuals. It is the structure of relations among these individuals that matter. Hence, in network theory one elaborates on the attributes of pairs of individuals (Borgatti & Everett, 1997). This paradigm has its roots on Graph Theory, firstly introduced be Euler (in the famous Konigsberg bridges problem). Graph Theory is being extensively studied since the 1950's, with many important results in many different aspects of research (Hage & Harary, 1983). During the last 30 to 40 years, major breakthroughs were made in Social Network Analysis (Watts & Strogatz, 1998; Barabási & Albert, 1999; Newman *et al.*, 2006). It is important to note that social networks actual play a very important role in today's life: Twitter, Facebook, LinkedIn, Google search are all implementations of social network analytic ideas and methods. A number of software tools that can be used to create, manipulate and study networks is also available such as PAJEK (Batagelj & Mrvar, 2002), NodeXL (Smith *et al.*, 2010), Gephi (Bastian *et al.*, 2009), NetworkX (Hagberg *et al.*, 2008), etc.

Social Network structure has an important trace on Economics (see the excellent reviews by Benhabib *et al.* (2011) and Jackson *et al.* (2017). Regular or sparser interaction between people has a major impact on the way people decide or form opinions in an extensive list of economic life, such as spreading information about new markets, new products, jobs, technologies and others. The structure of our social networks has an important impact on education, career, financing, business decisions and a large number of similar economic situations. According to Jackson *et al.* (2017), the above-mentioned situations are only a partial list of economic behavior of individuals affected by network structure. Furthermore, when we turn our view on organizations rather than individuals (countries and trade, alliances of corporations etc.) more insights can be gained when dealing with relationships rather than individual characteristics.

Economic behaviors are influenced by the underlying network structure and vice-versa. As an example, one can consider the famous interlocking board of directors (Mizruchi, 1996), a social network comprised of persons that serve simultaneously in directorates in large corporations: a bunch of well interconnected people affect economic decisions of a disproportionally large number of economic organizations in the USA. Important economic

decisions are also severely affected when networks are polarized or communities of actors are present: one can consider the current situation that has been emerged after the Russian imperialistic invasion in Ukraine (March 2022): the community of EU nations is collectively taking economic measures against Russia that would never have been taken if the structure of "community" was not present in the European states network. Even if some EU member states feel that some aspects of the sanctions (especially the natural gas payments) are not in favor of their narrow interests, the actual structure of the network is imposing a special, common direction.

SNA has been also used in investigating crises in general and particularly economic crises. Social systems are hard to understand because of their inherit complexity. SNA can enlighten important information that could be missed, since it can show subgroups, elements that can greatly alter a network an also pursues the longitudinal change of networks (Güreşci & Arpat, 2016). Social Networks may hinder the economic uncertainty spillover network, especially strong during the COVID-19 pandemic. Furthermore, developed provinces are more prone to create new links in spillover networks (Ma *et al.*, 2022). Morales *et al.* (2014) attempted to estimate bank financial strength during the 2008 economic crisis, by using SNA methods. Wang and Yang (2022), in a very important paper, developed a dynamic industry network model to evaluate critical industries in China. They also used SNA methods and metrics to assess industries quality. Iglič *et al.* (2021), again investigated the impact of economic crisis on the European social capital. They prove that changes in social trust and formal networks can especially be explained by the impact of the political factors, while variations in informal networks are mainly due to the changing economy. Moreover, the analyses show that while the economic crisis generally lowered social capital, some mechanisms such as a sense of togetherness and left-wing political activism, enhanced social capital.

In Macroeconomics, again, a number of researches have produced important literature. Bögenhold (2013) discusses the concept of Social Embeddedness and he conclude that SNA may provide with tools to foster the understanding of social dynamics. In turn, he argues that this enhances the debate on micro-macro gap and on limitations of the potential of economics. Acemoglu *et al.* (2016), provided an empirical exploration on Networks and the Macroeconomy. They argue that small shocks in small enterprises may quickly travel through the networks in which this enterprise is present. Such networks may be global, so the potential problems could lead to macroeconomic events. The cascading phenomenon, especially connected with the network topology, was investigated regarding risk propagation along supply chains in the U.K. (Spatareanu *et al.*, 2023). Economic policies and the impact of networks on them are discussed by Elliott *et al.* (2019). The authors focus on six policy domains, discuss the impact of network economics on them and argue that not only this type of analysis depends our knowledge on the inner construction of economic policies, but can also help in producing and applying new ideas and policies.

Network Science has also been used in Political research in a number of different ways, although with a slower acceptance (Żukiewicz *et al.*, 2018) and mostly by researchers in the USA rather than then more traditional European ones (Heaney & MacClurg, 2009; Ward *et al.*, 2011). According to *The Oxford Handbook of Political Networks* (2017), Social Network methods have been used to research on political parties and campaigns, international relations, vote choice, etc. Furthermore, during the last 10 years, much research is done regarding Social Media applications (such as Facebook or Twitter) and their impact on political life (Jungherr, 2016; Confessore, 2018). Content and sentiment analysis on political discourse is also present

(Chase Dunn, 2019; Keller & Klinger, 2019). Similar research is present in the Greek sphere (Kydros & Anastasiadis, 2017).

An attempt to investigate Greek political history, in the level of parliament members, through Networks Analysis was done by Kydros *et al.* (2012), resulting in a severely congested (highly knotted) network. In a recent paper, Kydros (2021) used a methodology similar to our study in order to create a network of ministers and mainly investigate the emerging relations of nepotism over the Greek ministerial elite. In this paper we use the same original dataset (with a difference in preprocessing) but we produce a different network view, together with a discussion on the relation to economy.

At this point, it must be noted that, to the authors' knowledge, similar to the present paper research has not been found in the literature. Hence, it is our hope that a new area of study might be emerged.

3. METHODOLOGY, NETWORK CREATION, VISUALIZATION AND METRICS

As already stated in the previous section, in this paper we will use an already formed data set containing all persons that have served as ministers and all corresponding cabinets over a period of 200 years. One can access the paper by Kydros (2021) in order to clarify the data-collection procedures from various sources. The original dataset is formed as a simple spreadsheet, where persons are stored in each row label and cabinets are stored as column labels. The entries of this two-way matrix are 1's and 0's: an entry (row, column) equals 1 if the person in (row) has served in the cabinet in (column). This matrix has 1955 rows and 386 columns.

A necessary preprocessing has to be held here, since these 386 original columns correspond to different formations of cabinets and not actual government period (as already noted, it is common in Greece to reshuffle cabinets during one government period). Hence all columns that belong to the same government period were merged in one column (a binary OR function was used). After this preprocessing the new 'clean' matrix contains 1955 rows and 205 columns.

Such matrices correspond to two-mode (or bipartite) networks (Borgatti & Everett, 1997). A bipartite network has two disjoined sets of nodes with cardinalities of N and M. All links connect nodes belonging to different sets and there is no link joining two nodes of the same set. A pictorial example, containing a small such matrix and the corresponding bipartite network is shown in Figure no. 1a and no. 1b respectively.

At this point, a simple linear algebra function, the dot (•) product of matrix A by AT (A transposed) yields two different matrices as follows: A•AT results in a square matrix N X N, which corresponds to a network of ministers that have served in the same cabinets, while AT•A results in a M X M square matrix that corresponds to the network of cabinets that have common ministers. The whole procedure is shown in Figures no. 1c and no. 1d, where we produce the network of cabinets.

	Cabinet1	*Cabinet2*	*Cabinet3*	*Cabinet4*	*Cabinet5*	*Cabinet6*
Minister1	1	0	1	0	0	0
Minister2	1	0	1	0	0	0
Minister3	0	1	0	0	1	1
Minister4	0	0	0	1	0	1
Minister5	0	0	1	0	0	0

Figure no. 1a – Original two-mode matrix A. Minister1 has served in Cabinets1 and 2, together with Minister2, Minister3 has served in three cabinets, etc.

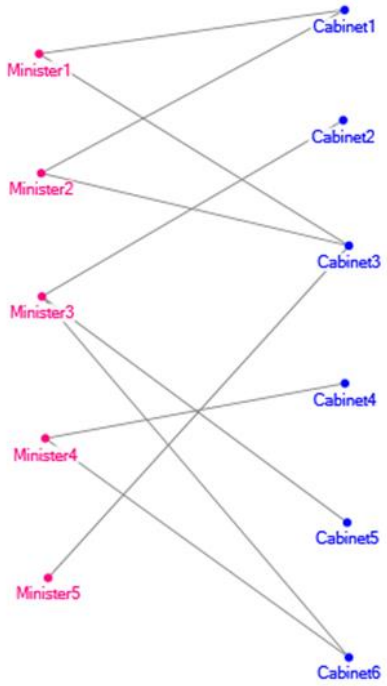

Figure no. 1b – Bipartite network corresponding to matrix A

	Cabinet1	*Cabinet2*	*Cabinet3*	*Cabinet4*	*Cabinet5*	*Cabinet6*
Cabinet1	2	0	2	0	0	0
Cabinet2	0	1	0	0	1	1
Cabinet3	2	0	3	0	0	0
Cabinet4	0	0	0	1	0	1
Cabinet5	0	1	0	0	1	1
Cabinet6	0	1	0	1	1	2

Figure no. 1c – The result of AT•A. By setting diagonal element to 0 and reducing all positive values to 1, an adjacency matrix is created

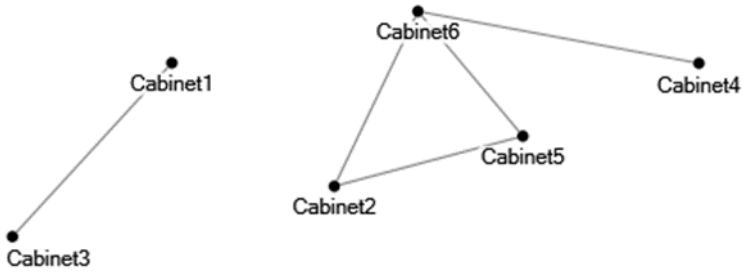

Figure no. 1d – The network of cabinets. Links correspond to cabinets that have common ministers

In our paper, all preprocessing was held in a spreadsheet and all network creation, visualizations and metrics calculations were held through the use of NodeXLPRO (Smith *et al.*, 2010), with some minor calculations performed in NetworkX (Hagberg *et al.*, 2008).

In Figure no. 2 we present a visualization of the cabinets' network. Figure no. 2 was prepared in high resolution and can be zoomed in. All cabinets are shown as nodes (points). A line between two nodes corresponds to ministers that served in both cabinets. Color is used to represent constitutional period (there have been thirteen such constitutional periods in Greece, with the latest been 'Metapolitefsi' from 1974 to present, shown in yellow). All nodes are labeled by the prime-minister's (or the head of the cabinet) names.

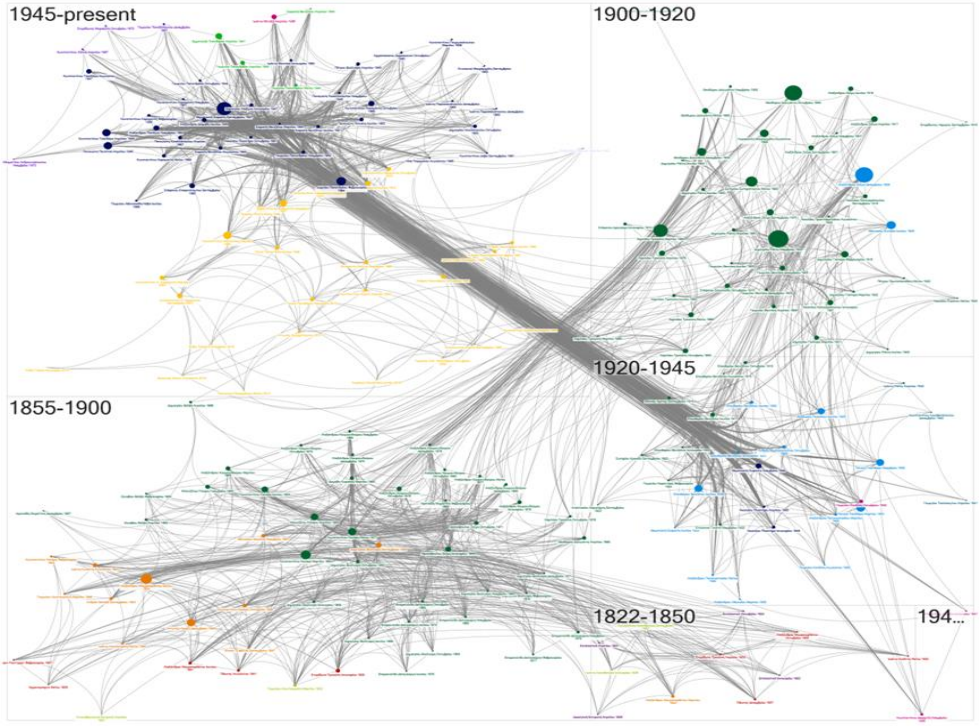

Figure no. 2 – The Greek cabinets network

In Figure no. 2, the size of nodes proportionally corresponds to betweenness centrality, a very important metric calculated as the proportion of actual shortest paths between all pairs of nodes passing through the specific node, divided by the total number of shortest paths. This metric actually corresponds to the degree of mediation of a node between other nodes. In our case, since we are actually interested in information shared between cabinets with the same ministers, betweenness centrality actually corresponds to the importance of a cabinet as a mediator (or broker) for the sharing of common ideas between cabinets.

Finally, Figure no. 2 depicts some segregation between cabinets, calculated as communities (Newman *et al.*, 2006). A community is a group of nodes where more links can be found between nodes within this group than nodes outside the community. Thus, a

community serves as a (rather loose but still present) group of nodes that seem to interact more between them. This is type of grouping that made obsolete some older grouping ideas (such as cliques, clans, etc.) which may rely on structure but have quite strict definitions. In Figure no. 2, communities are shown within rectangles. Links between communities are also present but 'bundled'. Communities do overlap with constitutional periods but nor in a strict manner and labeled accordingly.

Table no. 2 – Basic Metrics

Metric	Number	Explanation
Nodes	205	The number of cabinets
Links	2352	The number of connections (common ministers) between cabinets
Connected components	2, Number of nodes in the major component: 204	All cabinets (but one) are connected
Maximum Distance	8	The diameter of the network (the most distant pair)
Average Shortest Path	3.13	The average distance between two cabinets
Density	0.11	The proportion of actual links over the maximum possible number of links
Modularity	0.5	A measurement that shoes high clusterability.
Average Degree	22.9	The degree of a node is the number of its neighbors. In average, every cabinet is connected to about 30 others.
Average Clustering Coefficient	0.575	The clustering coefficient varies from 0 to 1 and represents the ability of a node to create dense neighborhoods around it.
Sigma coefficient	2.143	For sigma>1, a network is a small-world

In Table no. 2 we show a number of metrics calculated over the network. Most metrics are self-explanatory, perhaps except from sigma coefficient. Positive values over 1, mean that this specific network lies in the family of small worlds (Humphries & Gurney, 2008). Small worlds are characterized with small average path lengths and large clustering coefficient. This topology has been said to be common in many real-life networks (from social networks to the network of neurons in the human brain). It is characterized by tolerance to perturbations (Watts & Strogatz, 1998). In an attempt to check whether this network is also a scale-free network (Barabási & Albert, 1999) after fitting the nodes degree distribution, we came up with the results in Figure no. 3. Obviously, the cabinets network possesses a degree distribution closer to chi2 or gamma distributions, but not in the power-law one. This discussion fully answers our RQ1.

At this point, a normal study on the structure of our network would switch on a more microscopic view, studying the importance metrics and relevant rankings of individual nodes. However, in this paper we are mostly interested in the relationship between the network structure and major economic events, so we proceed to the relevant discussion in the next section.

distribution	sumsquare_error	aic
chi2	0.035523	956.478
gamma	0.035523	956.478
lognorm	0.035600	957.058
rayleigh	0.035679	952.581
norm	0.037477	1013.72

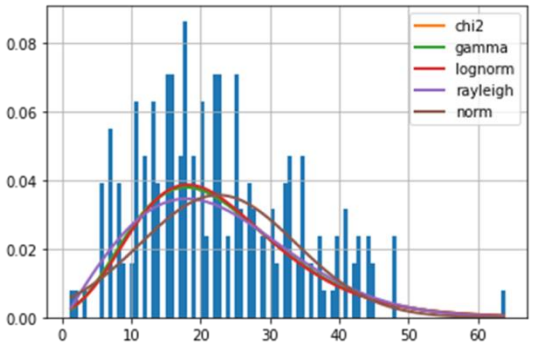

Figure no. 3 – Degree distribution and fitting to common distributions

4. NETWORK LONGITUDINAL STRUCTURE AND ECONOMIC CRISES

The evolution of networks over time is an important thread on research. A number of theories, varying from randomly created (Erdos-Renyi) networks to small-worlds, scale-free networks have - and is being - studied (Newman *et al.*, 2006). The simplest way to investigate this evolution is to visualize a network on an appropriate time-scale. In our dataset, we also recorded the date of cabinet creation, together with its duration in days. In Figure no. 4, we present this network over time, where each node is drawn at the time of the corresponding cabinet formation. In Figure no. 4, the size of nodes still corresponds to their betweenness centrality score while Y-axis represents their clustering coefficient score.

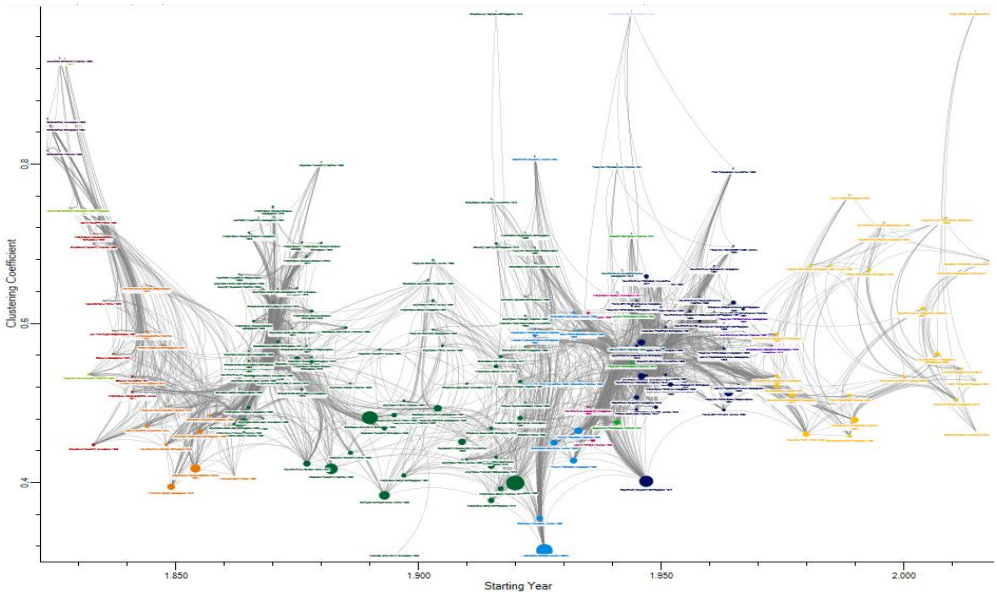

Figure no. 4 – The evolution of the network over time

We now produce Figure no. 5, where we use a dotted line to represent clustering coefficient and its rolling average (over 2 periods), after the removal of outliers. It is reminded that those nodes with high clustering coefficient operate as hubs in the overall network structure, since they seem to create highly interconnected nodes in their neighborhood. In our case, a cabinet with high clustering coefficient is one that exhibits many cooccurrences of ministers over this node and its immediate neighbors, which in turn implies a restricted 'ministerial pool' with fewer newcomers and many long-lasting ministers (even if cabinets change).

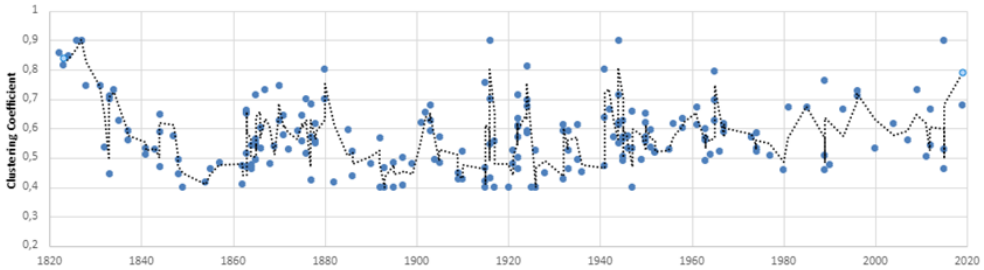

Figure no. 5 – Rolling Average of Clustering Coefficient over time

An interesting pictorial result of Figure no. 5 is that a type of periodical pattern, somehow similar to a sinus wave, seems to exist. This sinusoidal curve oscillates around a value of 0.6 in clustering coefficient. The curve seems to have denser and sparser periods, a fact that is natural since each value corresponds to a different cabinet formation: there have been extraordinary turbulent political periods in Greece when cabinets lasted for a few months or even a few days. However, it is tempting to point out that sinusoidal curves (waves) have been proposed in macroeconomics, ever since the early decades of the previous century, mainly by Kondratiev (the Kondratiev long waves of the economic cycles). This is a way of thought that has influenced a number of important economists or even historians/philosophists, such as Schumpeter or Hobsbawm. One could argue at this point that political life in the level of executive authority (at least in Greece) does follow this waving pattern, despite the lack of normality in frequency.

A possible explanation for this waving pattern is that over the years some political (or economic) situations yield cabinets that do not share too many common ministers. A lasting economic crisis, for example, might trigger a major shift in government formation, resulting not only in new political parties taking over the chair but also in a kind of 'sending the old personnel home': failed ministers should somehow pay for their faults. A major change in the personnel happens and clustering coefficient drops. However, it should be noted that in the Greek case low values of clustering coefficient (lower than 0.2) rarely happens, meaning that even with major changes, some ministers do keep on participating in cabinets.

We now turn our attention in our RQ2 and RQ3, namely the possible relation between the network structure and economic crises in Greece. As already stated, in Table no. 1 we listed the main economic disturbances over the years, some of them resulting to defaults. Of course, in some cases local economic crises happened for reasons outside the responsibility of the local political situations. Hence, in the following discussion we will not take under consideration the economic crises of 1827 (revolution period), 1921-1925 (Minor Asia war), 1942-43 (Nazi occupation), 1953 (not a real crisis) and 1973-1978 (global oil crisis). In our final Figure no. 6, we reproduce Figure no. 5 with the addition of red vertical lines that correspond to the remaining crises of Table no. 1.

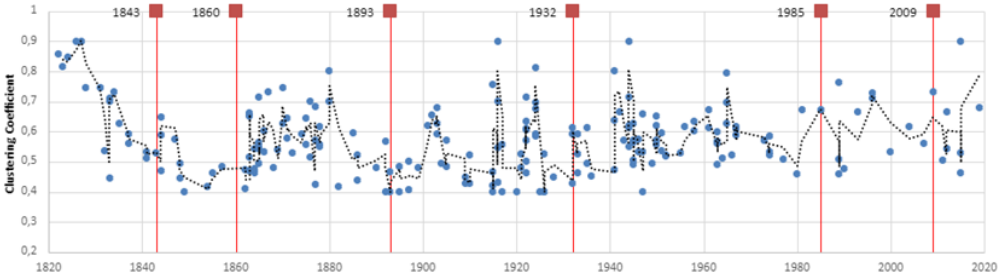

Figure no. 6 – Clustering coefficient and economic crises

Some first observations, relevant to our RQ1, are self-evident: economic crises seem to start on years with high clustering coefficient (all cases except 1860). Actually, the incidents happen on local maximum values or just before them, but not on absolute maxima. Hence, it is obvious that the answer to our RQ2 is positive: a relation seems to exist between the network structure and major economic crises. The interconnection of cabinets through common ministers do seem to play a role in the emergence of a crisis.

Regarding our RQ3, perhaps most importantly one should examine the time periods before and after the beginning of a crisis, since such major events do not happen spontaneously. In all our cases it seems that a period of five to ten years of absolute minima in clustering coefficients of the cabinets network is present right before the incidents. Also, since the events are found on local maxima, right after each event (and again for a period of 5 to ten years) a steep drop on clustering coefficient is also present.

An interpretation of this phenomenon might rely on the following thread of thinking: when a new cabinet is formed and this cabinet has a low clustering coefficient, this means that a large number of newcomers enter, probably because of a quite strong political polarization. This in turn means that older ministers, perhaps with much bigger experience and cautions are sent out. Newcomers cannot rely on trusted policies or try to implement new policies in a rather abrupt - a 'sorcerer's apprentice'- manner. Such a shift in policies triggers problems in economy which in turn and after a period of 5 to 10 years do lead to major economic incidents. Political polarization and major changes in economic policies are not always to the best of the economy.

It is interesting to note that in almost all cases the beginning of the crisis is found on local clustering coefficient maxima. The political personnel foresee that 'things are not going well' and tries to react by forming new cabinets, bearing more experienced (thus more interconnected) ministers, but it seems that these reactions come 'too late and too little'. The economic crisis is here and almost nothing can be done to reverse it. Hence, a new period of low clustering coefficient follows, with newly formed cabinets with many newcomers trying to cope with the situation.

The above discussion answers RQ2 and RQ3 in our context. We should point out that we do not prove that low clustering coefficients in the interconnected cabinets' network will eventually lead to crisis. In Figure no. 6 we can see such periods (after all we have already seen this as a wave) that did not lead to such a major event. Furthermore, as already stated, major economic crises usually have multiple causes, especially in today's highly interconnected world. However, our research can be seen a complimentary way of predicting (or at least warn) for possible such outcomes.

5. CONCLUSIONS

In this paper we used historical data from the Greek political – government history over a long period of 200 years in order to create a network of interconnected cabinets (cabinets that share the same persons as their ministers-members). We recorded relevant data in a two-way matrix and by proper linear algebra functions we produced the adjacency matrix of these cabinets.

Next, we used software to create and visualize the corresponding network and calculate important structural metrics on it. After a discussion on these results, together with an attempt to categorize this network, we continued by exhibiting the value of clustering coefficient of the nodes over time, where we noticed a sinusoidal (but not with a stable frequency) long wave.

We then overlapped this wave with time-stamps where an economic crisis was declared (but not a crisis created by exogenous reasons). We pointed out that economic crises were declared after a 5-10 period of low clustering coefficient values, followed by a local peak of clustering coefficient on the (almost) exact year and in turn followed again by a 5-10 period of reduced clustering coefficient.

Finally, we discussed probable interpretations of this phenomenon that could be used as a warning for forthcoming major economic crisis, in a complimentary fashion. Stability and experience in the decision-making level seem to be an important factor here.

This research was based on data from Greece, but can be easily extended to other countries that may share common characteristics in their political life, that is, countries where 'ministerial elites' are present, in the sense that despite changes in political parties taking over administration, a pool of persons is used to form the executive authority (cabinets) over and over again. It is our suspicion that this is a common situation, at least in countries where a stagnation in political personnel is present.

In an attempt to speculate on the possibility of yet another forthcoming major economic event in nowadays Greece, one should carefully inspect the far-right time period shown in Figure 6. The clustering coefficient seems to grow up after a local minimum in the year 2019, when a change in the ruling political party happened. During the last three and a half years the new Government has been quite stable, without many changes in its cabinet. If this situation continues after the following elections, and the new cabinet exhibits higher clustering coefficient (i.e. uses the same persons as ministers), then a major economic event might occur after about 4-5 years. However, again, we must insist that this is a speculation that will be verified in the not-so-close future. *Time will show!*

Still, as a final but important notice, one should point out that the interrelationships between politics and economy are extremely complicated. Our network paradigm is just one view of the study of this relationship but can be used to explore different aspects of it.

ORCID

Dimitrios Kydros http://orcid.org/0000-0003-0638-6701
Persefoni Polychronidou http://orcid.org/0000-0003-1517-011X

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Do Tax Rates Matter for Entrepreneurial Motivations? An Empirical Approach

Valentina Diana Rusu*, Adina Dornean**

Abstract: There are a number of factors that can hinder the path of entrepreneurship development and the literature highlighted the fact that taxes are one of the most important barriers for entrepreneurs. This paper aims at identifying the relationship between tax rates and entrepreneurship and to establish the impact of tax rates on entrepreneurs considering their motivations (necessity, opportunity or improvement-driven opportunity). The research focuses on a sample of 46 countries grouped according to their income level, for a period of eight years (2012-2019). In order to test our hypotheses, we use multiple linear regression based on balanced panel data and we consider, as dependent variables, indicators that measure entrepreneurship and entrepreneurial motivations (early-stage entrepreneurial activity, necessity-driven entrepreneurs, opportunity-driven entrepreneurs, improvement-driven opportunity entrepreneurs, and motivational index). As independent variables, we consider indicators that measure the tax rates supported by entrepreneurs (total tax and contribution rate, profit tax, labor tax and contributions, and other taxes payable by businesses). The results show that tax rates play a key role in fostering the creation of new companies. Moreover, the impact is different, depending on the entrepreneurs' motivations. Entrepreneurs motivated by necessity are positively related to total tax and contribution rate, while those motivated by opportunity are negatively related with this indicator. Therefore, tax rates discourage the entrepreneurs that seek innovation, but they do not affect those that do not have other options to obtain the necessary income for living.

Keywords: tax rate; entrepreneurial motivations; necessity entrepreneurs; opportunity entrepreneurs; panel data analysis.

JEL classification: C33; H25; L26.

* Institute of Interdisciplinary Research, Department of Social Sciences and Humanities, Alexandru Ioan Cuza University of Iasi, Romania; e-mail: *valentinadiana.ig@gmail.com* (corresponding author).
** Faculty of Economics and Business Administration, Department of Finance, Money and Public Administration, Alexandru Ioan Cuza University of Iasi, Romania; e-mail: *amartin@uaic.ro*.

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1. INTRODUCTION

Academics and practitioners agree that entrepreneurship is important for sustainable development. If the entrepreneurs are interested in innovation, are taking advantage of market opportunities and are interested in their continuous development, then positive effects will be generated on economies (Peredo & McLean, 2013; Pathak, 2021).

Knowing the substantial impact that new businesses have on the economy, not only at national level but also at a global level, it is important to understand what motivates entrepreneurs to initiate and to develop a business, both for researchers and policy makers.

Promoting entrepreneurship is an important priority of governments who are interested in implementing policies to stimulate entrepreneurship as a mean to create new employment opportunities, reduce poverty and foster innovation and economic growth (European Commission *et al.*, 2017).

In this context, tax policy is one of the main policies of the governments which affects entrepreneurship in order to maximize its benefits. For some entrepreneurs, the tax burden is considered high and discouraging, so they often resort to tax evasion or avoidance.

With the objective to encourage entrepreneurship, countries around the world attempt to simplify the tax system, to reduce administrative and compliance costs, and targeted reduction in tax rates through provisions and preferential regimes for small and micro businesses. For example, in addition to the mentioned measure, Latvia applies a low corporate income tax rate, favourable to the developing of entrepreneurial activity. Denmark has introduced a number of tax provision aimed at reducing the cost of investments and expenditures in R&D. Similarly, Italy has introduced measures aimed at the improvement of business environment and entrepreneurship, and in particular to facilitate access to finance and to target investment in R&D (European Commission *et al.*, 2017).

Taxation policy is complicated, it includes not only the tax rates, but also refers the taxation base, forms of application (linear, progressive, etc.), allocable subsidies, and so on. Each country has several taxation and tax policy related particularity (e.g. in some countries micro enterprise type start-ups don't pay profit tax, they have tax on revenues; excepted situations from paying labour tax for a given period of time due to new workplace creation, etc.).

Thus, this study investigates only to what extent the overall or total taxation rate influences the level of entrepreneurship in the countries considered in the analysis, but also whether different types of it (total tax, profit tax, labour tax, other taxes payable by businesses) levied on businesses have different influence on the entrepreneurs according to their motivation.

The paper contribution lies in the fact that it was used an extended sample of countries and for a large period of time. Also, the study analysis the impact of tax rates from different points of motivation (necessity, opportunity or improvement-driven opportunity) which were not found in the scanned literature. Considering the entrepreneurial sector's contribution to employment and GDP increases, this study is important also for the policy makers (in this case, for the government who establish the tax rates) that has to encourage and support, even through incentive policies on taxes, the successful implementation of entrepreneurship.

The rest of the paper is organized as follows. Section 2 summarizes the relevant previous literature regarding the determinants of entrepreneurial motivations, in general (conventional entrepreneurship), in different fields of entrepreneurship (environmental and social), focusing especially on the impact of taxes on entrepreneurship. Section 3 explains the data source used, presents the variables and introduces the work hypotheses. This section also describes the

methodology employed to test the work hypotheses. Section 4 is dedicated to the presentation of the main results but also to the presentation of the discussions based on them. Finally, Section 5 concludes and points out the most relevant results and their importance for the policymakers.

2. LITERATURE REVIEW

In order to address the research aim, we review the relevant previous papers which had analysed the determinants of entrepreneurship and then we discuss the most important findings related to the importance of taxes for entrepreneur's motivation to start and grow a business.

There are different factors which determine a person to become entrepreneur. The economists who created the first systematic theories of entrepreneurship stated that people become entrepreneurs for a variety of reasons and one of this reason is to make money and to obtain a financial gain (Knight, 1921; Schumpeter, 1934). The first perspective on entrepreneurship is from Schumpeter's book, The Theory of Economic Development published in 1911 and revised in 1934. Schumpeter (1934) noticed that individuals may launch new ventures out of the "joy of creating" or to establish a "private kingdom." Meanwhile, Knight (1921) observed that the motivations behind the decision to become an entrepreneur are the "prestige of entrepreneurship" and "satisfaction of being one's own boss". Therefore, the traditional views of economists focused on financial drivers of entrepreneurial action.

The Austrian perspective on entrepreneurship emphasizes that firm performance is driven by the firm's ability to take advantage of the disequilibrium recognized (Kirzner, 1973), whereas the Schumpeterian view focusses on firm advantages based on the firm's ability to upset the equilibrium (Schumpeter, 1934). According to Knight, profit – earned by the entrepreneur who makes decisions in an uncertain environment – is the entrepreneur's reward for bearing uninsurable risk.

Considerable modern research on entrepreneurship and entrepreneurial motivation had been written (Shane *et al.*, 2003; Hessels *et al.*, 2008; Block & Koellinger, 2009; Block & Sandner, 2009; Edelman *et al.*, 2010; Carsrud & Brännback, 2011; Dunkelberg *et al.*, 2013; Vidal-Suñé & Lopez-Panisello, 2013; Wood *et al.*, 2014; Stephan *et al.*, 2015a; Van der Zwan *et al.*, 2016; Hörisch *et al.*, 2017; Rusu & Roman, 2018; Murnieks *et al.*, 2020; Nițu-Antonie *et al.*, 2022). The papers of Carsrud and Brännback (2011), Stephan *et al.* (2015b) and Murnieks *et al.* (2020) are organized as reviews of different papers investigating the entrepreneurial motivation. Doing these reviews, they showed that there is an important number of papers analysing the motivational factors who count for entrepreneurship, but even so there are necessary more studies which have to respond to the question of "have we learned anything at all about entrepreneurs?" (Carsrud & Brännback, 2011). Stephan *et al.* (2015a) reviewed 51 relevant papers for this topic, published over the period of 2008-2013, by differentiating individual drivers of entrepreneurial motivation from contextual drivers. Individual drivers are factors related to the entrepreneur and his/her business, such as gender, age, education, ethnicity, personality differences and resources. The contextual drivers refer to regional and national characteristics including macro-economic variables (GDP), formal institutions (such as welfare systems and property rights), and informal institutions/national culture.

Murnieks *et al.* (2020) analysed the entrepreneurs' motivations on different phases of business development (initiation, growth, and exit) by reviewing 71 relevant papers and summarizing the findings of each study included in the sample. In the first phase, initiation of a business, economic motivation has been the most heavily studied driver of venture initiation

activity, intrinsic motives, pro-social motives, and entrepreneurial passion also stimulate behaviour during this phase. In the growth phase of new ventures, economic, intrinsic, identity congruence, social, and entrepreneurial passion motives are prominent drivers of venture growth in addition to playing a similar role in venture initiation. In the exit phase of the entrepreneurial process, the studies are scarcer and researchers have studied extrinsic, intrinsic, and identity-congruence motives.

In another study regarding entrepreneurial motivation focused on 18 European Union countries, the authors (Rusu & Roman, 2018) highlighted that the macroeconomic factors which reflect the economic conditions (the level of economic development of a country, the total tax rate, the unemployment rates, the inflation rates and the access to financial resources) from an EU country and also the perceptual indicators (fear of failure, entrepreneurial intentions, perceived capabilities, and opportunities) are important determinants of entrepreneurial motivation. Using data for the period 2002-2015 and applying six panel data regression models, the authors (Rusu & Roman, 2018) confirmed their hypotheses. With regard to the tax rate, which is important for the present study, Rusu and Roman (2018) found that the total tax rate in the analysed countries exert a negative influence on total entrepreneurial activity (TEA) and necessity driven entrepreneurs (European Commission *et al.*), which means that tax rate is negatively related to the entrepreneurial activity.

Reynolds *et al.* (1999) introduced the concept of opportunity and necessity entrepreneurship, which was mentioned in the Global Entrepreneurship Monitor. Opportunity entrepreneurship reflects "voluntary nature of participation in order to take advantage of a business opportunity" for personal interest, whereas necessity entrepreneurship exists when there are "no better choices for work" (Reynolds *et al.*, 1999) and in this case the entrepreneurship is often the best "but not necessarily the preferred option" (Reynolds *et al.*, 1999). Starting from this distinction between opportunity and necessity entrepreneurs there are many studies which investigated opportunity and necessity motivations (Levie & Autio, 2008; Block & Sandner, 2009; Edelman *et al.*, 2010; Valdez & Richardson, 2013; Amorós & Bosma, 2014; Stephan *et al.*, 2015b; Angulo-Guerrero *et al.*, 2017; Amorós *et al.*, 2019). In his review, Stephan *et al.* (2015a) found that resource-poor contexts are related to necessity-motivated, increase-wealth to opportunity-motivated and socially-motivated to early-stage entrepreneurship, whilst independence-motivated entrepreneurship and growth ambitions tend to be more common in resource-rich context. His findings are important for our study in which the sample of the considered countries is grouped by their income level.

Also, there are different factors which can determine entrepreneurial' orientation depending on the entrepreneurship type (conventional, social and environmental).

There are studies which investigates these determinants in different fields such as for environmentally oriented entrepreneurs. In this case, we mention the paper of Hörisch *et al.* (2017), where the authors statistically investigated the determinants of environmental orientation of entrepreneurial activity. Using a multilevel analysis, they found that environmental entrepreneurship is influenced by different determinants than conventional entrepreneurship and social entrepreneurship. If in the case of those two types of entrepreneurship, age and education are important variables, there is not the case of environmental entrepreneurship. For stimulating environmental entrepreneurial activity in OECD countries, they highlighted the importance of environmental taxes levels, which should be lower and adapted to every country economic context. Another important finding was that

a business-friendly context has a positive impact not only on environmental entrepreneurship but also on conventional one.

With the objective to alleviate social problems such as poverty, discrimination, or exclusion, social entrepreneurship become more important nowadays and it seems to be more efficient in developing countries than it is in the developed countries (Estrin *et al.*, 2013; Engelke *et al.*, 2016). In their paper, Estrin *et al.* (2013) investigated the relationship between social and commercial entrepreneurship, with a special focus on social entrepreneurship. Applying multilevel modelling to population-representative samples in 47 countries and using data from 2009 collected by the Global Entrepreneurship Monitor, they demonstrated that social entrepreneurship measured by the indicator „Country prevalence rate of young and established social entrepreneur" (Estrin *et al.*, 2013) (% of the adult population indicating that they are currently owner-managing a social enterprise) is facilitated by strong property rights and low government activism, results confirmed also by the results of Stephan *et al.* (2015b). Also, Estrin *et al.* (2013) found that social entrepreneurship attract people who are not typical commercial entrepreneurs, notably women (Stephan *et al.*, 2015a) and the more highly educated. In the light of this findings, they highlighted that social entrepreneurship could increase the diversity of those engaged in entrepreneurship in a nation. Another important finding regarding the determinants of social entrepreneurship consisted in the fact that social entrepreneurship builds social capital, especially through cooperative norms; an informal institution. The importance of formal and informal institutions in supporting social entrepreneurship was showed also by other scholars analysing the phenomenon of social entrepreneurship and its determinants (Stephan *et al.*, 2015b).

An important contribution to the social entrepreneurship literature is the paper of Blaga (2020) who explored entrepreneurial motivation and determined five motivations (extrinsic, intrinsic, and complex motivations; employment status; and start-up capital) that play a significant role in social entrepreneurship intention. In his research, Blaga (2020) used an exploratory and inductive analysis of the literature across four schools of thought (economics, sociology, psychology and management) for establishing which motivational factors play the most influential role in social entrepreneurship. Another important result of his work consisted in developing a theoretical model of social entrepreneurial motivation. This theoretical model regarding the relationship between the independent variables (motivations) and the dependent variable (social entrepreneurship intention) was tested in his recent research (Blaga, 2021). Blaga (2021) found that all variables have a positive effect on social entrepreneurship, but even more important is that his study tested for the first time the "complex motivation"(Blaga, 2021) which had a positive impact on social entrepreneurship up to the level that intrinsic and extrinsic motivation, become non-significant.

Even the above papers investigated different types of entrepreneurship, our paper focuses on traditional entrepreneurship. Thus, a best-known definition is offered by Global Entrepreneurship Monitor (GEM) who defines entrepreneurship as "any attempt at new business or new venture creation, such as self-employment, a new business organization, or the expansion of an existing business, by an individual, a team of individuals, or an established business" (Reynolds *et al.*, 1999). According to the Organization for Economic Cooperation and Development (OECD, 2012), entrepreneurship is a "phenomenon that manifests itself throughout the economy and in many different forms with many different outcomes, and these outcomes are not always related to the creation of financial wealth". At European Union level, The European Commission sees entrepreneurship "as acting upon opportunities and ideas and

transforming them into value for others, which can be financial, cultural, or social" (European Commission, 2016).

It is not important only the entrepreneurial intention to start a business or the entrepreneurial motivation, but also the performance of the activity and its determinants. Considering the contribution of entrepreneurship to economics and social development, Le Trinh (2019) analysed in his paper factors such as government policy, financial capital, cultural factors, social factors, and human capital that influence the start-up performance of SMEs in Danang City, Vietnam. In order to find how people may start their business and factors that affect their businesses, Le Trinh (2019) applied structural equation modelling using partial least squares (PLS-SEM) on 320 SMEs in Vietnam, from June 2018 to August 2018. His results support the conclusion that for a sustainable start-up, the government should apply suitable legal policies, including incentive policies on taxes in the first 3-5 years, when new businesses are established. Moreover, he recommended that governments should assist incentive loans to boost SMEs and to invest in education programs which promote entrepreneurial culture.

To understand more deeply how taxes can affect the decision of an individual to start a business we have analysed several researches dedicated to the study of the relationship between tax policy and entrepreneurial motivation. Total tax rate as an indicator of tax policy is considered and important macroeconomic indicator that might influence entrepreneurs and the decision of an individual to entry in a business. Thus, (Djankov *et al.* (2010); Vidal-Suñé and Lopez-Panisello (2013); Salman (2014)) have shown that high taxes influence negatively the entrepreneurship because are an obstacle for creating new businesses and can inhibit the entrepreneurial process. Han *et al.* (2022) have also shown that tax and infrastructure competition can harm local investment and the profitability of local firms. And pointed out that tax harmonization is not always beneficial to local businesses.

In this context, an extensive and recent study is that performed by Bruce *et al.* (2020) who reviewed the existing empirical literature in this area. After reviewing an important number of studies which have analysed different types of taxes (personal income taxes, corporate income taxes, sale taxes and other taxes) focusing on national and sub-national studies on USA and also on international studies, they found contradictory results regarding the impact of tax policies on entrepreneurial activity: some studies indicated that tax rates affect positively the entrepreneurial activity, other found a negative influence or no significance. In their work, Watson and Kaeding (2019) arrived to the same conclusion that tax rates have both positive and negative effect on entrepreneurial activity. From a theoretic point of view, taxes can both encourage and discourage entrepreneurial activity, depending how are applied (Hansson, 2012; Watson & Kaeding, 2019): if tax law allows the deductibility of losses, this encourages entrepreneurship, while the application of a progressive tax rate structure decrease the profit of successful entrepreneurs. In their opinion (Bruce *et al.*, 2020), the diversity of the results is explained by different data and time period, different definitions and measures of tax policies and entrepreneurial activity and also different econometric models.

Also, studying the impact of taxes on entrepreneurship for the case of US, Watson and Kaeding (2019), highlighted the fact that taxes are one of the most important barriers for entrepreneurs and recommended as solution to stimulate the entrepreneurial activity on short and medium term to change tax policy. In that sense, establishing a neutral tax code would increase incentives to work, save, and invest for all in the economy, including entrepreneurs. According to Watson and Kaeding (2019), the entrepreneurs are influenced in their decision to enter an industry, invest, and engage in risk-taking through two channels: the tax rates on their

income and the structure of the tax code—for example, how the tax code treats losses and capital investments. Both the corporate tax rate and the individual income tax rate affect negatively the level of entrepreneurship. In order to increase firm entry rates, lowering corporate income tax and reducing the marginal tax rates on individual income (in a progressive system) could be the solution. On the other hand, if personal income tax rates are higher than corporate income tax rates, some entrepreneurs with losses may decide to change organizational form ex-post to offset other income tax liability. Can (2021) pointed out that reducing personal income tax rates increases overall self-employment activity. He also emphasizes the need of analyzing the relation between tax policy and entrepreneurship by taking into account that different types of entrepreneurs might respond differently to the taxation policy. This affirmation is sustained by his results which showed that higher personal income tax rates encourage incorporated entrepreneurship but discourage unincorporated entrepreneurship.

A similar, extensive and complex research, to that of Bruce *et al.* (2020) was conducted at European Union level by European Commission *et al.* (2017). Regarding the impact of taxation on the decision to start a new business, the most important determinants, according to the results, are represented by the degree of progressivity, the treatment of losses and the differential tax treatment of employee's vis-a-vis self-employed.

If taxes are higher on wage employment than on self-employment, people should prefer to engage in self-employment, boosting entrepreneurial entry (Clingingsmith & Shane, 2015). Clingingsmith and Shane (2015) investigated only the impact of individual income tax policy on entrepreneurship. Similar to the previous mentioned studies on the impact of corporate tax rate on entrepreneurship, the findings are contradictory and there is no consensus that might inhibit or encourage an individual to start a new business because of different employed methodologies. Clingingsmith and Shane (2015) concluded, after analysing the literature, that for the policy makers who pursue to promote the entrepreneurial activity, it is probably better "to find ways of addressing this population directly through targeted policies, rather than through the blunt instrument of individual income tax rates that affect nearly everyone".

In addition, several studies have investigated the impact of tax policy on entrepreneurship in several countries. In Russia, fiscal stimulus measures introduced in the period from 1998 to 2008 had a positive effect on the level of development of entrepreneurship in the Russian Federation (Shakirova & Kurochkina, 2017).

The use of fiscal policy measures by the Bangladeshi government, such as tax rebate, tax relief for investments and investors revealed the importance of governments policies to encourage the entrepreneurial sector (Hoque, 2018) that increase job creation, eradicate poverty and enhance human capital development.

Another recent study (Haddadzadeh Hendou, 2019) investigated the impact of government tax policies on the performance of small and medium enterprises of West Azerbaijan, considering the mediating role of entrepreneurial orientation. In his paper, Haddadzadeh Hendou (2019) conducted a descriptive study on 1126 SMEs managers of West Azerbaijan province and he found a positive and significant relationship, through entrepreneurial orientation, between the tax policy and the financial performance of the SME of West Azerbaijan province. Implementing tax policies which are not costly and complex for companies will improve the financial performance of SMEs. Also, the study of Haddadzadeh Hendou (2019) showed that the government's tax policies affect the entrepreneurial orientation of SMEs in West Azerbaijan.

Taking into account the literature on taxation and entrepreneurship, analysed above, we assume that entrepreneurship might increase if taxation is more business friendly and also that this factor is depending by the economic development of countries. Therefore, the first research hypothesis of our study is:

H1*: Taxation is influencing entrepreneurial motivations.*

Contrary to the above studies, earlier research conducted by Hansson (2012) in Sweden showed that both average and marginal income tax rates negatively affect the decision to become self-employed. The results obtained by Hansson (2012) were contradictory to those obtained in a previous study (Gentry & Hubbard, 2000) focused on data available for US households over the period 1979–1992. Gentry and Hubbard (2000) investigated the impact of tax rates and, in particular, tax progressivity on the decision to become an entrepreneur and his results highlighted that less progressive tax rates determine a significant increase in entrepreneurial entry. The contradictory results obtained in Sweden and USA was explained by Hansson (2012) by the differences between the Swedish and US tax structure, because the latter encourages risk-taking and tax-driven self-employment. Differences between countries were also obtained by other studies, for example the study conducted by Granda-Carvajal and García-Callejas (2022) found that personal income taxation, in developing countries, plays no significant role on self-employment, while for the developed countries the results are mixed.

Therefore, starting from this, we also propose to test if taxation influences entrepreneurial motivations differently for different countries. The second hypothesis is:

H2*: The relationship between taxation and entrepreneurial motivations depends on the level of development of countries.*

The negative relationship between taxes and entrepreneurship is also empirically evidenced by Bilan and Roman (2020) who conducted a study on the EU 28 countries over the period 2006-2018. Using a panel-data linear regression model, Bilan and Roman (2020) found that an increase in tax rates strongly discourages new firms from entering into the market, confirming the findings of previous empirical studies on the effects of tax policy on entrepreneurial activities. Comparing with previous studies, Bilan and Roman (2020) examined not only the relationship between tax rates and entrepreneurship, but also the relationship between tax administrative burden and entrepreneurship (less investigated) and showed that both tax rates and tax administrative burden play a key role in stimulating the creation of new companies.

Regarding the impact of income tax on entrepreneurship, Keuschnigg and Nielsen (2003) suggests that higher and progressive taxation delays entrepreneurship. The negative link between higher tax rates and entrepreneurship has been studied from 1944 by Domar and Musgrave (1944) and later, Gentry and Hubbard (2000) emphasized that the effect of higher taxes and progressivity on entry into entrepreneurship could be ambiguous or even positive when the government allows full offset of losses. In this context, the empirical evidence on the impact of taxation on entry into entrepreneurship arrived to mixed conclusions. Some of the conducted researches found that higher tax rates tend to discourage entrepreneurship (Long, 1982; Blau, 1987; Bacher & Brülhart, 2013); other studies showed positive relationships between tax rates and entrepreneurial activity (Cowling & Mitchell, 1997; Robson, 1998); and the third group of studies are less conclusive and present mixed results

(Bruce, 2000; Gentry & Hubbard, 2000; Carroll *et al.*, 2001; Bruce, 2002; Cullen & Gordon, 2007; Bruce & Deskins, 2012; Baliamoune-Lutz & Garello, 2014).

Resuming, taxation and entrepreneurship have been the research topic of an important number of studies across the world. Reviewing the findings, it is clear that taxes are an important determinant of entrepreneurship, and next we provide empirical evidence on how the total taxation rate and different tyes of it (total tax, profit tax, labour tax, other taxes payable by businesses) affect entrepreneurship in different countries across the world, according to their development level.

3. METHODOLOGY

The aim of the present paper is to identify the impact of tax rates on entrepreneurship and the relationship between tax rates and entrepreneurial motivations, considering the important role of entrepreneurship for economic development and to formulate possible solutions for stimulating entrepreneurial activity.

In order to test the research hypotheses, this study uses a sample of 46 world countries. The period considered for the empirical investigation it covers eight years, between 2012 and 2019. The choice of the sample of countries and also the period of analysis was conditioned by the availability of data.

Given that the data set combines time series and cross-section, an estimation of a balanced panel data will be pursued in order to study the effects of a set of explanatory variables on the motivations of entrepreneurs. Thus, in order to observe how taxes and fees charged to businesses are correlated with the motivation of entrepreneurs it is used the multiple linear regression method adapted to panel data, drawing inspiration from the models used by Amorós and Bosma (2014) and Angulo-Guerrero *et al.* (2017).

The general equation of the model is as follows:

$$y_{it} = \beta_1 tax_{it} + \beta_2 control_{it} + \mu_{it} \quad (1)$$

where: *i* represents the country and *t* is the time (2012…2019); y_{it}: represents the dependent variable measuring entrepreneurial motivations; tax_{it}: represents the indicators considered for expressing the tax policy; $control_{it}$: the control variables; β_1, β_2: are the coefficients; μit: the error term.

For measuring the entrepreneurial motivations, it is used a set of indicators offered by Global Entrepreneurship Monitor Reports (Xavier *et al.*, 2013; Amorós & Bosma, 2014; Singer *et al.*, 2015; Kelley *et al.*, 2016; GEM, 2017, 2018; Bosma & Kelley, 2019; Bosma *et al.*, 2020). Thus, the first indicator is represented by the total early stage entrepreneurial activity, and after that, the different motivations of the entrepreneurs: necessity, opportunity, improvement. Another indicator considered is the motivational index.

In order to quantify empirically the taxes, were considered a series of indicators that measure the taxes and duties applied to enterprises: total tax and contribution rate, profit tax, labour tax and contributions, other taxes payable by businesses. The definition of this indicators, and their abbreviations are presented in Table no. 1. The model also included two control variables: GDP growth and unemployment rate.

Table no. 1 – Description of the variables included in the econometric model

Variables	Abbreviations (Measures)	Definition
		Dependent variables
Early-stage entrepreneurial activity	TEA (%)	Percentage of 18-64 population who are either a nascent entrepreneur (in the phase of stating a new business) or owner-manager of a new business (42 months after the birth of the firm).
Necessity-driven entrepreneurs	NDE (% of TEA)	Percentage of TEA which are pushed into starting a business because they have no other options for work.
Opportunity-driven entrepreneurs	ODE (% of TEA)	Percentage of TEA which are pulled to entrepreneurship by opportunity and because they desire independence or to increase their income, as opposed to finding no other option for work.
Improvement-driven opportunity entrepreneurs	IDE (% of TEA)	Those opportunity-driven entrepreneurs who sought to either earn more money or be more independent, as opposed to maintain income.
Motivational index	MI	Percentage of those involved in TEA that are improvement-driven opportunity motivated, divided by the percentage of TEA that is necessity-motivated.
		Independent variables
Total tax and contribution rate	Totaltax (% of profit)	The amount of taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions as a share of commercial profits. Taxes withheld (such as personal income tax) or collected and remitted to tax authorities (such as value added taxes, sales taxes or goods and service taxes) are excluded.
Profit tax	Profit (% of commercial profits)	The amount of taxes on profits paid by the business.
Labor tax and contributions	Labour (% of commercial profits)	The amount of taxes and mandatory contributions on labour paid by the business.
Other taxes payable by businesses	Other (% of commercial profits)	Include the amounts paid for property taxes, turnover taxes, and other small taxes such as municipal fees and vehicle and fuel taxes.
		Control variables
GDP growth	GDP (annual %)	GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.
Unemployment	Unempl (% of total labour force)	The share of the labour force that is without work, but available for and seeking employment.

Source: authors own elaboration after data from GEM (2021) and World Bank (2021)

The world countries included in the sample were classified and analysed in line to their level of economic development, in order to conduct a comparative analysis. Thus, the countries were grouped according to the World Economic Situation and Prospects 2020 Report, realized by the UNCTAD (United Nations, 2020).

This report realizes a classification of countries according to the level of GNI per capita in June 2019. The grouping of countries according to the mentioned criterion is presented in Table no. 2. According to Table no. 2, the sample of countries includes 46 countries, from which 29 are high income countries, 13 upper middle income countries and 4 lower middle income countries.

Table no. 2 – The classification of countries according to the level of GNI per capita in June 2019

High income countries			Upper middle income countries	Lower middle income countries
Australia	Ireland	Portugal	Argentina	Egypt
Canada	Israel	Slovak Republic	Brazil	India
Chile	Italy	Slovenia	China	Indonesia
Croatia	Japan	Spain	Colombia	Morocco
Estonia	Latvia	Sweden	Ecuador	
Finland	Luxembourg	Switzerland	Guatemala	
France	Netherlands	United Kingdom	Iran	
Germany	Norway	United States	Malaysia	
Greece	Panama	Uruguay	Mexico	
Hungary	Poland		Peru	
			Russian Federation	
			South Africa	
			Thailand	

Source: authors own elaboration after data from United Nations (2020)

For performing the panel data analysis, first, the variables were tested for stationarity, for the existence of a unit root. None of the variables included in the study turned out to have a united root. Following, was performed the descriptive statistics of all the variables included in the model, and also the correlation matrix. From the correlation matrix resulted a strong correlation only between total tax and contribution rate and other taxes payable by business, but this was expected, because the total indicator includes these taxes in its component. Therefore, were ran separate models for the indicator that measures total tax and separately for the other indicators that express taxation. For testing the hypothesis formulated above, were run the multiple panel data regression models. The econometric analysis was carried out with the help of Eviews 10 software.

4. RESULTS AND DISCUSSIONS

The summary of the descriptive statistics (see Table no. 3) shows that early stage entrepreneurs have the highest values (36.7%) in Chile (2019) and the lowest values (2.8%) in Italy (2019). The variables measuring the motivation of entrepreneurs vary significantly across countries and time. The entrepreneurs motivated by necessity have higher percentages (47.6%) in Egypt (2019) and the lowest percentage (3.54%) in Norway (2014). The entrepreneurs motivated by opportunity have higher values (90.9%) in Poland (2018) and the lowest values (39.1%) in India (2017). Improvement driven opportunity entrepreneurs have the highest standard deviation and vary between a minimum of 18.4% in Italy (2013) and a maximum of 76.3% in United States (2017). Motivational index varies between a minimum of 2.8% in Chile (2016) and a maximum of 19.5% in Norway (in 2014). Thus, the motivation of entrepreneurs to open a business depends on the country in which these entrepreneurs are located but also on the period in which the decision is made.

Table no. 3 – Descriptive statistics of the variables

Variable	Mean	Max.	Min.	Std. Dev.	Obs.
Early-stage entrepreneurial activity (TEA)	11.935	36.700	2.800	6.602	322
Necessity-driven entrepreneurs	22.598	47.600	3.540	9.951	286
Opportunity-driven entrepreneurs	73.743	90.900	39.100	9.510	204
Improvement- driven opportunity entrepreneurs	49.395	76.300	18.400	12.330	286
Motivational index	11.935	19.500	2.800	6.602	322
Total tax and contribution rate	43.615	137.600	18.400	17.112	316
Profit tax	16.111	28.600	0.000	7.371	316
Labour tax and contributions	22.389	54.000	3.800	11.513	316
Other taxes payable by businesses	5.189	108.200	0.000	13.478	316
GDP growth	2.527	25.176	-7.444	2.835	322
Unemployment	7.976	28.470	0.210	5.391	322

Source: authors own calculations

From the independent variables, the highest variation is registered for the total tax and contribution rate, which varies between a minimum of 18.4% in Croatia (2014) and a maximum of 137.6% in Argentina (2015). Other taxes payable by businesses also vary significantly between countries and across time, from a minimum of 0 in Norway (2013-2015) and a maximum of 108.2% in Argentina (2015). Labour tax and contributions vary between a minimum of 3.8% in Chile (2012-2013) and a maximum of 54% in France (2014). Profit tax has the lowest variation, between a minimum of 0 in Argentina (2013-2015) and a maximum of 28.6% in Thailand (2012).

These results show that in the sample are both countries which have friendly tax rates to businesses and also countries where business taxes are a burden and discourage firms to enter into the market. This is one of the reasons for the decision to divide the sample of countries into groups according to their level of economic development.

Table no. 4 compares the means of the indicators for each group of countries. Early stage entrepreneurial activity is higher in upper middle countries, followed by lower income and high income countries. The result is similar with that of Bampoky *et al.* (2013), which showed that middle income countries have, on average, more entrepreneurs than high income countries. Our findings also suggest an inverse U-shape relationship between entrepreneurship and the income of countries. This means that when the income is increasing, the TEA rate will also increase, but up to a threshold point after which the relationship becomes negative. Thus, when countries improve their income level, will determine higher entrepreneurial activity up to a point where further economic development does not imply higher business activity (Rodrigues Brás & Soukiazis, 2019).

The mean values obtained for the indicators measuring the motivation to become entrepreneurs highlighted that the necessity motivated entrepreneurs have higher percentages in lower middle income countries, while opportunity and improvement motivated entrepreneurs have higher percentages in high income countries. This is because individuals from the poorest countries are driven by poverty and survival, lacking work options. In developed countries usually, the main motivations for starting a business are opportunity and innovation. Therefore, if the poverty is higher, predominates the necessity entrepreneurship (Raynolds *et al.*, 2001; Rosa *et al.*, 2006).

Motivational index has the highest mean values in high income countries. This is because this index reflects the improvement motivated entrepreneurs reported to necessity ones. And this ratio is the highest in high income countries.

Table no. 4 – Comparing indicators means by groups of countries

Variable	High income countries	Upper middle income countries	Lower middle income countries
Early-stage entrepreneurial activity (TEA)	9.951359	**16.63380**	10.96250
Necessity-driven entrepreneurs	19.45357	27.42747	**30.76333**
Opportunity-driven entrepreneurs	**76.39992**	70.52379	65.22444
Improvement- driven opportunity entrepreneurs	**51.604**	47.978	35.851
Motivational index	**3.564063**	2.255172	1.333333
Total tax and contribution rate	39.77206	**52.18409**	44.86667
Profit tax	14.74461	18.14545	**20.27500**
Labour tax and contributions	**22.74412**	22.22727	19.97083
Other taxes payable by businesses	2.282353	**12.08636**	4.616667

Source: authors own calculations

The mean values for the indicators considered in the analysis vary across group of countries, emphasizing the significant difference that are registered between these groups as regarding entrepreneurship but also tax rates. As regards total tax and contribution rate it has the highest mean value in upper middle income countries, followed by lower middle income countries. The lowest value is registered in high income countries. According to Ortiz-Ospina and Roser (2016), the available long-run data shows that in the process of development, countries have increased the levels of taxation, while at the same time changing the patterns of taxation, mainly by providing an increasing emphasis on broader tax bases. With other words, countries rely on higher tax revenues resulting from higher incomes or profits and less from rising tax rates. Also, Ortiz-Ospina and Roser (2016) highlighted the fact that the time series show that highest income countries have had relatively stable levels of tax revenues in the last decade; while trends and patterns are less clear across the developing countries. In many cases, especially among upper-middle income countries, tax revenues have been going up consistently, which might be an explanation for our results. Other aspect that must be considered is that the amount of collected taxes depends on compliance and efficiency of tax collection mechanisms.

Profit tax is the highest in lower income countries and the lowest in high income countries. As the development of the country decreases, there is an increase in the amount of the profit tax paid by businesses. If the income is lower the overall profit tax is higher.

Labour tax and contributions are higher in high income countries, and as the country's development decreases, so does this tax. But the differences are not very big between groups of countries. These differences can be generated by specific aspects that occur in each group of countries, such as: higher statutory rates, higher employer social security contributions and/or reductions in employee social security contributions.

Other taxes payable by businesses are higher in upper middle income taxes, and the lowest in high income countries. The difference between upper middle income countries and the others is significant.

The correlation matrix of the variables shows that there exists correlation between total tax and contribution rate and the components broken down by categories of taxes perceived

on businesses. Thus, separate regression models are run, first considering total tax and contribution rate as independent variable and then considering the other indicators measuring tax policy as independent variable.

The results of the first model applied are summarised in Table no. 5. Necessity motivated entrepreneurs resulted to be positively and statistically significant related to total tax and contribution rate. Opportunity and improvement motivated entrepreneurs and also motivational index resulted to be negatively and statistically significant related to total tax and contribution rate. Paying taxes discourages the entrepreneurs that wish to profit from opportunities and increase their profits. At the same time, even if the total tax paid by the businesses increases, the entrepreneurs motivated by necessity will continue to enter entrepreneurship, because having no other options to work, they consider this the optimal option to obtain the necessary incomes for living. Total early stage entrepreneurial activity did not result to be significantly related with total tax and contribution rate.

Table no. 5 – The relationship between tax policy and entrepreneurial motivations

Dependent variable	TEA	NDE	ODE	IDE	MI
Total tax and contribution rate	0.008	**0.093*** **	**-0.096*** **	**-0.088*** **	**-0.018*** **
	(0.013)	**(0.011)**	**(0.006)**	**(0.021)**	**(0.001)**
GDP growth	0.101	0.446	-0.364	**-0.749*** **	**-0.117*** **
	(0.200)	(0.188)	(0.234)	**(0.253)**	**(0.039)**
Unemployment	**-0.353*** **	**0.574*** **	**-0.424*** **	**-1.053*** **	**-0.138*** **
	(0.040)	**(0.064)**	**(0.077)**	**(0.080)**	**(0.017)**
Intercept	**14.512*** **	**12.588*** **	**82.353*** **	**63.783*** **	**5.231*** **
	(1.162)	**(0.910)**	**(1.392)**	**(1.327)**	**(0.308)**
Obs.	316	280	204	280	204
R-squared	0.093	0.117	0.089	0.215	0.123
R-squared adjusted	0.084	0.107	0.075	0.203	0.110
F-statistic	10.718***	12.219***	6.518***	24.898***	9.365***

Note: *, ** and *** represents significant values at 1%, 5% respectively 10%.
Standard error in parenthesis
Source: authors own elaboration

As regards control variables, GDP growth resulted to have a negative relation with improvement motivated entrepreneurs and motivational index. The relationship between economic development and entrepreneurial activity is negative because, because when the economy becomes more developed, fewer people will be interested in pursuing entrepreneurial activity (Acs *et al.*, 2008).

Unemployment rate resulted to have a negative relation with total entrepreneurial activity and the variables that express the motivation of entrepreneurs related to following opportunity and innovation, and a positive relation with necessity motivated entrepreneurs. This result is in line with the findings of other studies (Vidal-Suñé & Lopez-Panisello, 2013; Fuentelsaz *et al.*, 2015; Amorós *et al.*, 2019) and it can be explained by the fact that those entrepreneurs who are motivated by the pursuit of opportunities are negatively influenced by the increase of unemployment because this increase is usually associated with a reduction or stagnation of the process of development of the economy and implicitly with less opportunities for entrepreneurs. At the same time, higher unemployment rates stimulate

entrepreneurs motivated by necessity to engage in entrepreneurial activities having no other option for work (Rusu & Roman, 2019).

The values of R-squared adjusted vary between 8% and 20% showing that total tax and contribution rate explain a small part of the variation in entrepreneurship and entrepreneurial motivations. This is also shown by the high values of the intercept, which emphasizes that there are other factors with significant influence on entrepreneurial motivations, in addition to taxation. This result was expected because as other studies have shown there are also many factors that influence the motivation of entrepreneurs. However, the purpose of our study, to show that tax rates significantly influences entrepreneurial motivations, was achieved. Furthermore, the values for R-squared and R-squared adjusted which are close to each other and the significant values for F statistically show us that the model is good. Thus, the first hypothesis which states that taxation has a significant relationship with entrepreneurial motivations, is confirmed.

In the analysis broken down by components of taxation (see Table no. 6), we notice that the profit tax turned out to have a positive relationship with TEA. Labour tax and contribution resulted to have a positive relationship with NEA and a negative relationship with TEA, ODE, IDE and motivational index. Other taxes payable by business resulted to have a positive relation with TEA and NEA and a negative relation with ODE, IDE and motivational index. The results can be explained by the fact that more successful businesses see higher taxes as discouraging because cut into their profits (Audretsch *et al.*, 2021).

Table no. 6 – The relationship between category of taxes and entrepreneurial motivations

Dependent variable	TEA	NDE	ODE	IDE	MI
Profit tax	**0.109*** **	0.030	-0.039	-0.079	-0.010
	(0.019)	(0.064)	(0.065)	(0.062)	(0.013)
Labour tax and contributions	**-0.142*** **	**0.108*** **	**-0.156*** **	**-0.155*** **	**-0.015** **
	(0.013)	**(0.029)**	**(0.026)**	**(0.036)**	**(0.006)**
Other taxes payable by businesses	**0.095*** **	**0.081*** **	**-0.060*** **	**-0.048** **	**-0.020*** **
	(0.018)	**(0.011)**	**(0.014)**	**(0.025)**	**(0.002)**
GDP growth	0.094	**0.445** **	-0.334	**-0.752*** **	**-0.116*** **
	(0.173)	**(0.189)**	(0.213)	**(0.079)**	**(0.038)**
Unemployment	**-0.260*** **	**0.550*** **	**-0.381*** **	**-1.014*** **	**-0.138*** **
	(0.043)	**(0.058)**	**(0.080)**	**(0.079)**	**(0.014)**
Intercept	**14.742*** **	**13.512*** **	**82.128*** **	**64.600*** **	**5.041*** **
	(0.893)	**(1.528)**	**(1.572)**	**(1.997)**	**(0.085)**
Obs.	316	280	204	280	204
R-squared	0.198	0.119	0.098	0.217	0.124
R-squared adjusted	0.185	0.103	0.076	0.205	0.101
F-statistic	15.347***	7.472***	4.347***	15.257***	5.609***

Note: *, ** and *** represents significant values at 1%, 5% respectively 10%.
Standard error in parenthesis
Source: authors own elaboration

Thus, findings from Table no. 6 confirm once again the first Hypothesis (H1) that taxes and duties imposed on businesses have a significant influence on entrepreneurship but also on the motivation of entrepreneurs. The results for R squared but also for statistical F, and intercept show us the same things as in the previous model.

When the analysis of the relationship between total tax and contribution rate was performed according to the groups of the countries (see Table no. 7) the results show that there

are not significant differences between the groups of countries in terms of total tax and contribution rate effects on entrepreneurial motivations. Thus, the results are similar to those obtained in Table no. 5 for the entire sample of countries. Entrepreneurs motivated by necessity are positively and significantly related to the total tax and contribution rate regardless of the group of countries they come from. Thus, it is shown that these entrepreneurs, having no other options to procure the necessary income, will decide to enter the entrepreneurship even if the taxes imposed on the enterprises are high. On the other hand, entrepreneurs motivated by opportunity are negatively related to the total tax and contribution rate, because the taxes lead to reductions in their profits and discourage the entrepreneurs. These findings are valid regardless of the group of countries from which the entrepreneurs come.

The only difference obtained is for the variable TEA, which appears to be negatively and significantly related to total tax and contribution rate, showing that entrepreneurs, especially those at the beginning of the road, are generally discouraged by the taxes and fees that their businesses have to pay. These results are in line with other findings from the literature (Klapper *et al.*, 2006; Vidal-Suñé & Lopez-Panisello, 2013; Ferede, 2021).

Values for adjusted R squared range from 5.5% to 51.8%, with lower values in upper middle income countries and higher values in lower middle income countries. Thus, we can say that between 5% and 51% of the variation of the number of entrepreneurs, with different motivations, can be explained by the variation registered at the level of the total tax rate for enterprises. The small differences between R squared and R squared adjusted but also the statistically significant values for F-statistic show us that the chosen models are suitable and validated.

Table no. 8 presents a more in-depth analyses broken down both by groups of countries and by types of taxes imposed on businesses. Significant differences appear here. Thus, profit tax resulted to be positively related to TEA from upper middle income countries and negatively related to TEA from lower middle income countries. Those with above average incomes are not negatively influenced by the profit tax when they want to start a new business or when they do something innovative, because usually this category of entrepreneurs benefits from support or facilities from public authorities.

In countries with lower average incomes, there are also facilities for start-ups, but it turns out that the size of the profit tax is important when making the decision to start an activity.

Also, for all the groups of countries profit tax resulted to be negatively related with NDE. A positive relationship resulted for profit tax and ODE and MI for all groups of countries. IDE and profit tax are positively related only for upper and lower middle income countries.

Another component of corporate taxation, labour tax and contributions resulted to be negatively related to TEA and IDE for all the countries. Regarding the other variables that measure the motivation of entrepreneurs, the results are divided. Labour tax is negatively related to NDE for high income countries, and positively for upper and lower middle income countries. For the case of MI the signs are opposite to those of NDE. Labour tax is negatively related to ODE for upper and lower middle income countries. Thus, entrepreneurs in all countries are discouraged by high rates of labour tax and contributions.

In terms of motivation, there are differences between groups of countries, with the entrepreneurs in more developed countries being influenced differently by the labour tax compared to those in less developed countries. Entrepreneurs motivated by opportunity and improvement in upper and lower middle income countries are negatively influenced by high values of labour tax and contributions, while those motivated by necessity decide to enter the business even if these taxes are high.

Table no. 7 – The relationship between tax policy and entrepreneurial motivations by groups of countries

Groups	High income countries					Upper middle income countries					Lower middle income countries				
Dependent variable	TEA	NDE	ODE	IDE	MI	TEA	NDE	ODE	IDE	MI	TEA	NDE	ODE	IDE	MI
Total tax and contribution rate	0.008	**0.093*** **	**-0.096*** **	**-0.088*** **	**-0.018*** **	-0.033	**0.028***	**-0.043** **	**-0.059*** **	**-0.012*** **	**-0.253** **	**0.260** **	**-0.473*** **	**-0.253** **	**-0.011***
	(0.013)	**(0.011)**	**(0.006)**	**(0.021)**	**(0.001)**	(0.025)	**(0.015)**	**(0.019)**	**(0.017)**	**(0.003)**	**(0.105)**	**(0.118)**	**(0.130)**	**(0.105)**	**(0.005)**
GDP growth	0.101	**0.446** **	**-0.364**	**-0.749*** **	**-0.117*** **	-0.102	**-0.411***	0.282	-0.109	0.015	0.436	**1.661** **	**-2.295** **	0.436	**-0.140*** **
	(0.200)	**(0.188)**	**(0.234)**	**(0.253)**	**(0.039)**	(0.190)	**(0.230)**	(0.191)	(0.280)	(0.024)	(0.677)	**(0.772)**	**(1.013)**	(0.677)	**(0.036)**
Unemployment	**-0.353*** **	**0.574*** **	**-0.424*** **	**-1.053*** **	**-0.138*** **	**-0.416*** **	**0.273*** **	**-0.211*** **	**-0.747*** **	**-0.078*** **	-0.286	**1.648*** **	**-1.513*** **	-0.286	**-0.115*** **
	(0.040)	**(0.064)**	**(0.007)**	**(0.080)**	**(0.017)**	**(0.042)**	**(0.024)**	**(0.048)**	**(0.086)**	**(0.014)**	(0.456)	**(0.267)**	**(0.314)**	(0.456)	**(0.007)**
Intercept	**14.512*** **	**12.588*** **	**82.353*** **	**63.783*** **	**5.231*** **	**21.932*** **	**25.024*** **	**73.581*** **	56.827***	**3.417*** **	**22.284*** **	-1.540	**19.486*** **	**22.284*** **	**3.417*** **
	(1.162)	**(0.910)**	**(1.392)**	**(1.327)**	**(0.308)**	**(1.909)**	**(1.367)**	**(1.766)**	(1.431)	**(0.432)**	**(6.085)**	(4.504)	**(7.252)**	**(6.085)**	**(0.345)**
Obs.	316	280	204	280	204	88	79	58	79	58	24	21	18	24	18
R-squared	0.093	0.117	0.089	0.212	0.123	0.125	0.074	0.055	0.165	0.133	0.361	0.419	0.383	0.361	0.518
R-squared adjusted	0.084	0.107	0.075	0.203	0.110	0.093	0.037	0.003	0.131	0.084	0.265	0.316	0.251	0.265	0.414
F-statistic	10.718***	12.219***	6.158***	24.828***	9.365***	4.003***	2.005**	1.064**	4.951***	2.764**	3.768**	4.086**	2.900*	3.768***	5.016***

Note: *, ** and *** represents significant values at 1%, 5% respectively 10%. Standard error in parenthesis
Source: authors own elaboration

Table no. 8 – The relationship between category of taxes and entrepreneurial motivations by groups of countries

Groups	High income countries					Upper middle income countries					Lower middle income countries				
Dependent variable	TEA	NDE	ODE	IDE	MI	TEA	NDE	ODE	IDE	MI	TEA	NDE	ODE	IDE	MI
Profit tax	-0.025	**-0.164*** **	**0.174** **	-0.079	**0.030***	**0.370*** **	**-0.637*** **	**0.538*** **	**0.859*** **	**0.088*** **	**-0.356** **	**-0.092*** **	**1.489*** **	**1.168*** **	**0.062*** **
	(0.018)	**(0.060)**	**(0.069)**	(0.062)	**(0.016)**	**(0.095)**	**(0.170)**	**(0.129)**	**(0.206)**	**(0.019)**	**(0.149)**	**(0.250)**	**(0.166)**	**(0.323)**	**(0.002)**
Labor tax and contributions	**-0.199*** **	**-0.080*** **	0.038	**-0.155*** **	**0.029*** **	**-0.109*** **	**0.194*** **	**-0.252*** **	**-0.195*** **	**-0.040*** **	**-0.490*** **	**1.269***	**-1.306** **	**-0.376*** **	**-0.059** **
	(0.023)	**(0.019)**	(0.024)	**(0.036)**	**(0.009)**	**(0.028)**	**(0.061)**	**(0.028)**	**(0.044)**	**(0.009)**	**(0.160)**	**(0.606)**	**(0.477)**	**(0.105)**	**(0.019)**
Other taxes payable by businesses	**0.383*** **	**0.162***	0.155	**-0.046***	**-0.106***	**0.075*** **	**-0.171*** **	**0.152*** **	**0.182*** **	**0.018*** **	0.099	**0.697***	**-2.409** **	-0.607	**-0.064** **
	(0.070)	**(0.097)**	(0.192)	**(0.025)**	**(0.054)**	**(0.025)**	**(0.042)**	**(0.544)**	**(0.045)**	**(0.005)**	(0.256)	**(0.382)**	**(1.017)**	(0.397)	**(0.029)**
GDP growth	0.179	**0.315** **	-0.030	**-0.752*** **	**-0.095*** **	-0.067	**-0.516*** **	**0.586*** **	-0.015	**0.060***	-0.088	-0.895	4.150	0.208	0.075
	(0.147)	**(0.135)**	(0.077)	**(0.246)**	**(0.035)**	(0.153)	**(0.138)**	**(0.214)**	(0.265)	**(0.035)**	(0.888)	(0.930)	(2.544)	(0.971)	(0.092)
Unemployment	-0.018	**0.884*** **	**-0.601*** **	**-1.014*** **	**-0.238*** **	**-0.469*** **	**0.350*** **	**-0.277*** **	**-0.836*** **	**-0.089*** **	-0.071	-1.305	2.068	0.379	0.041
	(0.040)	**(0.089)**	**(0.158)**	**(0.079)**	**(0.024)**	**(0.039)**	**(0.025)**	**(0.049)**	**(0.068)**	**(0.014)**	(0.577)	(1.392)	(1.193)	(0.285)	(0.042)
Intercept	**13.767*** **	**14.888*** **	**77.602*** **	**64.600*** **	**4.882*** **	**15.260*** **	**35.717*** **	**65.015*** **	**40.446** **	**1.811*** **	**28.501*** **	**35.875*** **	**34.348**	**18.233***	0.807
	(0.952)	**(1.477)**	**(1.399)**	**(1.997)**	**(0.254)**	**(2.438)**	**(4.492)**	**(3.498)**	**(4.309)**	**(0.424)**	**(8.339)**	**(11.143)**	**(17.993)***	**(10.046)**	(0.668)
Obs.	204	180	128	280	128	88	79	58	79	58	24	21	18	21	18
R-squared	0.237	0.258	0.174	0.217	0.186	0.243	0.322	0.324	0.379	0.336	0.392	0.636	0.682	0.574	0.760
R-squared adjusted	0.218	0.237	0.140	0.203	0.153	0.196	0.276	0.279	0.336	0.272	0.223	0.515	0.549	0.432	0.660
F-statistic	12.333***	12.124***	5.164***	15.257***	5.607***	5.265***	6.956***	5.414***	8.924***	5.275***	2.322**	5.250***	5.149***	4.050**	7.602***

Note: *, ** and *** represents significant values at 1%, 5% respectively 10%. Standard error in parenthesis
Source: authors own elaboration

Other taxes payable by businesses resulted to be positively related to TEA in high income countries and upper middle income countries, to NDE in high income countries and lower middle income countries, and with ODE, IDE and MI in upper middle income countries. On the other hand, appear negatively related with NDE in upper middle income countries, with ODE in lower middle income countries, with IDE in high income countries and with MI in high and lower middle income countries. These results confirm hypothesis H2.

Values for adjusted R squared range from 17% to 76%, with lower values in high income countries and higher values in lower middle income countries. Thus, we can say that between 17% and 76% of the variation of the number of entrepreneurs, with different motivations, can be explained by the variation registered in the tax's levels supported by enterprises. The small differences between R squared and R squared adjusted but also the statistically significant values for F-statistic show us that the chosen models are suitable and validated.

5. CONCLUSIONS

The aim of the paper was to investigate if taxation, specifically the tax rates impacts entrepreneurship on a sample of 46 world countries grouped into three categories according to the GNI level per capita (in June 2019). For this purpose, we used panel data models for a period of eight years (2012-2019) for which data was available. We investigate the impact of a set of variables measuring the taxes applied to the firms on the dependent variables that measure the motivations of entrepreneurs. Also, to assure the accuracy of the results, two control variables were included, namely the economic growth rate and unemployment rate, which the literature indicates as important determinants of entrepreneurship.

One important result consists in the fact that tax rates affects the decision of individuals to become entrepreneurs, which is in line with the results obtained in previous empirical studies (Djankov *et al.*, 2010; Vidal-Suñé & Lopez-Panisello, 2013; Salman, 2014; European Commission *et al.*, 2017; Watson & Kaeding, 2019; Bilan & Roman, 2020). The results showed that the motivations of entrepreneurs are closely related to the level of economic development of countries. Another finding consists in the fact that the tax rates are significantly related with the motivation of entrepreneurs. In this case we cannot compare the results of the present research with the results of previous studies because there are no studies that applied this approach to study the impact of tax rates on entrepreneur's motivations (necessity-driven, opportunity-driven, improvement-driven opportunity and motivational index). Also, the way in which entrepreneurs perceive the influence of tax rates depends on the country they come from, on the characteristics of the economic and business environment, which implicitly determines them and their motivation to enter into business. These findings are in line with those of Bruce *et al.* (2020), and could be useful to policymakers, concerned with supporting and encouraging entrepreneurship and especially entrepreneurs interested in innovation and development. They could adapt fiscal policy to help these categories of entrepreneurs which might have positive effects on economies. Also, depending on entrepreneurial motivation, the policy makers can consider different forms of support by the type of entrepreneurship they want to prioritize.

In this context, the recommendations for the policymakers is to adopt favourable measures for entrepreneurship (tax incentives, a decrease of the marginal rates if it is applied a progressive taxation regime, R&D tax credits and allowances etc.) which will contribute to job creation, economic growth and increase of innovation.

Therefore, this paper contributes to the expansion of the literature in the field by providing evidence on the correlation between tax rates and entrepreneurship motivation, on an extended sample of countries, classified according to their income level and for a large period of time.

Besides the important findings, the paper also presents some limitations. First, the data regarding entrepreneurial variables were restricted to the variables included in the GEM Reports. Secondly, the availability of data for the indicators and the period considered determined us to limit the number of analysed countries to only 46.

Further research could extend the analysis by considering a model that takes into account a system of rates (progressive or proportional) in the analysed countries. Moreover, other elements of taxation could be considered, such as deductions or fiscal facilities. The present paper focused on traditional entrepreneurship, but the impact of tax rates on different types of entrepreneurial fields (social entrepreneurship, environmental entrepreneurship) could also be studied.

ORCID

Valentina Diana Rusu http://orcid.org/0000-0002-5974-9150
Adina Dornean http://orcid.org/0000-0002-8009-4961

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Bibliometric Review on the Business Management Field

Tayfun Arar*, Gülşen Yurdakul**

Abstract: The purpose of this article is to review the business management field evolution from 2000 up to date and to map the conceptual, social, and intellectual structure of the research in this field. Data were collected from the WoS database, comprising 12,145 articles published between 2000 and 2022. Several bibliometric techniques were applied, including analysis of co-words, co-citation, bibliographic coupling, and co-authorship networks in addition to performance analysis. VosViewer and the Bibliometrix/Biblioshiny packages were used to perform the analyses. Besides revealing the evolution of the business management field, the results identify the most active and influential authors, articles, journals, and topics in this field.

Keywords: business management; bibliometric analysis; VosViewer; Biblioshiny; Web of Science (Wos).

JEL classification: M10; C88.

* Business Department, Kırıkkale University, Kırıkkale, Türkiye; e-mail: *tayfunarar@kku.edu.tr* (corresponding author).
** Business Department, Kırıkkale University, Kırıkkale, Türkiye; e-mail: *gulsen.yurdakul10@gmail.com*.

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1. INTRODUCTION

Business management gained its systematic and scientific character with the approach that W. F. Taylor (1911) expressed the principles that can provide effectiveness and efficiency in organizations in his work entitled 'Principles of Scientific Management'. These principles, also known as Taylorism, pioneered the Classical Management Approach. The Classical Approach was later developed by Fayol's (1918) 'Management Process Approach', in which he stated the ideal management process and the intricacies of the formal organizational structure. Finally, the 'Bureaucracy Approach', which Weber (1924) expressed as an effective and efficient working order constitutes the last main point in this approach. The classical approach focuses on a closed system that envisages a formal organizational structure such as division of labor, specialization, hierarchical structure, and chain of command to provide effectiveness and efficiency in organizations. Fayol states that if the principles specified in the approach he developed are met, the 'best and correct' organizational structure will be provided (Fells, 2000). One of the main disadvantages of this approach is that the organization treats everything, including labor, as a machine (Bodrožić & Adler, 2018). However, in the 1930s, 'Behavioral Approach to Management', which states that organizations are not 'machines' but 'social' structures by focusing on the importance of the human element in the organizational structure, emerged with Hawthorne Studies under the leadership of Mayo (1949) (Hamner & Organ, 1978; Levinthal, 2011). This view, also known as the Neo-Classical Approach, tries to explain the social and behavioral aspects of the organization with different theoretical approaches (see McGregor, 1960; Likert, 1979) by considering human behavior on both individual and group basis.

By the years of World War II, making the right decisions about how to use resources, methods to be used in production, logistics, and strategy was seen as a prerequisite for surviving in a war environment (N. Anderson *et al.*, 2014; Liao *et al.*, 2019). Quantitative methods such as statistics, physics, operations, and mathematics have contributed significantly to the studies, especially in the United Kingdom, on issues such as the military early warning radar system, submarine dimensions, and accurate determination of the bombing site (D. R. Anderson *et al.*, 2018). After the war, the development of the operational techniques used continued, both in the military and organizational terms, and the foundations of the "Management Science Approach" were settled (Johnson, 1997). In this way, quantitative methods have been used frequently to collect data about an organizational problem or purpose, to create a model, and to produce solutions (B. W. Taylor *et al.*, 2013). The frequent use of quantitative methods has created an interdisciplinary field of study in organizations. In this way, the field of organizational management has expanded even further.

Later, the perspective, which consists of two approaches addressing different points and is generalized as the 'Modern Management Approach', started to develop. The first of these approaches is the 'Systems Approach', which is a holistic mathematical field of study that can adapt to all systems that the biologist von Von Bertalanffy (1950) has been working on for a long time. Rather than relying on a specific discipline or perspective, this approach considers the organization with a holistic perspective and sees organizations as a whole consisting of parts, with internal and external factors (Jackson, 2007). Therefore, the System Approach defines organizations as open systems (Stern & Barley, 1996; Mingers & White, 2010) which both affects and are affected by its internal and external environment. As the second approach of modern management, the 'Contingency Approach' has been adopted, which states that there

is no 'one and the best' organizational structure adopted by the Classical Management approach in organizations and that it will vary according to different situations and conditions (Pugh, 1966). We can say that all the management approaches that have been explained so far confirm the contingency approach. Because each approach is shaped according to the requirements of the conditions it is in (Hatch, 2018). Finally, the 'Post-modern Management Approach' had a perspective that foresees innovations and changes at the macro level in organizations between the 1970s and 2000s. Parallel to the rapid development of technology, it expresses an approach in which concepts such as digitalization, virtual organizational structure, technological collaborations, network organizational structure, information technologies, and information have begun to be adopted in organizations (Lacan, 2019). In addition, a contemporary perspective that foresees maximum quality standards and minimum cost has been brought with approaches such as Total Quality Management and Six Sigma (Spencer, 1994; Qasrawi *et al.*, 2017).

According to Ramos-Rodríguez and Ruiz-Navarro (2004), as a scientific discipline has grown mature enough, researchers generally concentrate their attention on the literature generated by academia to perform literature reviews to assess the state of the art. Business management is one of the fields that have reached maturity in terms of quantity and quality. Bibliometric analysis is one of the methods used in the literature to examine the conceptual, social, or intellectual development of studies in a particular field or on a particular subject. Bibliometric analysis is attracting increasing attention from researchers and is becoming an encouraging field with the spread of information technologies (Bar-Ilan, 2008; Merigó & Yang, 2017; Donthu *et al.*, 2021). The obvious reason for this increased interest is that it provides a systematic and general overview of the vast scholarly literature on a particular discipline (Eck & Waltman, 2014; van Nunen *et al.*, 2018). Bibliometrics is an application that aims to measure the impact of literature reviews and scientific publications and their level of dissemination through quantitative techniques (Cuccurullo *et al.*, 2016; Forliano *et al.*, 2021). In this sense, it offers researchers the opportunity to examine very large data with a high level of rigor, transparency, and reproducibility (Zupic & Čater, 2015; Castillo-Vergara *et al.*, 2018). The bibliometric analysis examines the scientific data in question from a quantitative point of view in a way that helps to organize the knowledge in a specific field (Castillo-Vergara *et al.*, 2018) and lays the groundwork for the analysis of the details of the research topic (Chen & Xiao, 2016). Moreover, bibliometric analyzes that provide access to the details of the research topic can map the characteristics and evolutionary direction of scientific data belonging to a specific field (Li & Hale, 2016; van Nunen *et al.*, 2018). In addition, the performance and collaboration models of authors, journals, and countries can give an idea about the thematic diversity, multidisciplinary character of the research field, and the current developments and development direction of the research field (Waltman *et al.*, 2010; Zupic & Čater, 2015; van Nunen *et al.*, 2018). In addition, the science maps used in bibliometric analysis define the structures that characterize the subject studied conceptually, intellectually, and socially. While the conceptual structure is analyzed as a result of the commonization of keywords that enable the definition of thematic clusters (Merigó & Yang, 2017); the social structure is analyzed as a result of the relationships they have created through the co-authors, and the intellectual structure is analyzed through the references of the documents that most affected the research field in the period included in the research (Forliano *et al.*, 2021).

The evolution of the field of business management, which is tried to be summarized with important points in the first three paragraphs, shows that the field is quite dynamic and suitable for development. Business management, which has been growing like a snowball with new approaches and theories from the past to the present, seems to continue to grow and change. In this context, it is important to take a current picture of business management and to see in which areas the literature continues to develop. In this way, determining the current focal points of business management is important both in terms of following current developments in the field of management and guiding researchers. For this reason, this research aims to see the current position of business management by making a bibliographic examination of business management in the period from 2000 to the present. The main idea is to reveal the development of the research field of business management according to the data collected from the Web of Science (WoS). This study concentrates on the evolution and development of the business management field of research by analyzing articles, authors, journals, and sizeable countries.

In the current literature, to the best of our knowledge, there is not an extended and up-to-date study that covers bibliometric analysis in the business management field. Hereby, this study makes some contributions to the literal development of the business management field. First, it indicates the performance analysis of the field considering annual scientific production, the number of citations, and the most relevant authors, documents, and journals. Second, it describes the conceptual structure through co-word analysis and maps. Third, it identifies the intellectual field by a co-citation analysis of articles and journals. Forth, it identifies and organizes the most up-to-date themes and cutting-edge studies through a bibliographic coupling analysis. Finally, it identifies the social structure of the research field by showing the collaboration ratios of authors and countries. Hence, this article provides scholars with guidance for future research, by highlighting the most prominent contributions on the topic and by identifying the evolution trends in this field of research.

The following sections of this study are as follows: Section 2 describes and explains the steps in the methodology used. In Section 3, the results of performance analysis, co-words analysis, co-citation analysis, bibliographic coupling analysis, and co-authorship analysis are presented. In Section 4 the main conclusions are exposed and in Section 5, discussions about the results and limitations of the study are performed advising to shed light on further research.

2. METHODOLOGY

In this study, bibliometric analysis is conducted. The structure of the research methodology is as follows: (1) clarifying the objectives (2) criteria of data query; (3) tools selection; (4) selection of scientometric analyses; (5) interpreting and discussing the results (Figure no. 1).

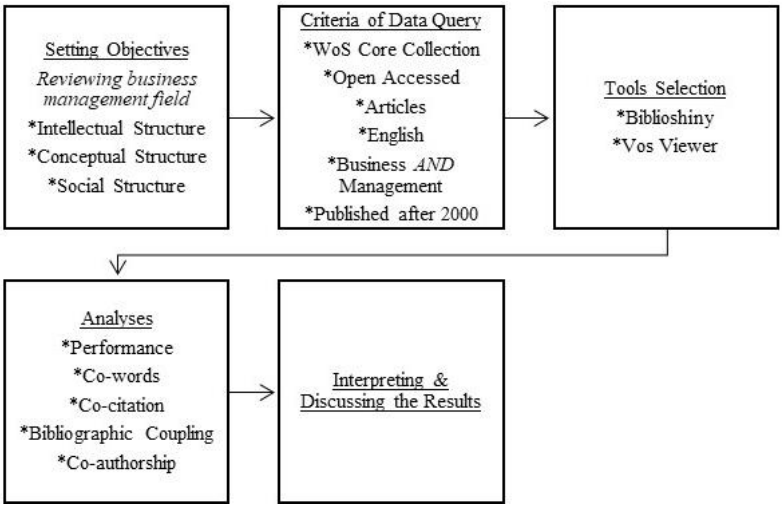

Figure no. 1 – Research Steps

In the first phase as a start point, the research questions are clarified based on the main purpose of the study. In this sense, the first question is (*RQ1*): What is the performance analysis in terms of production and citation of studies in the business management field? & How has the business and management literature evolved so far? The second is (*RQ2*): What is the conceptual structure of the business management field? & What are the specific topics associated with the business management field and how is the evolution of issues? The third one is (*RQ3*): What is the intellectual structure of the business management field? The last one is (*RQ4*): What is the social structure of the business management field?

In the second phase, we gathered data. To do so, we preferred the Web of Science (WoS) Core Collection. Because the Web of Science Core Collection embodies more than 21,000 peer-reviewed, high-quality worldwide journals in coverage of 254 scientific fields with 1,5 billion cited references and 74,8 million records (Clarivate, 2022). Meanwhile, the data query required some criteria, in addition, to being indexed in SSCI and/or SCI-Expanded in WoS Core Collection. The publication type should be a journal article since journal articles are considered verified information (Block *et al.*, 2020). Furthermore, these articles should be open accessed, published in the English language, and should be published after 2000. Moreover, the keyword query as WoS Category is *Business* and *Management* in terms of compatibility with the aim of the study. On July 25th we obtained 12,145 results that meet all these criteria. We downloaded data in both tab-delimited file forms for VosViewer and plain text file forms for Biblioshiny.

In the third phase, bibliometric analysis tools are selected. VosViewer and Biblioshiny software were used to analyze the collected data. Studies are using the combination of VosViewer and Biblioshiny (e.g., Radha & Arumugam, 2021; Singh & Bashar, 2021; Boakye *et al.*, 2022). VosViewer is a software program developed for the visualization of bibliometric maps by Waltman and Van Eck (2012) from Leiden University in the Netherlands. The program is offered to users free of charge at "www.vosviewer.com" (van Eck *et al.*, 2010). This software helps with text mining, the creation of bibliometric maps, and comprehensive visualization of scientific research topics (van Eck *et al.*, 2010). On the other hand,

Biblioshiny was developed by Aria and Cuccurullo (2017) from the University of Naples and Campania in Italy. The most important distinguishing feature of this software is that it is 'non-coding bibliometric' (Moral-Muñoz *et al.*, 2020). In addition, this software program in R language is well organized for bibliometric analysis, and data matrix drafting, and its menu is segmented according to the scientific mapping analysis (SMA) workflow (Aria & Cuccurullo, 2017; Kumar & Goel, 2021). Meanwhile, there are empirical studies that compare tools such as VosViewer and Biblioshiny (see Moral-Muñoz *et al.*, 2020; Ahmi, 2022).

In the fourth phase, several analyses will be conducted. The reason is that the more analyses performed, the more chance to better understand and analyze the relative field. Each analyze has its pros and cons (Zupic & Čater, 2015). Therefore, we did not use a few but the most important ones in this study. In this sense, to see the general situation of the field, we conducted several performance metrics analyses. Moreover, to understand how conceptual, intellectual, and social structures are, we performed co-words analysis, co-citation analysis and bibliographic coupling analysis, and also co-authorship analysis respectively.

Finally, in the last step, the results of analyses are interpreted in the conclusion and discussion part.

3. RESULTS

In this study, 12.145 articles published by 22.711 authors in 84 journals in total between 2000-2022 were scanned. 1069 of these studies have a single author and the international co-authorship percentage is 46.46%. A total of 22.323 keywords were used and the average number of citations to the studies was 38.05.

3.1 Performance Analysis

In this section, to answer the first research question group, performance indicators are provided within the scope of bibliometric analysis.

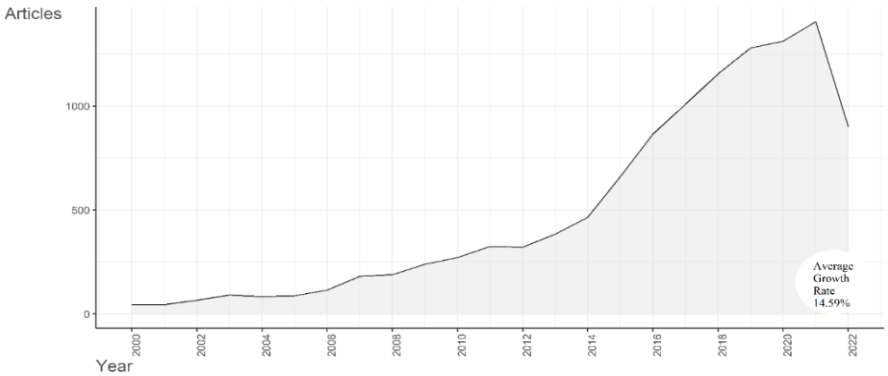

Figure no. 2 – Annual Scientific Production

In Figure no. 2, it is clear that since 2000, the number of publications has risen and it is observed that this upward trend has become steeper, especially since 2014. It can be stated that an important reason for this is that China took the title of "the world's largest economy"

from the USA in 2014 (Morrison, 2019). Because China is increasing global competition even more with its growing economy and cheaper labor advantage (Silagadze *et al.*, 2016). Therefore, as can be seen in Figure no. 7, it is thought that more scientific content has started to be produced for the researchers in the USA, which is registered as the country with the second-highest number of publications and the highest number of citations, for the companies in their countries to develop management strategies compatible with the global competition conditions. We see that the lowest number of publications was conducted in 2000 (n=45) and the highest number of publications was performed in 2021 (n=1406) and the average growth rate is 14.59% in this period. When data is collected, for 2022, there are only 900 articles published. However, considering that the data were collected in July and many journals in the Web of Science published the article in the following years, it is predicted that this number will exceed the previous year.

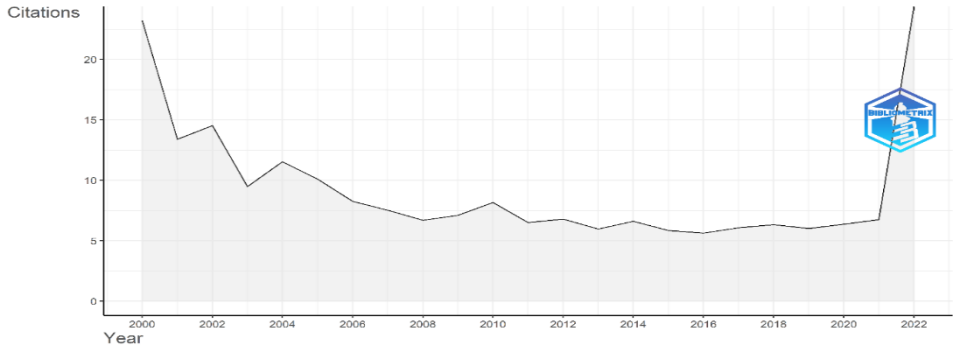

Figure no. 3 – Average Article Citations per Year

In Figure no. 3, the average article citations per year is provided. The citation rate, which started at 23.2% in 2000, hit the bottom at 5.6% in 2016 and started to rise again in the following years. This trend of average citation per year does not seem to match the trend of annual scientific production with an ongoing rise. The reason why this average is more at the beginning arises from the fact that the number of articles was so few in 2000 (n=45). In that year, it is seen that 77.7% of the articles (n=35) are co-authored publications. In addition to common topics studied in the aforementioned year such as competitive advantage, work-family conflict, resource-based view, etc., in terms of content, it is seen that there are also publications beyond their time such as Dyer's and Nobeoka's study (2000) entitled as "*Creating and managing a high-performance knowledge-sharing network: The Toyota case*", published in Strategic Management Journal. The study investigated the importance of knowledge-sharing behavior which has gained importance recently in the literature. Over the years, with an exponentially increasing number of studies with a single author or loss of attractiveness by constantly working on similar topics instead of producing new content being conducted, the citation rate may not have caught the publication production rate simultaneously. Another reason could be due to the small proportion of international collaboration between prominent countries in terms of the number of publications which will be stated in Figure no. 8. This small number of collaborations could result in a low impact on the scientific community in terms of citations (Locatelli *et al.*, 2021).

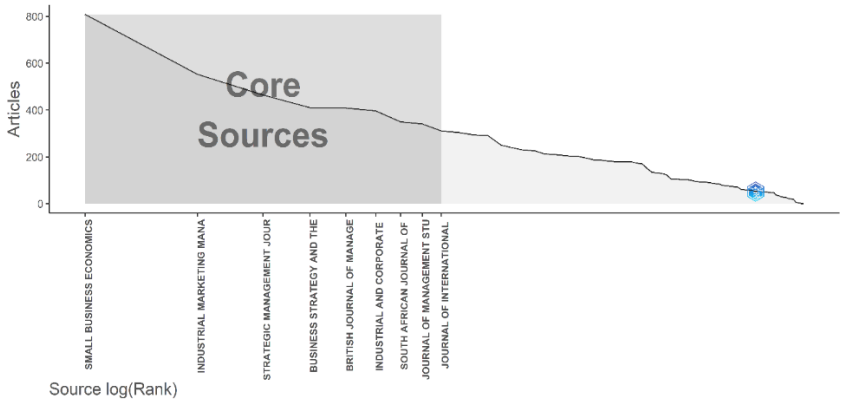

Figure no. 4 – Bradford's Law

In Figure no. 4, Bradford's Law is provided. According to Bradford Law (1985), there are two dimensions in this figure. On axis X there are the journals while on axis Y there is the number of articles. The field that is formed by the interception of these axes is divided into three zones in terms of an equal number of citations. In the first zone, which is also called as core zone, there are a few journals that have the highest citations. In the second zone, more journals exist to access the same number of citations and in the third zone, there are more journals than in the second one (Yang *et al.*, 2016). As we move from zone one to zone three, there is a 'decreased productivity' described by Bradford, known as the 'law of scattering' (Venable *et al.*, 2016). In Figure no. 4, there are 4037 articles in zone 1, core zone, published by 9 journals: Small Business Economics, Industrial Marketing Management, Strategic Management Journal, Business Strategy and the Environment, British Journal of Management, Industrial and Corporate Change, South African Journal of Business Management, Journal of Management Studies, and Journal of International Business Studies. In zone 2 there are 19 journals with 4148 articles and in the third zone, there are 3,960 articles with 56 journals.

Table no. 1 – Most Relevant Journals

Journals	h_index	g_index	m_index	Total Citations	N. of Pub.
Strategic Management Journal	113	231		57,290	443
Academy of Management Journal	99	188	4,304	37,568	290
Small Business Economics	87	147		31,225	749
Journal of International Business Studies	82	153		25,819	297
Journal of Organizational Behavior	77	147	3,348	22,331	209
Journal of Management Studies	74	127		19,427	324
Industrial Marketing Management	70	111	3,043	19,902	518
Journal of Management	66	140		20,496	233
Academy of Management Review	60	102	2,609	19,666	102
Journal of Product Innovation Management	58	101	2,636	11,385	195
British Journal of Management	57	92		12154	375

Journals	h_index	g_index	m_index	Total Citations	N. of Pub.
Administrative Science Quarterly	56	117	2,435	17028	117
Industrial and Corporate Change	53	89	2,524	11380	370
Business Strategy and The Environment	51	81		10025	366
Corporate Governance-An International Review	49	85	2,13	7867	143
Supply Chain Management-An International Journal	49	83		8229	197
California Management Review	46	82	2	7160	125
Long Range Planning	44	92	1,913	9616	197
International Small Business Journal-Researching Entrepreneurship	40	66		6032	208
Academy of Management Annals	39	60	2,438	5495	60

In Table no. 1, the h-index, m-index, and g-index of the top 20 journals are provided. The h-index, a bibliometric measure, was found by Hirsch (2005) and defined as: "a scientist has index *h* if *h* of his/her *N* papers have at least *h* citations each and the other (*N*–*h*) papers have no more than *h* citations each" (Hirsch, 2005, p. 16569). The h-index is seen as an advantage as it measures productivity (number of articles) and impact level (citations to articles) (Walters, 2007). The g-index is expressed as an improved form of the h-index to measure the global citation performance of a series of articles (Moussa & Touzani, 2010). This index is defined by Egghe (2006, p. 131) as "If this set is ranked in decreasing order of the number of citations that they received, the *g*-index is the (unique) largest number such that the top *g* articles received (together) at least g^2 citations". Therefore, it is expressed as the complement of the h-index (Bontis & Serenko, 2009) in that it takes into account both the over-cited outliers that the h-index ignores and the general citation consistency. The m-index is defined by Bornmann *et al.* (2008) as the median of the number of citations received by the articles in the h-core. Due to the skewed distribution of citation numbers, he recommends using the median instead of the m-index arithmetic mean (Bornmann *et al.*, 2008). In Table no. 1, it is seen that although in terms the number of publications is fewer than others, *Strategic Management Journal* is on the first line due to its h-index, g-index, and the total number of citations number followed by *Academy of Management Journal* due to same reasons in the same condition. It is also seen that the most published journal is Small Business Economics with 749 publications. This journal's impact factor (IF) is 2.63 and indexed in Q1 (ScimagoJR, 2021). It is followed by Industrial Marketing Management (IF=2.21, Q1) with 518 publications and Strategic Management Journal (IF=9.44, Q1) with 443 publications. More publication does not mean more citations.

The performance indicators made within the scope of the study so far are related to the resources; the following metrics are about the authors.

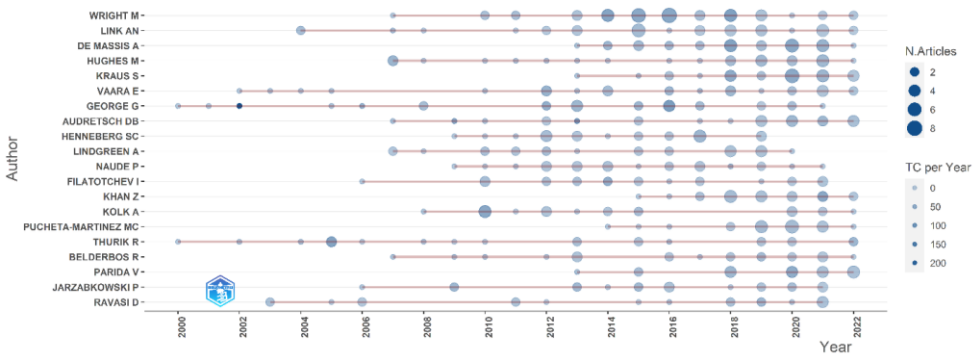

Figure no. 5 – Top 20 Authors' Production over Time

Figure no. 5 shows the publication flow of the 20 most productive authors. While the size of the circles represents the number of articles, the intensity of the color of the circles represents the impact level of the research (Adekunle *et al.*, 2021). In this period (2000-2022), the first articles belong to George and Prabhu (2000) entitled *"Developmental financial institutions as catalysts of entrepreneurship in emerging economies"* published in The Academy of Management Review and von von Gelderen *et al.* (2000) entitled as "*Strategies, uncertainty, and performance of small business startups*" published in Small Business Economics. It is clear that both these "earliest" articles were about entrepreneurship which is the basic topic (see Figure no. 14) and a relatively past time but still an interesting issue (see Figure no. 13). On the other hand, the most current articles are published by many authors. Among them, the greatest number of articles belong to Parida (n=5; TCPY=17) while the greatest total citation per year (TCPY) belongs to Thurik (n=35) with two publications. The first of Thurik's study (2022) with Belitski, Guenther, and Kritikos is entitled "*Economic effects of the covid-19 pandemic on entrepreneurship and small businesses*" and the other is entitled "*Risk of burnout in French entrepreneurs during the covid-19 crisis*". Both were published in Small Business Economics. As it is seen here while entrepreneurship is still an interesting topic in 2022, covid-19 has its popularity (see Figures no. 11, no. 13, and no. 14) which has begun since 2019 when the pandemic started. Moreover, topics related to technology and digitalization mentioned in Sjödin, Parida, and Visnjic's study (2022) entitled "*How can large manufacturers digitalize their business models? Framework for orchestrating industrial ecosystems*" published in California Management Review and, Thomson, Kamalaldin, Sjödin and Parida's (2022) study entitled as "*A maturity framework for autonomous solutions in manufacturing firms: The interplay of technology, ecosystem, and business model*" published in International Entrepreneurship and Management Journal indicates that how these topics are more current (see Figure no. 13 and no. 15).

In Figure no. 6 Lotka's Law is provided. According to Lotka's Law (1926), the increasing number of publications is directly proportional to decreasing number of authors who have more publications. It defines the publication frequency of authors in a particular field (Kumar & Goel, 2021). In the figure above, where the line becomes horizontal, it is seen that the number of authors with 10 or more publications is 128 (% 0.056), making a significant contribution to the literature while 22.643 authors have less than 10 articles.

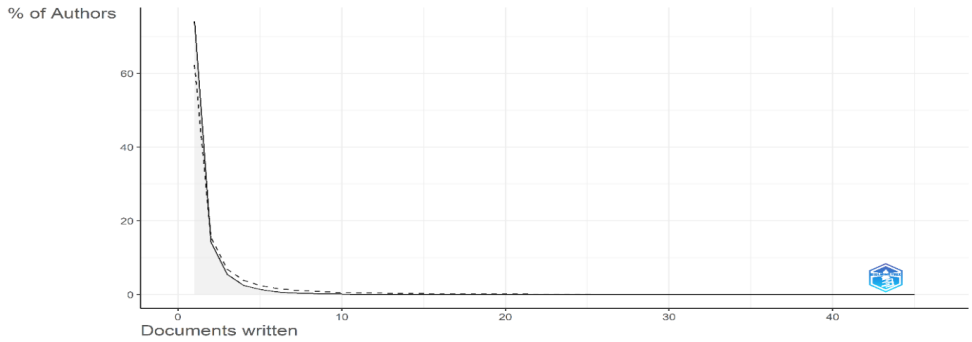

Figure no. 6 – Lotka's Law

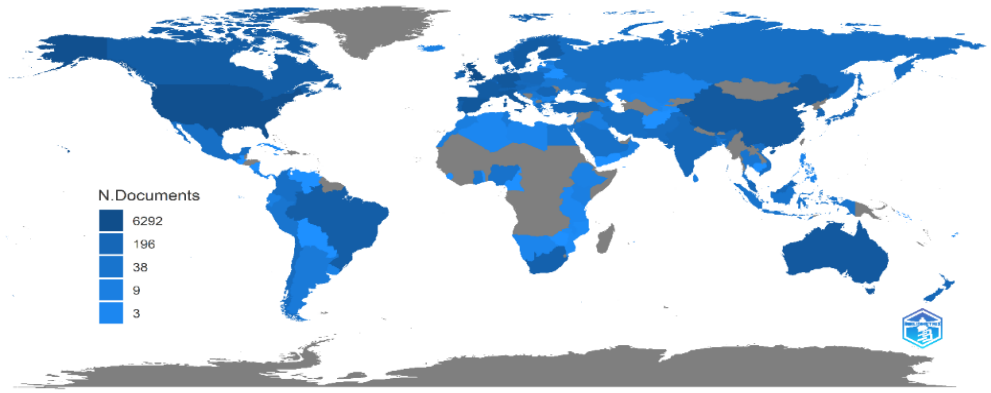

Figure no. 7 – Country Scientific Production

In Figure no. 7 the publication performance of countries is provided. As it gets darker blue, the performance is higher. UK ranks first with 6,292 publications, followed by the USA with 4,509, Spain with 1,668, Netherlands with 1,627, Germany with 1,595, and Italy with 1,575. However, when we look at the number of citations in Table no. 2 of the top 20 countries of total citations and average article citations, it is seen that the USA is ahead of the UK in terms of both total citations by doubling and average article citations by tripling. The Netherlands and Spain also switched places.

Table no. 2 – Country Citation Metrics

Country	Total Citations	Average Article Citations
USA	161,477	102.20
United Kingdom	84,723	33.29
Netherlands	32,640	49.76
Spain	21,147	28.54
Germany	17,985	29.39
Australia	16,816	30.46
Italy	14,242	23.12
Canada	12,802	42.67

Country	Total Citations	Average Article Citations
China	11,469	25.89
Sweden	9,186	24.63
France	8,872	28.90
Switzerland	7,344	41.26
Denmark	6,944	34.55
Finland	6,732	24.48
Belgium	6,290	35.74
Singapore	4,194	41.94
Portugal	3,278	18.84
Norway	2,871	22.97
Ireland	2,696	22.10
Austria	2,672	24.74

In Figure no. 8, the collaboration performance of the top 20 countries is provided. It is seen that the United Kingdom ranks first, followed by the United States of America by far. In this figure, the orange bar represents multiple country productions while the green bar represents single country publications. Spain, Brazil, South Africa, Portugal, and Romania are famous for their publications, usually by authors from a single country in the business management field while Switzerland, Denmark, Canada, France, and China hosted mostly multi-country publications. Meanwhile, in the UK, USA, Netherlands, Italy, Germany, Australia, Sweden, Finland, Belgium, and Norway, this ratio is almost 50%.

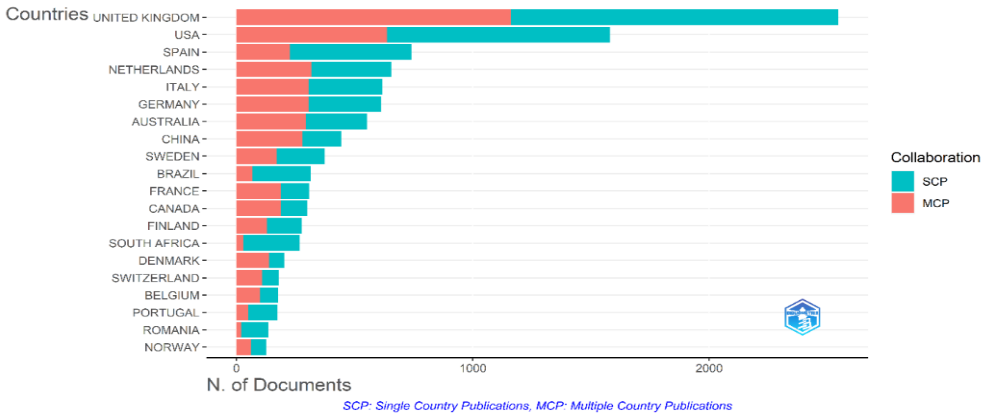

Figure no. 8 – Corresponding Author's Country

The performance indicators made within the scope of the study so far are related to the authors; the following metrics are about the documents.

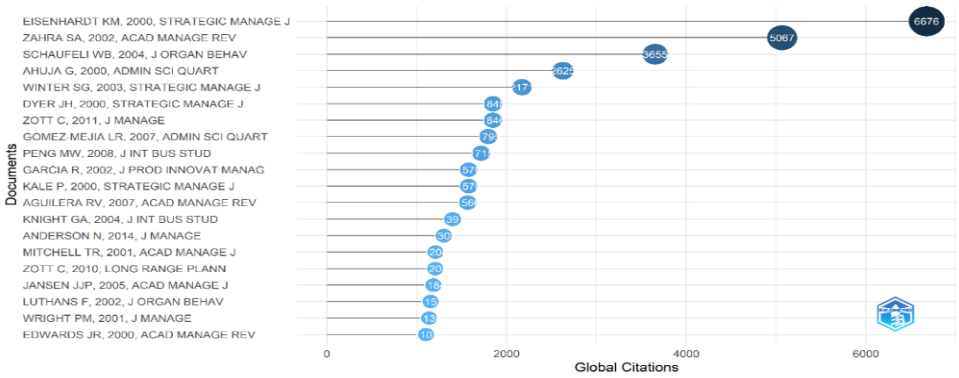

Figure no. 9 – Most Global Cited Documents

In Figure no. 9, the top-most cited 20 articles are provided. When the journals in which these studies are published are examined, it is seen that Strategic Management Journal has the highest number of studies, followed by Administrative Science Quarterly. Checking the top five, in the first place Eisenhardt and Marting's study (2000) whose title is "*Dynamic capabilities: What are they?*" exist. This study is published by *Strategic Management Journal* and cited 6.676 times by the scientific World. It is followed by Zahra and George's study (2002) entitled "*Absorptive capacity: A review, reconceptualization, and extension*". It is published by the *Academy of Management Review* and cited 5.087 times. In the third place, Schaufeli and Bakker (2004) study entitled "*Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study*" exists. It is published in the *Journal of Organizational Behavior* and cited 3.655 times. After then Ahuja's study (2000) comes which is entitled "*Collaboration networks, structural holes, and innovation: A longitudinal study*", published in *Administrative Science Quarterly* and cited 2.625 times. Finally, Winter's study (2003), entitled "*Understanding dynamic capabilities*" is published in *Strategic Management Journal* as cited 2.164 times by other scientific products. One of the common reasons why these five studies have reached such a high number of citations is that they were published in the first years of the sample. However, it is also important that the nature of the subjects they deal with and that there are collaborative studies in general.

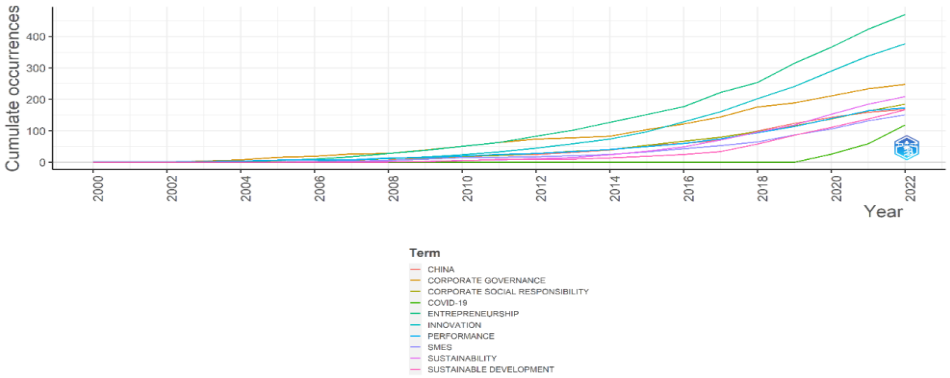

Figure no. 10 – Word Growth Graph

In Figure no. 10, 10 cumulatively most occurred words exist. It is seen that *entrepreneurship* and *innovation* steeply rises from 2008 through 2022. *Covid-19*, on the other hand, started to occur in 2019 when the pandemic was declared.

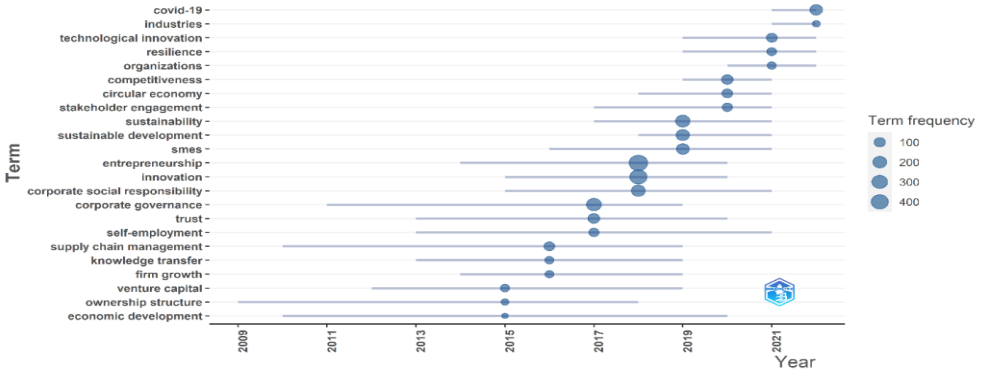

Figure no. 11 – Trend Topics in Business Management Field

In Figure no. 11, the minimum occurrence of keywords was set as 30. It is observed that while economic development, ownership structure, and venture capital were popular in 2015, supply chain management, knowledge transfer, and firm growth took their place in 2016. In 2017 the popular topics were corporate governance, trust, and self-employment, in 2018 they were entrepreneurship, innovation, and corporate social responsibility, and in 2019 they were SMEs, sustainability, and sustainable development. When it comes to 2020, they became stakeholder engagement, circular economy, and competitiveness, and what was popular in 2021 is covid-19 and technological innovation.

3.2 Conceptual Structure

In Figure no. 12, network visualization of co-occurrence of keywords analysis is performed. Due to the sample size, we preferred to set the minimum occurrence as 30. This threshold is mostly set as 5 in studies in which the analysis is conducted on rather a specific topic (e.g., Saini *et al.*, 2022; Zhang *et al.*, 2022). Based on this threshold, a total of 143 words met this criterion. Word elimination was conducted and 116 words which constitute 6 clusters were obtained. In the first and red cluster, which is called *current issues of business firms* and where sustainability is most studied, 41 items are existing such as covid 19, artificial intelligence, blockchain, business model innovation, climate change, competitive advantage, digital transformation, open innovation, new product development, servitization, and value creation. In the second and green cluster, which is called *technology and development* and where innovation is most studied, 28 items are existing such as emerging markets, firm growth, intellectual capital, knowledge management, knowledge transfer, learning, mergers and acquisitions, R&D, technology, start-ups, and venture capital. In the third and blue cluster which is called *leader's traits* and where entrepreneurship is most studied, there are 24 items such as social entrepreneurship, self-employment, trust, leadership, motivation, performance, creativity, HRM, sense-making, and satisfaction. In the fourth and yellow cluster which is called *performance* and where corporate governance leads, there are 11 items such as business

performance, firm performance, SMEs, board of directors, and ownership structure. In the fifth and purple cluster which is called *environmental sensitivity* and where corporate social responsibility plays the pioneering role, there are 9 items such as environmental performance, sustainable development, and environmental policy. In the last and aqua colored-cluster which is called *economic advancement* and where competitiveness is most studied, there are three items such as economic growth and economic development.

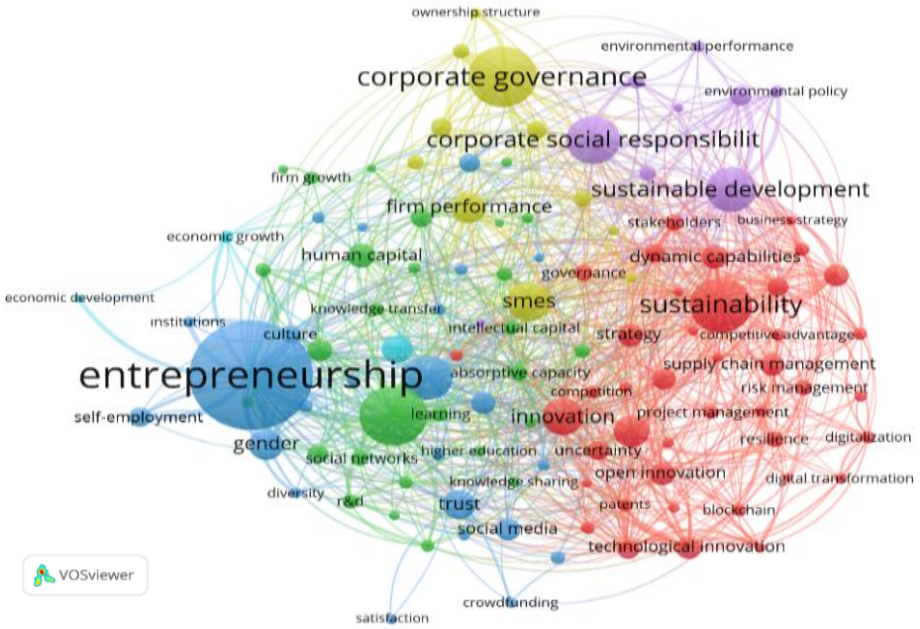

Figure no. 12 – Network Visualization of Keywords

In Figure no. 13, an overlay visualization of the aforementioned data is provided. Checking the last five years, yellow ones are the subjects respectively currently studied while blue ones are studied more in past. Due to the pandemic, and its effects on the global production line and countries' economies, *covid-19*, *competitiveness*, and *sustainable developmen*t have emerged as the most studied topics recently. In addition, thanks to technological development, topics such as *technological innovation, digitalization, business model innovation, artificial intelligence, and blockchain* appear as the most up-to-date issues. On the other hand, while issues such as *supply chain management, knowledge management, economic development, and corporate governance* are relatively past topics, *SMEs, dynamic capabilities, leadership, social capital, diversity, and social entrepreneurship* are still interesting topics.

Figure no. 14 creates the thematic map of the authors' keywords. It refers to the research themes obtained from the conceptual structure of the articles included in the bibliometric analysis. While the circles in the figure indicate the themes of the research, the size of the circles shows the ratio of the relevant theme to the number of keywords (Ragazou *et al.*, 2022; Romero-Perdomo *et al.*, 2022). The upper right quadrant of the graph denotes 'motor themes' with both high intensity and centrality, while the lower right quadrant denotes 'basic themes' with high centrality but low intensity; the upper left quadrant is defined as the research areas

'niche themes' and the lower left region as 'emerging or declining themes' with low centrality and density (Mühl & de Oliveira, 2022). Centrality and density have an important place in the graph. Centrality refers to the intensity of connections with other clusters and therefore expresses the importance of the theme to develop a particular area (Callon *et al.*, 1991; Saini *et al.*, 2022). Density, on the other hand, expresses the strength of the links that connect the words that make up the set and measures the self-improvement capacity of the theme (Callon *et al.*, 1991; Cobo *et al.*, 2011).

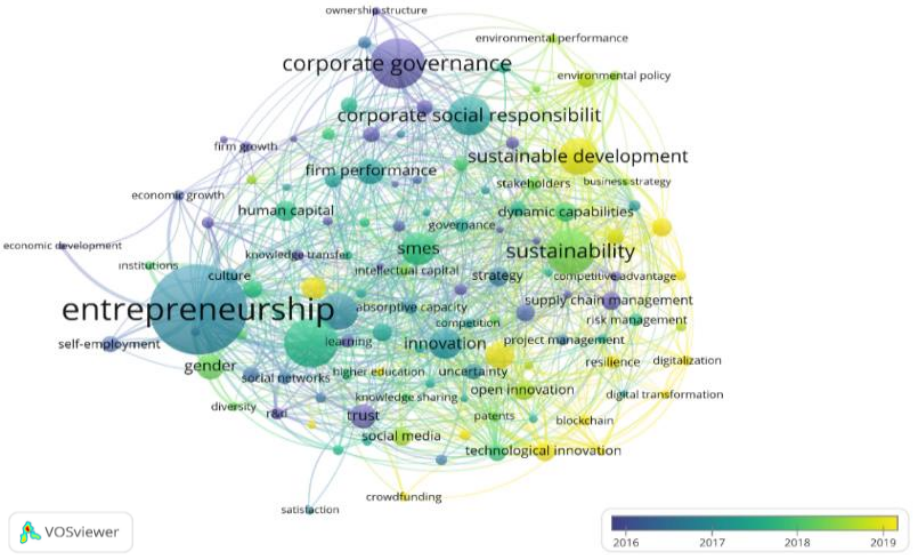

Figure no. 13 – Overlay Visualization of Keywords

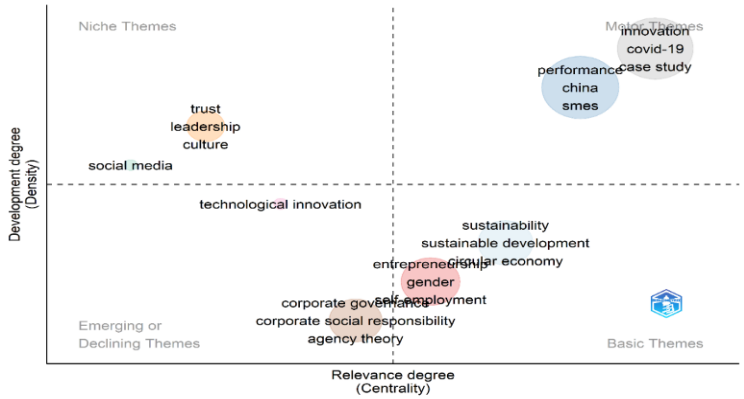

Figure no. 14 – Thematic Map of Authors' Keywords

According to Cobo *et al.* (2011), *Motor themes* are well-developed themes that are important in structuring the research field. In this sense, the terms *'performance*, *SME*, and *innovation'* are highly developed topics in the business management literature and are

frequently addressed with other clusters in the thematic map. However, although *China* is in the 9th place in terms of country contribution to the literature (see Table no. 2), the reason why it is in this field is that it has been studied in a very wide range in the field of business management. Another reason could arise from the fact that China has a 63% rate of multinational studies in the context of author collaboration and the problematic issue of WoS that it is based only on the first author in multi-author studies, and in possible Chinese-based multi-author studies, the word may have been included in the motor theme area since the first author was not Chinese.

In addition, the fact that studies in the field of business management methodologically dealt with relatively narrow samples may also have caused the word *'case study'* to take place in this region. Although it is a new issue, the reason why '*covid-19'* is located in this region is that it has been overworked as a result of the pandemic affecting almost every issue in the field of business management, directly or indirectly. *Basic themes* refer to themes that are important for the field but they are still developing (Callon *et al.*, 1991). The terms such as *'sustainability, sustainable development, and entrepreneurship'*, besides being the main subjects of business management, need to be constantly developed for the organizations interacting with their environment to adapt to the changing environmental conditions so that these phenomena can continue to exist. *Emerging or declining themes* are those that are losing their impact in terms of the field or are just beginning to emerge. It can be stated that 'corporate governance, corporate social responsibility, agency theory' does not have a stable development in the field of business management. However, the 'technological innovation' theme in the same region can be said to be a subject that has started to show its effect in the field of business management due to its higher density. *Niche themes* refer to specific topics in the field. Therefore, these themes are developed in a specific area that constitutes its environment. It can be stated that 'trust, leadership, culture' and 'social media' are clusters that have been studied in specific areas within business management. Since the social media cluster is a newer theme than the leadership and culture cluster, it is seen as a more remote (from the center) and less developed field in the field of business management.

It is seen that the network visualization (Figure no. 12) and the thematic map (Figure no. 14) are compatible with each other because all the themes that appear prominently in the thematic map are also prominently included in the network visualization as clusters. Furthermore, the overlay visualization (Figure no. 13) is also compatible with the thematic map (Figure no. 14) because the themes located in different quadrants according to centrality and density in the thematic map are colored in a way that is compatible with the overlay visualization. For example, the themes in the basic theme area that need to be developed are represented in yellow color representing the newly studied area that needs to be developed in the overlay.

Before going to the next step, we also desired to see the effects of Covid-19 in the evolution of studies. Therefore, we split the studies into two parts (2000-2019) in Figure no. 15 and (2020-2022) in Figure no. 16 to point out how the pandemic affected the literature.

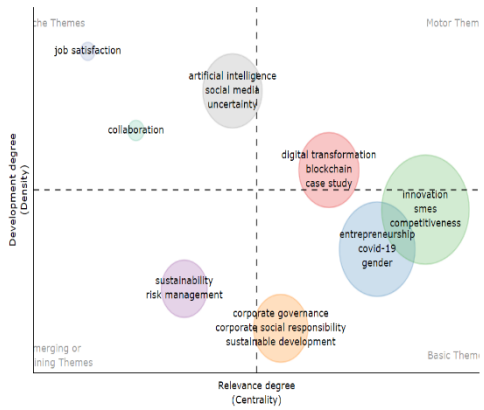

Figure no. 15 – Pre-Covid Analysis

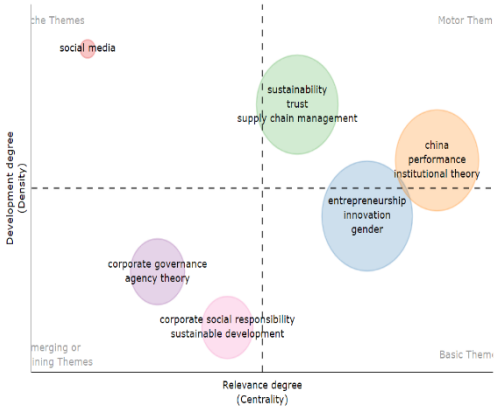

Figure no. 16 – Post-Covid Analysis

For pre-Covid analysis, it is seen that the terms 'sustainability, trust, supply chain management', whose centrality is evident in the *motor theme* section in Figure no. 15, are highly developed topics in the business management literature, especially in terms of the modern period. In addition, these terms are frequently discussed together with other clusters in the thematic map. The terms 'China, performance, institutional theory', which have a more pronounced density feature in this field, are also frequently discussed with other fields of business management. In addition, although 'China' is in the 9th place in terms of country contribution to the literature (see Table no. 2), the reason why it is in this field is that it has been studied in a very wide range in the field of business management, in addition to the issues of multi-authored studies and multinationalism conditions which were mentioned in the discussions for Figure no. 14. In addition to being the main topics of business management, concepts such as 'entrepreneurship and innovation', these facts need to be constantly improved for organizations that interact with their environment to adapt to changing environmental conditions and to survive. In addition, the concept of 'gender' is included in the *basic theme* section. The reason may be due to the necessity of gender-based diversification in research subjects. It can be stated that the term 'social media' in the *emerging or declining themes* section has started to emerge relatively recently in the field of business management and is a subject that has begun to show its effect in the field. In addition, since social media is a current and underdeveloped subject, it is seen that it is located far from the center. Finally, it can be stated that *niche themes*, corporate governance, agency theory, corporate social responsibility, and sustainable development are clusters that are studied in specific areas of business management.

For post-Covid analysis, the terms 'digital transformation, blockchain', which are prominent in the *motor theme* part, especially emphasize the digitalization issue that occurred after Covid-19. The related subject is frequently included in the research carried out to create alternatives for measures such as remote working and isolation brought about by the pandemic process. In addition, the fact that the studies in the field of business management were methodologically conducted with relatively narrow samples may have caused the word 'case study' to be included in this region. As the *basic themes* section deals with “still developing issues”, more than one clustering has emerged. The concepts of 'innovation, SMEs, and competitiveness' express the concepts that gain importance, especially with the pandemic, and which need to be developed to ensure the future and sustainability of the enterprises. Especially

with Covid-19, the fact that SMEs are faced with the danger of extinction, competition has become more difficult in this crisis process and innovation has become compulsory have caused these concepts to be included in the *basic themes*. On the other hand, the terms 'entrepreneurship, Covid-19, gender', which can be expressed as the second cluster, mean that there are issues that need to be developed in almost every subject after the pandemic process. Although the terms 'corporate governance, corporate social responsibility, sustainable development', which is the last cluster in this field, were included in the *niche theme* section in the pre-covid-19 period, it draws attention as it is included in the *basic themes* section in the post-covid-19 period. This situation indicates that institutionalization and sustainability are among the issues that need to be developed and gain importance with the pandemic process. *The emerging or declining themes* section also consists of three separate clusters. The first prominent clustering here is the terms 'artificial intelligence, social media, uncertainty'. In this cluster, issues that started to emerge with the pandemic process and gain importance are realized. Especially the technology-based progress of business, which entered our lives with the pandemic, the digitalization of socialization to protect social distance, and the sense of uncertainty created by the pandemic process has caused these issues to emerge in the field of business management. The other two clusters consist of the terms 'collaboration' and 'job satisfaction'. It can be stated that because they are relatively outworn issues in business management compared to the first cluster, they have begun to lose their relative influence or have begun to be dealt with indirectly. It is seen that 'sustainability', in the *niche themes* section, is among the topics that were specifically addressed in the pre-covid-19 period. However, since 'risk management' is important in terms of business management with the covid-19 process, it can be said that it has started to take place in this field and has been especially addressed in a certain framework.

Lastly, we also wanted to normalize the data as extracting Covid-related keywords to see the pure business management topics studied since 2000, in Figure no. 17.

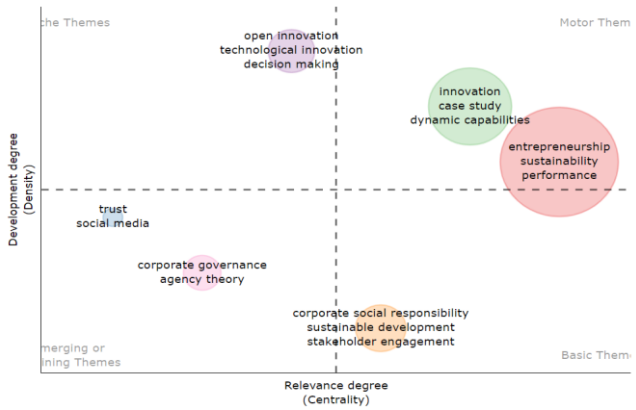

Figure no. 17. Pure Business and Management Topics Thematic Map

Two clusters occur in the *motor theme* part. These consist of advanced basic topics in the field of business management, which are the terms 'entrepreneurship, sustainability, performance' and 'innovation, case study, dynamic capabilities'. The fact that these concepts are not very current concepts based on business management and that they are still studied intensively means that they need to be discussed in detail in terms of business management

and are considered to be of great importance for the field. In addition, the inclusion of the term 'case study' in this section means that the studies in the field are often handled specifically through narrow samples. In the *basic theme*, on the other hand, the terms 'corporate social responsibility, sustainable development, stakeholder engagement' means that they continue to be developed and researched in different aspects of the business management literature. Therefore, in the field, it can be stated that subjects such as institutionalism, sustainability, and participation of stakeholders in the organization constitute the skeleton of modern and post-modern management approaches. In *emerging or declining themes* 'open innovation, technological innovation, and decision-making are the new emerging topics in terms of business management. The fact that the term 'innovation' is an advanced topic in *motor themes* means that the research in this field has been expanded and new topics have been added to the field and the literature has been developed in this sense. In addition, the concept of "decision making" in this section means that different perspectives are tried to be developed in business management. Finally, it is seen that there are two clusters in the *niche themes* section. The first consists of the terms 'corporate governance, agency theory, and these concepts express that the concept of institutionalization and its theoretical infrastructure are discussed in a certain framework in the business literature. The second cluster consists of the terms 'trust, social media'. It shows that both concepts are handled within a specific field in terms of business management. Therefore, it shows that the concepts in the *niche themes* section consist of studies surrounded by a specific area in the business management literature and can be diversified in terms of being far from the center and having a low density.

3.3 Intellectual Structure

Co-citation Analysis is one of the analyses in science mapping which indicates publications that are cited together frequently are on the same theme (Donthu *et al.*, 2021). Here we conduct this analysis for two types of units which are references and journals. Regarding co-citation analysis, two studies exist in the third study's citations, and these two studies are called co-cited (Liao *et al.*, 2018).

It is seen in Figure no. 18, there are 195 references within 7 clusters. In the red cluster, there are 46 items which are led by Jensen and Meckling's study (1976) entitled "*Theory of the firm: Managerial behavior, agency costs and ownership structure*" published in the Journal of Financial Economics. In the green cluster, there are 36 items which are led by Podsakoff's study (2003) entitled "*Common method biases in behavioral research*" published in the Journal of Applied Psychology. In the blue cluster, there are 34 items which are led by Cohen and Levinthal's study (1990) entitled "*Absorptive capacity: A new perspective on learning and innovation*" published in Administrative Science Quarterly**.** In a yellow cluster, there are 30 items led by Eisenhardt's study (1989) entitled "*Building theories from case study research*" published in The Academy of Management Review. In the purple cluster, there are 20 items led by Barney's study (1991) entitled "*Firm resources and sustained competitive advantage*" published in the Journal of Management. In the aqua blue cluster, there are 16 items led by Dyer and Singh's study (1998) entitled "*The relational view: Cooperative strategy and sources of interorganizational competitive advantage*" published in the Academy of Management Review. In the orange cluster, there are 13 items led by Shane and Venkatamaran's study (2000) entitled "*The promise of entrepreneurship as a field of research*" published in the Academy of Management Review. In Table no. 3, there are more details given about the clusters.

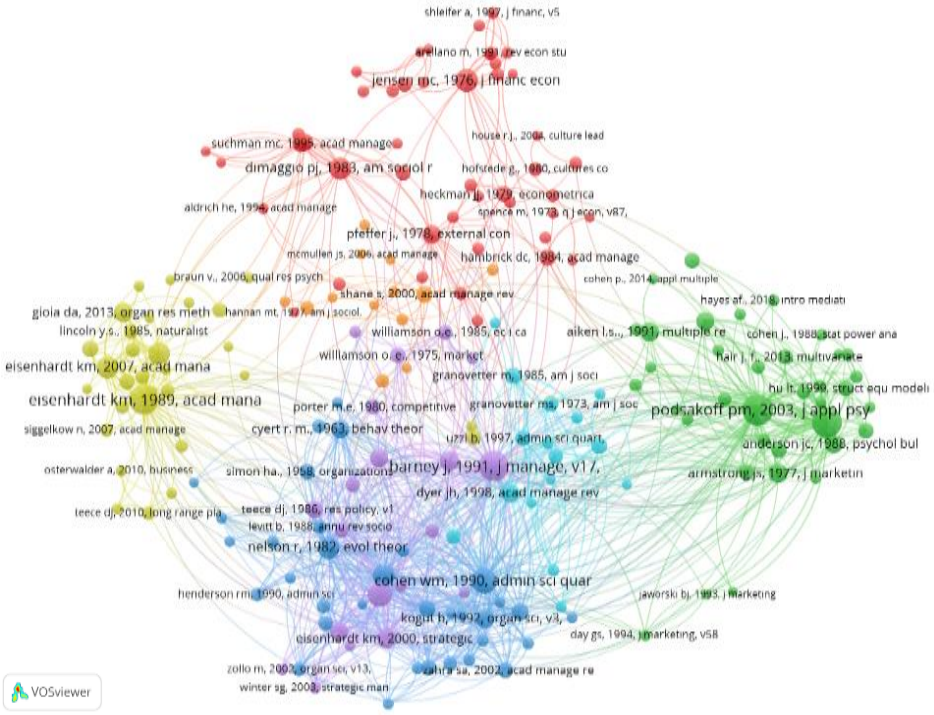

Figure no. 18 – References Co-Citation Analysis (Min N of Citations=100)

Table no. 3 – Cluster Information of References Co-citation Analysis

Cluster	Authors	Year	Journal	Theme	NC	TLS
Red	Jensen & Meckling	(1976)	Journal of Financial Economics	Organizational Behavior	472	1793
	Dimaggio & Powell	(1983)	American Sociological Review		449	2286
Green	Podsakoff	(2003)	Journal of Applied Psychology	Methodology	846	4764
	Fornell & Larcker	(1981)	Journal of Marketing Research		798	4365
Blue	Cohen & Levinthal	(1990)	Administrative Science Quarterly	Organization Management	614	4695
	Nelson & Winter	(1982)	The Business History Review		443	3460
Yellow	Eisenhardt	(1989)	The Academy of Management Review	Case Study	775	3953
	Eisenhardt & Graebner	(2007)	Academy of Management Journal		447	2427
Purple	Barney	(1991)	Journal of Management	Strategic Management	797	5860
	Teece et al.	(1998)	Strategic Management Journal		551	4646
Aqua Blue	Dyer & Singh	(1998)	Academy of Management Review	Economic Structure & Business Strategies	321	2458
	Granovetter	(1985)	American Journal of Sociology		245	1573
Orange	Shane & Venkataraman	(2000)	Academy of Management Review	Competitive Theories	258	1360
	Schumpeter	(1934)	Harvard Economic Studies		174	1010

NC= Number of Citations TLS=Total Link Strength

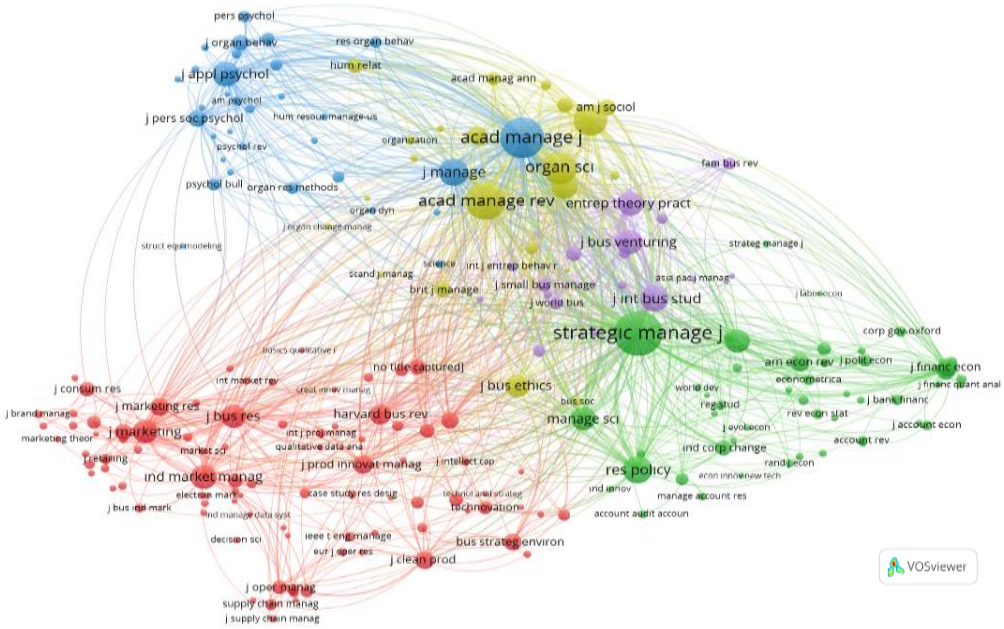

Figure no. 19 – Journal Co-Citation Analysis (Min N of Citation = 500)

In journal co-citation analysis, where the size of the nodes represents the activity of the journal and the distance of two nodes indicates the citation frequency between two journals, the overall structure of the field and the characteristics of journals are indicated (Liao *et al.*, 2018). In Figure no. 19 there are five clusters of 211 journals that have at least 500 citations. It is seen that Strategic Management Journal is the most active one with 29,435 citations followed by Academy Management Journal with 24,079 citations. The red cluster is constituted of 89 journals and is led by Industrial Marketing Management Journal, the journals are related to marketing. In the green cluster constituted of 49 journals and led by Strategic Management Journal, the journals are mostly related to strategic management and financial development. The blue cluster of 33 journals is led by Academy Management Journal, the journals are mostly related to psychology and organizational behavior. In yellow cluster led by Academy Management Review has 22 journals that are mostly related to management. Finally, the purple cluster is led by the Journal of International Business Studies have 18 journals that are related to entrepreneurship and SMEs.

Bibliographic coupling uses the number of references shared by two documents as a measure of similarity between two documents. The more the bibliographies of the two articles overlap, the stronger their connection is**.** The unit was selected as "document" and "fractional counting" was chosen as the analysis method as Perianes-Rodriguez *et al.* (2016) suggested. In Figure no. 20, among 12,145 articles, 288 met the criterion which requires the number of citations should be at least 250. There are 8 clusters formed. The details of clusters are depicted in Table no. 4 with the two most cited journals as representative ones.

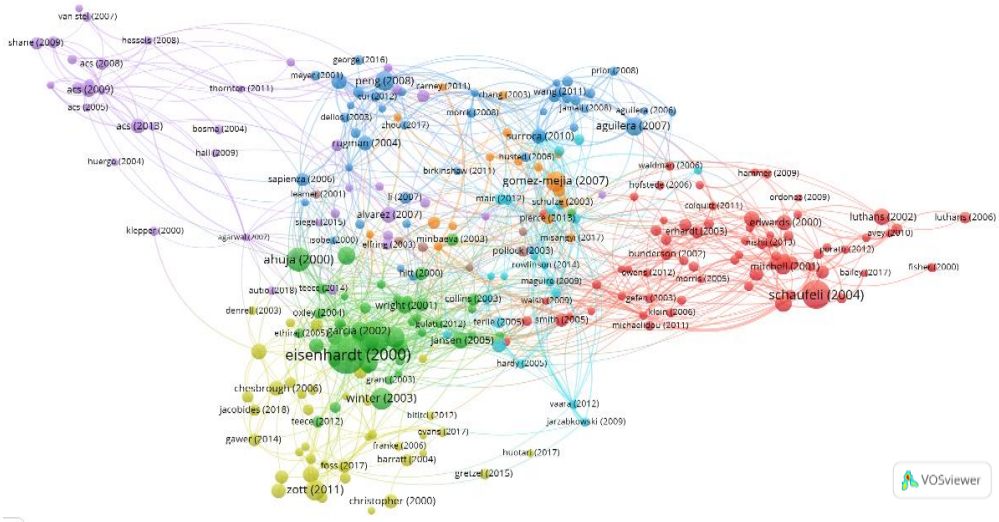

Figure no. 20 – Bibliographic Coupling of Documents (Min N of Citations = 250)

Table no. 4 – Cluster Information of Bibliographic Analysis

Cluster	Authors	Year	Journal	Theme	NC	TLS
Red	Schaufeli & Bakker	(2004)	Journal of Organizational Behavior	Organizational Behavior & HR	3655	21
	Anderson et al.	(2014)	Journal of Management		1300	89
Green	Eisenhardt & Martin	(2000)	Strategic Management Journal	Strategic Management	6676	67
	Zahra & George	(2002)	Academy of Management Review		5067	59
Blue	Peng et al.	(2008)	Journal of International Business Studies	Organizational Management Theories	1715	69
	Aguilere et al.	(2007)	Academy of Management Review		1566	98
Yellow	Zott et al.	(2011)	Journal of Management	Business & Organization Models	1846	44
	Zott & Amit	(2010)	Long Range Planning		1205	23
Purple	Alvarez & Barney	(2007)	Strategic Entrepreneurship Journal	Entrepreneurship	1012	45
	Acs & Sanders	(2013)	Small Business Economics		948	52
Aqua Blue	Gibbert et al.	(2008)	Strategic Management Journal	Innovation	978	13
	Ferlie et al.	(2005)	Academy of Management Journal		604	15
Orange	Gomez-Mejla et al.	(2007)	Administrative Science Quarterly	Performance Management in SMEs	1795	29
	King et al.	(2004)	Strategic Management Journal		675	32
Brown	Pollock and Rindova	(2003)	Academy of Management Journal	Acquisition & Learning	551	21
	Baum et al.	(2000)	Administrative Science Quarterly		417	38,98

3.4 Social Structure

In Figure no. 21, there are 14 clusters of 91 authors. Considering the first five important clusters, in the first (red) cluster Ertuğ with 15 publications, in the second (dark green) one Coad and Foss with 16 publications per each, in the third one (dark blue) George with 23 publications, in the fourth one (yellow) Aguilere with 11 publications and in the fifth one Vaara with 23 publications are in evidence. It is also obvious that Wright plays a prominent role in terms of the number of publications (n=45), despite being in the 10th cluster.

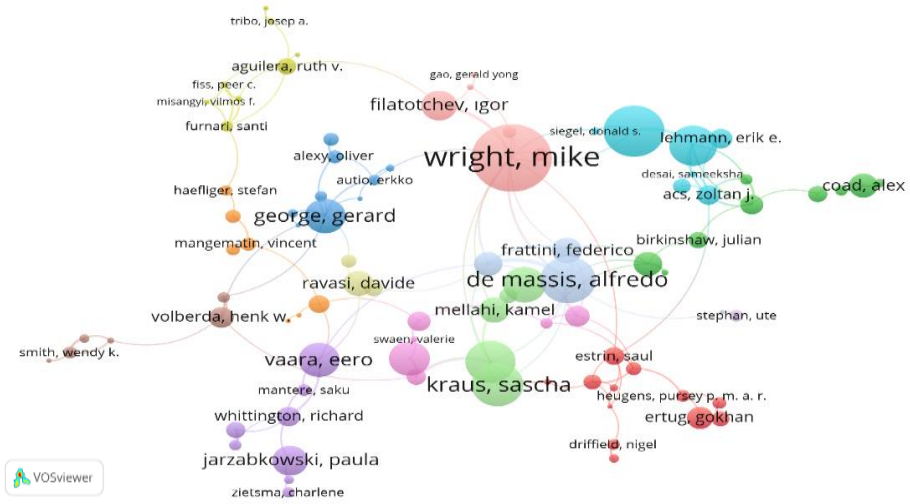

Figure no. 21 – Co-authorship Analysis of Authors (Min N of Pub. = 2; Min N of Cit. = 500)

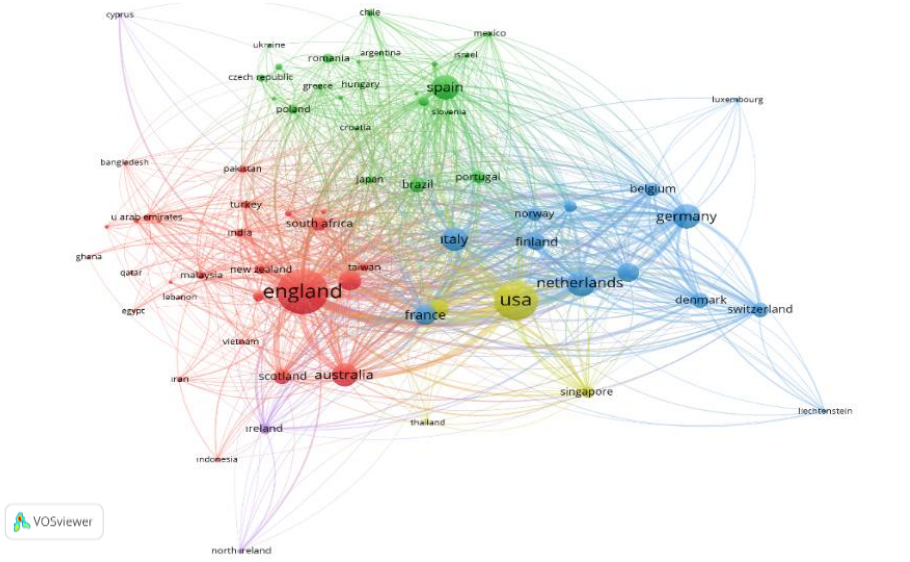

Figure no. 22 – Co-Authorship Analysis of Countries (Min N of Pub. = 10; Min N of Cit. = 100)

As seen in Figure no. 22, five clusters were formed in co-authorship of countries in the business management field in terms of the number of publications. England with 3,565 publications, the USA with 2,653 publications, Spain with 1,057 publications, Germany with 1,026 publications, and Ireland with 193 publications are in evidence in their clusters.

4. CONCLUSION

This study was carried out to see the development of business management since 2000 and to predict which area it has evolved towards, and bibliometric analysis and visualization techniques were used for this purpose. In this context, the articles scanned in WoS were examined and firstly the performance analyses were conducted to see the general view. Then the thematic mapping technique with co-words analysis was applied to measure the conceptual structure. Co-citation and bibliographic coupling analyses were performed to see the intellectual structure. Finally, co-authorship analysis was performed to see the social structure.

As a result of the performance analysis, it was seen that the annual number of publications has increased continuously since 2000, especially in 2014. Considering the average number of citations per article, fluctuations are seen in contrast to the publication graph. It is observed that the fluctuations observed especially until 2014 turned into a horizontal course after 2014. When the 20 most relevant journals in the field of business management are examined, the 'Strategic Management Journal ranks first with 443 publications and 57290 total citations. Considering the top 20 prolific authors, Wright ranks first with 45 studies in terms of the number of publications, while George ranks first with 8755 citations in terms of the number of citations. When the publication performance of the country is examined, the United Kingdom ranks first with 6,292, followed by the USA with 4,509 studies. On the other hand, when the citation numbers are observed, the USA ranks first with an average of 102.2 citations per publication, with a total of 161,477 citations, while the UK ranks second with an average of 33.29 citations and a total of 84,723 citations. When the studies of countries with single and multiple authors are examined, it is seen that EU countries such as Spain, Portugal, and Romania are predominantly SCP, while the rate of MDP is higher in EU countries such as Switzerland, Denmark, and France, as well as Canada and China. In countries such as the UK, USA, Netherlands, Italy, and Germany, which are at the top of the list in terms of the number of publications, these rates are around 50%. When the 20 most cited studies are examined, Eisenhardt and Martin's (2000)'s work, *'Dynamic Capabilities: What Are They*?', which is included in the 'Strategic Management Journal' and has 6676 citations, takes the first place. Furthermore, when we look at the development graph of the most preferred words, it is seen that the words 'entrepreneurship' and 'innovation' are in the first two places and these subjects have been studied frequently since 2008. It is seen that the trendiest topics are 'covid-19' and 'technological innovation'.

As a consequence of the co-words analysis, 116 words most frequently used in the studies were included in 6 clusters "Current Issues of Business Firms", "Technology and Development", "Leader's Traits", "Performance", "Environmental Sensitivity" and "Economic Advance". In addition, as a result of the thematic mapping and overlay visualization, the subjects of 'supply chain management', 'knowledge management', and 'corporate governance' are gradually losing their currency while the subjects of 'SMEs', 'leadership', 'social capital', 'diversity' and 'social entrepreneurship' still constitute the topics that attract the attention of the literature.

As a result of the references co-citation analysis, 195 studies with at least 100 citations from the bibliography of 12,145 studies included in our sample are located in 7 clusters and entitled 'organizational behavior', 'methods', 'organizational management', 'case analysis', 'strategic management', 'economic structure' and 'competitive theories'. Moreover, based on the journal co-citation analysis, the journals included in the bibliography of 12145 studies included in our sample were examined, and 211 journals were obtained that met the criteria of having at least 500 citations. These obtained journals were collected in 5 clusters, and Strategic Management Journal is at the top of the list with 29,435 citations. The first cluster is about 'marketing' and the most active journal of the cluster is 'Industrial Marketing Management'. The second cluster, led by the Strategic Management Journal, is generally about 'strategic management and financial development'. The third cluster, led by the Academy Management Journal, is about 'psychology and organizational behavior'. The cluster in which Academy Management Review ranks first is among the journals in the field of 'management' while the cluster in which the Journal of International Business Studies ranks first is about 'entrepreneurship and SMEs'.

In the wake of bibliographic coupling analysis, 288 studies that reference some of the 12,145 studies in our sample in their bibliography and which have at least 250 citations were found. These studies include 8 themes including 'organizational behavior and HR', 'strategic management', 'organizational management theories', 'business and organizational models', 'entrepreneurship', 'innovation', 'performance management in SMEs', and 'acquisition and learning'.

According to the co-authorship analysis of the authors, a total of 91 authors with at least 2 publications and at least 500 citations were distributed in 14 clusters. While the most prolific among the authors was 'Mike Wright', the most active author in the cluster with the largest number of authors was 'Gökhan Ertuğ' with 15 publications. Finally, when we look at the co-authorship analysis of the countries, the countries with at least 10 publications and 100 citations were included in 5 clusters. England is the first with 3,565 publications, while the USA follows closely with 2,653 publications.

5. DISCUSSION

According to the annual scientific production graph, the performance structure of business management generally has a dynamic and constantly developing structure. The performance analysis confirms the thoughts that the field of business management continues to develop and evolves into topics such as technologic innovation, sustainability, entrepreneurship, and performance. The fact that the concepts of sustainability and performance are a subject that has been accepted and should be provided by businesses from the very beginning, the importance of entrepreneurship in creating new areas, and the sale of knowledge to other businesses in the form of know-how by using it in a way that will create a competitive advantage, makes these issues mentioned frequently in academic studies. In particular, sustainability has been examined with different approaches in the literature on how it can be achieved with changing environmental conditions. The concept of sustainability, whose importance has been increasing continuously since 2000, has increased the importance of the business in the last 3 years, especially in extraordinary situations such as pandemics, and it will continue to increase in the face of many global problems that will be encountered in the future. Especially with Covid-19, which caused a global crisis in 2019, many businesses

had difficulty in retaining their existing workforce or supplying the potential, producing, marketing, or distributing their services or goods, and their sustainability was endangered. In this context, in the literature, Covid-19 has been discussed with many business management issues and has emerged as a shining subject. The efforts of the organizations experiencing the pandemic to develop flexible strategies to make quick decisions and produce alternative solutions in times of crisis will shed light on strategic management and crisis management for future researchers. However, although its effect has started to revive with new variants in recent days, the effect of the pandemic will pass soon and the concept will gradually fade from the studies. Although the concept of Covid-19 will fade, the concept of remote working, which is forced during the pandemic period, is the result of technological developments such as artificial intelligence, led by technological innovation, since its feasibility has been tested and its acceptability is high because it reduces costs and increases efficiency in many sectors, it is anticipated that this effect will be discussed more in the coming periods. Furthermore, the effect of the exponential development of technology on business life, business relations, and employee behavior in organizations is another issue that we think will attract the attention of researchers. With the increase of globalization, which we see the negative impact of such as the rapid spread of the virus during the pandemic, it is expected that new business models will be produced in businesses in a way to create international cooperation networks that will benefit all parties in extraordinary and ordinary situations. It is estimated that digital competition, which will increase with the development of technology, will prompt researchers to work on these issues.

So much so that with the increase of artificial intelligence from a futuristic point of view, together with robotized machines that replace human beings (large companies providing online shopping services only use robots instead of humans in their distribution locations, the production of drones, etc.) does business management field evolve to a place where human beings are considered as relatively unimportant just in Taylorism? Moreover, can the transformation of organizations into a form that only exists intangibly and cannot be mentioned as a physical organization, causes organizational structures and management to focus on different issues? Then, by understanding that these robots should interfere with self-management control and emphasizing that emotions and thoughts should come to the fore as in the Hawthorne studies, the unemployment situation that will arise when the work done by people is given to robotized machines and the research to be done to balance the employment policies of the states. does the business management field draw a circle again? Afterward, by understanding that people should interfere with the self-management control of these robots and emphasizing that emotions and thoughts should come to the fore as in the Hawthorne studies, the unemployment situation that will arise when the work done by people is given to robotized machines and the researches to be carried out to balance the employment policies of the states, does the business management field draw a circle again? We will see the answers in future research in the business management field literature.

It is also seen that while the number of publications of the authors increased, the number of citations did not increase at the same rate and even remained horizontal in the form of a plateau in the last decade. Therefore, to increase the impact factor, the authors should publish multi-author and multinational publications while developing new approaches to key issues of business management.

When the 20 most relevant journals in the field are examined, it is seen that the 'Strategic Management Journal ranks first in terms of h-index, g-index, and of total citations, while

'Small Business Economics' and 'Industrial Marketing Management', which have more publications, are ranked 3rd, and 7th respectively. Considering the total number of citations, h-index, and g-index, it is understood that these two journals should give more importance to quality in the new issues they will publish.

As the most prolific authors are investigated, *Wright* ranks 1st in terms of the number of publications and *George* in terms of the number of total citations. The most cited publication by *Wright* is *"Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems*" published in Strategic Entrepreneurship Journal in 2017 (TC=336) while it is "*Absorptive capacity: A review, reconceptualization, and extension"* published in Academy of Management Review in 2002 (TC=5,085) for *George*. Thus, researchers who will study innovation, dynamic capabilities, technology transfer, and co-evolution should pay attention to George's study, and the ones who will study entrepreneurship, start-up, and knowledge creation should pay attention to Wright's study.

As a result of the publication performances of the countries, it is thought that the high scientific productivity in developed countries such as UK and USA, is due to the governmental or non-governmental funds and supports provided to researches that carry out scientific studies. This situation also indicates the degree of importance attached to science in developed countries.

Two of the five most cited studies are about 'Dynamic Capabilities'. Although the subject is not very up-to-date in general, it may need to be developed with different aspects or different perspectives in the literature. However, it is thought that the topics of 'entrepreneurship', 'covid-19', and 'technological innovation' are more contemporary respectively and researchers can focus on these issues as well.

Regarding conceptual analysis results, it is thought that if the researchers focus on the subjects within the scope of the clusters obtained in the network display as a result of the co-word analysis carried out within the scope of the conceptual structure, the subjects in the green and yellow field display in the overlay display, the current effects in their work would be higher. However, while 'performance', 'sustainability', and 'entrepreneurship' were determined as the main and still interesting topics of the literature, 'corporate social responsibility' and 'corporate governance' issues were determined as the topics that started to lose their impact according to the thematic map.

According to the Intellectual structure results, the analysis that will help researchers who want to do research in the field of business management about the literal background of the field they want to work on at the macro scale is the journal co-citation analysis. In the same context, the analysis that will provide more specific guidance is the reference co-citation analysis. On the other hand, a researcher who wants to see a current gap in the literature or to see which topics the research problem is handled with should use bibliographic coupling. The clusters of all three analyzes illustrate the journals or studies in which the relevant field is concentrated. For example, if the subject chosen by the researcher who wants to work in the field of organizational behavior covers the subject of the publications in the red cluster in Figure 18, it is important to examine all the studies in the cluster to understand the background of the relevant subject. However, the researcher who wants to work in the field of strategic management needs to examine the studies in the green cluster in Figure no. 20 to see the current status of the subject he has chosen and to determine which areas are being studied.

Lastly, regarding social structure results, it can be claimed that if any of the important authors of the subject the researcher is working on is included in Figure no. 21, the researcher

should also examine the works of other names in the cluster in which this author is located. Moreover, when the three largest clusters of co-authorship of countries are examined, the red cluster led by England generally includes Arab culture countries (n=27), the green cluster led by Spain generally includes relatively less developed EU countries and countries with Latin American culture (n=23), and in the blue cluster led by Germany, it is seen that there are generally developed EU countries (n=13).

This study has some shortcomings arising from the problems related to software such as ignoring the rest of the authors in multiple-authored studies but the first, benefiting from only one source is WoS. Other limitations consist of the criteria we consider necessary to obtain data. Thus, downloading papers only in English by avoiding the others though they are proportionally small, and analyzing only the articles which were published after 2000 are other limitations. Maybe one of the most important shortcomings could be that we selected Business and Management as a WoS category. If we chose these two issues as a topic instead of WoS categories, we would probably have a larger sample size to analyze. Therefore, it will be possible to obtain more comprehensive analyzes by paying attention to these points in future studies.

ORCID

Tayfun Arar http://orcid.org/0000-0001-6132-1121
Gülşen Yurdakul http://orcid.org/0000-0003-2064-0278

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