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COOPETITION AND SMALL FIRMS VALUE CREATION

Adedeji Saidi Adelekan[1], James Olanipekun Ojo[2], Powel Maxwell Worimegbe[3]

[1] *Dominican University, Ibadan, Nigeria*
[2] *Mountain Top University, Ibafo, Nigeria*
[3] *Olabisi Onabanjo University, Ago-Iwoye, Nigeria*

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ABSTRACT

Small firms are faced with the challenges of competing with larger firms. This has given birth to utilising different strategies to enhance the small firms' capacity to achieve their corporate goals. This study examines the nature of coopetition among small firms and how it has influenced their ability to create value. Employing the survey research design, the study sampled 1119 small firms and established the interaction between coopetition and value creation in small firms using the partial least square-structural equation model. The results reveal entrepreneurial orientation is the most prevalent type of coopetition among small firms and that coopetition is a significant driver of value creation among small firms. The study recommends that small firms should integrate coopetition into their strategy to remain relevant, increase their revenue, customise their services through value-added services and create new products and services.

KEY WORDS

coopetition, collaboration, competition, value creation, small business

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C30, D21, M13

1 INTRODUCTION

The firm environment's evolving nature has brought about new opportunities, alliances, challenges, and new ways of addressing variations in a firm's operations and performance. In most recent times, competing firms have come together to achieve their individual corporate goals by creating synergy and combining strength and opportunities (Worimegbe, 2020). This paradoxical relation is known as coopetition (Arndt et al., 2018). Coopetition is a simultaneous situation where rival firms existing in the same market or with the same competencies combine resources to undertake a particular venture in other to achieve a

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win-win situation. Di Benedetto et al. (2019) assert that the primary purpose of collaboration among competing firms is to pursue goals that would be otherwise difficult to achieve alone. Coopetition is not the only alliance that could bring about achieving complex goals. However, coopetition reduces the complexities that could have been encountered in other forms of relationships since firms in coopetition have a better understanding of their core competencies and the needs of the market they operate (Seetharaman and Gallucci, 2020).

Crick and Crick (2020) opine that coopetition has changed firms' firm models by providing new ways of achieving their goals by sharing capabilities and resources while enjoying mutually beneficial outcomes. Coopetition as a firm strategy could exist regardless of the firms' strategic status (horizontal or vertical) and the number of years in operation. Using a judicious mixture of collaboration with manufacturers, consumers, and firms manufacturing complementary or similar goods, coopeting firms gain an advantage that is not feasible if they stand alone (Worimegbe, 2020). Hayes (2020) posits that competing small firms and emerging firms can collaborate to fight larger firms or integrate to capture the market that more prominent firms have already occupied. This relationship makes the smaller firms become more substantial entities, enhancing the individual firms' capacity to grow through cross-channel promotion. Coopetition can improve efficiency, create value, exploit and access scarce resources, drive innovation and achieve market traction and power among small firms (Bouncken et al., 2015; Ritala and Sainio, 2014).

Coopetition provides the best strategic option, creates the most efficient inter-firm relationship, and opens up opportunities for different firms' levels (Walley, 2007; Le Roy and Czakon, 2016). The role of small firms in the economy cannot be undervalued. Ackerman (1999) emphasises that small firms are indispensable in any society since they contribute immensely to the economy and that these contributions could be summarised into two. First, small firms are pivotal to the renewal processes that are apparent throughout market economies. That is, emerging firms and small firms are integral in the innovation and experimentation that brings about economic growth, technological change and productivity. Second, small firms are the most crucial mechanism utilised by many entrepreneurs to gain access to broader social and economic mainstreams as witnesses in the developed economies. Small firms are critical to the Nigerian economy as a whole.

Aladejebi (2020) believes that small firms are the major drivers of the Nigerian economy, providing employment, increasing gross domestic products, and leading to the country being the biggest economy in the economy. However, Turner and Akinremi (2020) explain that 80% of the small firms in Nigeria close shop within the first five years of their operations due to their inability to compete favourably with larger firms. Morris et al. (2007) reveal that applying a coopetition strategy in small firms operation will increase their capacity to play in the same terrain with larger firms and capture a substantial part of the market while increasing their competitiveness.

Various studies have established the impact of coopetition on customers experience in the banking sector (Worimegbe, 2020); the role of coopetition in innovation and market performance (Ritala and Tidström, 2014; Czakon, 2018); the influence of coopetition on tourism (Czakon et al., 2020); how coopetition has helped in the fight against global pandemic (Crick and Crick, 2020) and the underlying nature of coopetition among small firms (Morris et al., 2007) Yet, it has been observed some firms adopt coopetition more than others (Wang and Krakover, 2008) while the effect among the various firms varies greatly (Bouncken and Fredrich, 2016; Kylänen and Rusko, 2011). To the best of our knowledge, there is a dart of literature on how coopetition could drive small firms value creation in developing countries, especially in the Nigerian context. According to Czakon et al. (2020), there is a strong need for studies to investigate the influence of coopetition on firms' operations, while Crick and Crick (2020) suggests that it is critical to understand the nature of coopetition across

all types and levels of industries. Therefore, this study seeks to establish the nature of coopetition among small firms in Nigeria and examine the extent to which coopetition could drive the survival of these firms. Small firms' choice as the theatre of the study was influenced by Turner and Akinremi (2020) assertions, who argue that most small firms do not survive due to large firms' coopetition. Thomason et al. (2013) point out that coopetition is better identifiable in small firms because they are more proactive, intentional and interactive in their coopetitive relationship than larger firms and that smaller firms will find coopetition relatively easier than larger firms. In achieving the main objective of the study, three specific questions where postulated in strengthening the literature on coopetition and small firms performance:

1. What is the nature of coopetition among small firms in Nigeria?
2. To what extent does coopetition affect small firms value creation?
3. Which of the dimensions of coopetition and value creation should the small firms pursue?

2 LITERATURE REVIEW

2.1 Construct of Coopetition and Its Measurement

Coopetition's paradoxical nature has been extensively discussed in the extant literature (Gnyawali and Charleton, 2018; Czakon and Czernek, 2016; Park et al., 2014). Bengtsson and Kock (2000) explains that coopetition is a simultaneous relationship where the degree of competition is matched with the magnitude of cooperation within a particular industry. As firms collaborate, they do not let go of their original nature but interact with other firms in the same industry with some level of rivalry. Cygler et al. (2018) note that coopetition increases a firm's capacity to be more innovative, efficient, understand why their rivals undertake specific actions in the industry and do not weaken a firm's ability to compete. Jankowska (2010) argues that although the coopetition relationship is seen as opposite behaviour, it is pivotal for sustaining a firm's survival and competitiveness. Competitive collaboration among firms is generally seen as a strategic option employed to provide the firm with the unique opportunity to access resources that would have been too onerous to utilise (Stadtler and Van Wassenhove, 2016). Coopetition strategy does not negate the individualistic drive and corporate goals; instead, it increases a firm's capacity to achieve its goals by collaborating with its rivals in the same industry.

Moore (1993) explains that firms can no longer grow in a vacuum; instead, there is a need to attract strategic resources and strength through a partnership with available sundries; this, coopetition provides. Ornstein and Sandahl (2015) opine that coopetition can be created in vertical and horizontal relationships in reality and that the emergence of the collaborative relationship among competing firms changes the traditional view of either cooperating or competing. Small firms are challenged by the need to harness resources in the external environment to overcome their incapacities. Technology, innovation and knowledge management have been established as the main drivers of coopetition among firms and that where these constructs exist, there is protection against risks, opportunism, knowledge hoarding that would have risen as a result of such a complicated relationship while simultaneously enhancing strategic agility and innovation among collaborating firms (Gardete, 2016; Ritala et al., 2016; Soppe et al., 2014; Bouncken and Kraus, 2013).

The issue of measurement of coopetition in extant literature has been a significant concern, and this is because coopetition is multifaceted (Windsor, 2013). Contextual and systematic review show that coopetition measurements are industry-specific (Bengtsson et al., 2016; Czakon and Rogalski, 2014). Czakon et al. (2020) established that coopetition measure-

ments are intra-industry competition, the degree of change in the industry, the existence and power of regulatory bodies, and the industrial recycling phase. Worimegbe (2020) and Czakon (2018) argue that the dimensions of coopetition are common central procurement (CCP), common risks management (CRM), strategic alliance (SA), common network governance (CNG) and sales of a common product with individual brands (SMFs). Luo (2007) reveals that the right measures of coopetition in small firms are strategic alliance, technological linkage, market dynamics. Crick and Crick (2019) validate that the measures of coopetition in small firms should be. However, this study adopts the measures proposed by Bengtsson and Johansson (2014). The authors suggest that small and medium firms coopete to create and sustain opportunities; therefore, coopetition could be measured from the standpoint of alliance portfolio management capabilities (APMC), entrepreneurial opportunities and industries specifics such as market convergence, temporal relationships and technological convergence. These measures reflect what is currently obtainable among small firms in Nigeria and are also in tandem with the opinion of Zgarni (2019).

Alliance portfolio collects focal firms who operate simultaneous and direct relationships or networks, which could increase revenues and the firm's capacity to capture more markets. According to Hoffmann (2007), the more extensive the alliance portfolio with different partners in by a firm, the more its access to a diversity of resources and information. Saebi (2011) asserts that although most small firms are aware of this strategy's importance, only a few of these firms have mastered the capacity to achieve successful performance through alliance portfolio. On the other hand, entrepreneurship opportunities are situations where firms or entrepreneurs create more viable channels and develop better capacities to create more values and create more values and lead to better performance. Klein (2010) posits that entrepreneurial opportunity deals with discovering, assessing and utilising opportunities to bring new services and goods into the market through actions that were not previously in existence. The entrepreneurial opportunities are driven by creativities, innovation, team building, leadership and technical skills (Windsor, 2013). The industry-specific measure explains the collaboration among industry players and how new standards are created through the strategies prevalent in such industries at a particular time (Bengtsson and Johansson, 2014). Industry specifics also involves the degree of customisation of products and services in the industry.

2.2 Small Firms in Value Creation

The groupings and definitions of small firms are divergent. The small and medium firms development agency (SMEDAN, 2019) define small firms as firms with 10–49 employees with a total value between 10,000–100,000 dollars. Olaolu and Obaji (2020) opine that small firms are pivotal to job creation, economic development, poverty alleviation, and improving living standards, although they encounter numerous hurdles in their operations. Worimegbe (2020) explains that small firms are critical in redistributing wealth and restructuring the macroenvironment to achieve sustainable goals. According to Machado (2016), growth is a pivotal drive in small firms and that their survival depends on their capacity to participate in strategic alliances, create values and compete with other firms in the market.

Small firms' growth is hinged on their ability to create value, and most small firms do not survive because they lack the strategy that will increase the capacity to compete (Worimegbe, 2020; McKelvie and Wiklund, 2010). Davidow (2018) opines that the right measures of value creation are systematically absent in existing literature. This is borne on the premise that available measures are centred on financial measures. Small firms are not most times concerned about net present values; rather, they seek alternative ways to make their firm more sustainable and competitive in the long run. Thiel and Masters (2018) suggests that small firm must create value and that not all values are useful to the firm and society. If a small firm exists in a competitive equilibrium industry, its

strategy and survival will not matter in the market since an undifferentiated rival is ready to take its place (Jorgenson, 2015). Morris et al. (2007) argue that in comparison to large and medium firms, small firms are more vulnerable to rely on the patronage of the customers, suffer from the limited market, fluctuating demand and the ever-evolving firm environment.

Jorgenson (2015) posits that before a firm becomes profitable, it should be first concerned about value creation. Georgescu-Roegen (1971) asserts that a firm has created an economic value if it achieves the conditions of irreversibility (creating an irreversible value), fitness (creating values that benefit human purpose) and entropy (there is an increase in such value created). In order words, small firms create value through an irreversible process, which provides the resource holder more significant benefits for society. Sharma and Carney (2012) believe that financial measures for value creation do not capture the true essence of small firms. Merchant and Sandino (2009) are of the view that financial measures of value creation ignore value changes and economic values, conservatively biased, transaction-oriented and focus on the past. Jorgenson (2015) establishes that value creation should be measured in terms of revenue and the competitive cost of providing a service. Merchant and Sandino (2009) also suggest that a combination of revenue, customer satisfaction, productivity, research and development expenses and market shares should be employed to measure value creation. Value creation stems from the systematic implementation of strategies that costs, sales capital invested and capacity utilisation.

In determining the measures of value creation in this study, the point of view of Lieberman and Balasubramanian (2007) would be considered. The researchers posit that value created can only be captured by the consumer or the producer (small firms). Jorgenson (2015) argues that small firms fail when they do not create value for both the producers and consumers. Hence, non-financial measures will be adopted in this study. The choice is also influenced by the fact that most SMEs in Nigeria do not have proper accounting records (Olaolu and Obaji, 2020). The non-financial measures that reveal value creation in both consumer and producers in small firms are sales, new markets, new service or product added and value-added services (Markgraf, 2020).

2.3 Empirical Evidence Linking Coopetition and Small Firms

Bengtsson and Johansson (2014) examine the interaction between coopetition small and medium-sized firms (SMEs) in the telecoms industry to create entrepreneurial opportunities in Sweden. The study explores SMEs' managerial issues when they employ the coopetition strategy with larger firms and how such a relationship could be balanced to sustain vital opportunities. Utilising three exploratory case studies, the study established that SMEs could increase their capacity by managing their status and maintaining their competitiveness through coopetition. The study demonstrated the alliance portfolio, industries specifics and entrepreneurial opportunities as measures of coopetition in SMEs. Ornstein and Sandahl (2015) investigate the link between coopetition and firm model. The study looks into how technological innovations have brought about rapid telecommunication and information technology firm environments. The changes witnessed has made firms change the way they operate and do firm and operate. They opined that it is not feasible for firms to operate in isolation any longer and that firms should engage in strategic alliances such as coopetition with horizontal and vertical competitors. The study further reveals that coopetition is necessary to create and deliver values that will enhance customers satisfaction and capture the market. The study enriches existing literature by connecting coopetition to firm models since value capture and value creation is the crux of both concepts. Morris et al. (2007) explore coopetition as a driver of small firm strategy and Turkey performance. The study investigates the nature of coopetition in small firms and its relevance to small firms' operations utilising the dimensions of mutual benefits, trust and commitment as a coopetition measure. Using

a survey research design and a sample of 647 small firms, the study reveals that coopetition is based on mutual benefits in small firms and that coopetition dimensions employed in the study are dependent on one another.

Crick and Crick (2020) studied coopetition as a strategic tool for fighting the COVID-19 pandemic by small firms, technological firms, pharmaceutical organisations, non-governmental organisations and retailers. The study contributed to the extant literature by revealing the heterogeneity of different firms during the global crisis. The study recommends that firms should evaluate the reward and risks involved in the coopetition strategy before integrating it into their actions. The authors suggest that it is critical to ascertain the nature of coopetition among the different players in the economy and to investigate further which is the most significant form of coopetition firms should embark on.

Worimegbe (2020) looks into how coopetition leads to customers experience in the Nigerian banking industry utilising technology as a moderating factor. The dimensions of common network governance, sales of a common product, strategic alliance and common central procedures were employed as coopetition measures. Using a sample of 1537 deposit money banks customers and the partial least square-structural equation model (PLS-SEM) analytical tool, the study established that coopetition is a driver of customers experience. The study recommends that further studies should be conducted in more vibrant sectors of the economy.

Zgarni (2019) study the supremacy of coopetition compared to cooperation in its pure form using internal and external factors. Employing the survey research design, the study sampled 400 Tunisian industrial firms and established that the influence of the simultaneous adoption of strategic capabilities and competitive intensity is significant in firm performance. The study further shows that the most significant dimension of coopetition affecting customers strategies while competitive intensity is the most considerable construct affecting suppliers' cooperation.

Czakon et al. (2020) evaluate the behavioural dimensions of coopetition by developing a scale. The study looks into managers' perception of what they believe coopetition among 368 polish tourism firms to understand why such managers adopt the coopetition strategy. A systematic review of coopetition literature reveals that the two most valid constructs of coopetition are coopetition mindset and strategic rationale. The confirmatory factor analysis shows that the two latent variables reaffirm that coopetition is intentional since the strategic rationale drives it. Besides, the study reveals that firms pursue coopetition with the motive of achieving the capacity they could not attain while operating alone. The authors contributed to the methodology and measurement instruments in coopetition while also empirically showing the connection between behavioural and rational dimensions of coopetitive strategic behaviour in firms. Randolph et al. (2018) analysed the inter-firm network social capital and information technology among fifteen non-profit organisations in the United States of America. The descriptive survey research was utilised in the study. 1,250 respondents were sampled. The validity and reliability of the research instruments employed reveals that legitimacy, resilience, knowledge sharing, cohesion and shared goals are measures of coopetition which will promote coopetition and significantly affect convergence among firms. The study also gives credence to the role of technology as a facilitator of coopetition.

2.4 Research Gap

While the empirical literature reveals the extent to which coopetition affect both SMEs and multinational firms' performance, the studies mentioned above did not empirically show how coopetition affects small firms value creation. The choice of value creation was influenced by the assertions of Jorgenson (2015), who opines that before a firm could be moved to make a profit and remain relevant in the long run, it must consider value creation first. Such value creation can be achieved through the right strategy. Hence the following hypotheses were formulated:

Hypothesis 1: The dimension of alliance portfolio management capabilities significantly affects value creation in small firms.

Hypothesis 2: The dimension of entrepreneurial opportunities significantly affects value creation in small firms.

Hypothesis 3: The dimension of industries specifics significantly affects value creation in small firms.

2.5 Theoretical Framework: Games Theory

The study is anchored on the game theory. The game theory describes a situation of strategic interaction which involve two or more players (decision-makers) who can act in two or more ways (strategies) in such a way that the outcome of their actions is a function of the strategies the players employed (Bhuiyan, 2016). Each player has well-defined priorities of all the possible results, allowing corresponding utilities (payoffs) to be allocated. The rules governing players' interactions, the feasible tactics of players, and their expectations over results are evident in a game (Bicchieri and Sillari, 2005). The game theory is premised on the idea that a game has three pivotal elements; strategies, payoffs and players. In applying this to coopetition and value creation, the game theory explicitly explains the players as the competing small firms, strategies as coopetition and payoffs as the value created. Geckil and Anderson (2010) opine that a game can be distinguished from players' perspectives, according to rationality, cooperation, normal and extensive forms, and zero-sum and non-zero-sum games. For evaluating various strategies in the firm world, game theory has become pivotal. It provides useful methods for solving problems with the process. Many firm strategies are plans for achieving sustainable profitability, either in the short or long term. A firm will often position itself effectively in the market with the right strategy, and a firm will suffer from the wrong plan in the long run. We believe coopetition and value creation are centred on the rationality and cooperation elements of the games' theory. This is because the rational player is one who, considering what he wants his rivals to do, always chooses an action that gives the result he likes most. Two severe manners can be distinguished. The first is referred to as the 'intelligent' player who behaves rationally. The other side is the player choosing for random acts (Bicchieri, 2007). Games may be classed as cooperative and non-cooperative. A game that requires players to collaborate on a joint strategy is called a 'cooperative game' (Bhuiyan, 2016). The assumption is that players (competing firms) would make strategic choices (coopetition) that will add value to their operations. Samuelson and Nordhaus (2010) argue that economic life entails numerous circumstances in which firms or other organisations engage strategically. Game theory analyses how two or more groups compete in an environment like a market and choose strategies or actions that affect all participants jointly. Hence, in the apriori, it is expected that there will be a positive relationship between coopetition dimensions and value creation in small firms.

3 METHODOLOGY

The survey research design was utilised in the study. The study area adopted for the study is Lagos State, Nigeria. Lagos State's choice was influenced by the fact that according to SMEDAN (2019), the state has the highest number of small firms in Nigeria and Lagos state is the seventh-largest economy in Sub Sahara Africa. The total population of small firms in this state are 8,042. The raosoft sample-size calculator at 2% margin and a 95% confidence interval was employed in arriving at a sample size of 1398. According to Hamburg (1985), this sample size is sufficient and recommended for this survey and that it is most efficient to provide the right answers to the phenomenon at hand than a larger sample size where the survey responds to just a small percentage of the sample. A sample size $\geq$ of 400 reduces

the error component so that small differences are regarded as statistically significant (Hair et al., 2010). Hence, considering the constraints of the research setting and theoretical aspect of this study, the sample size of 1398 was considered adequate for the study and making it possible for the generalisation of the result in line with the position of Mugenda and Mugenda (2003). Since the small firms in focus are diverse in characteristics, the sample size was further divided between the small firms in the service sector and manufacturing sector to ensure the respondents' adequate representation was taken from each category (service sector and manufacturing). This criterion was used to capture the small firms' sector adequately.

The questionnaire research instrument was utilised in the study. Mugenda and Mugenda (2003) posit that the questionnaire has a higher level of objectivity in comparison to other survey instruments. To ensure adequate representation of the sample size, the simple proportion method was employed. The questionnaires were equally divided between the top managers/operating officers in the selected service and manufacturing sector. Six hundred eighty-nine questionnaires were each distributed to the service and manufacturing sector. The questionnaire developed by Bengtsson and Johansson (2014) for coopetition and Markgraf (2020) for small firm value creation was adapted for the study with modification to capture the local dynamics. A seven Likert scale questionnaire was employed in the collection of data. According to Worimegbe (2020), the seven Likert scales provide a more accurate reflection and true evaluation of respondents' opinions. The Seven Likert scale measurement was designed from 1 = least agreed, 7 = strongly agreed. This also was to optimise the reliability and accuracy of the research instrument.

The research instrument consists of two sections tagged "Coopetition" and "Value Creation". The questionnaires were administered with the aid of research assistants to the small firms' owners/managers. A total of 1119 questionnaires (80.04%) were retrieved (533 in the service industry, 77.3% and 586 in the manufacturing sector, 85.1%). This shows that the sample size sufficiently satisfies the conditions for multivariate and subgroup analysis as established by Hair et al. (2010). The multivariate analysis was adopted in order to establish the interaction between the dimensions of coopetition (alliance portfolio management capabilities, entrepreneurial opportunities and industries specifics) and the dimensions of value creations (sales, new markets, new service or product added and value-added services). It will also allow the simultaneous assessment of all response variables in this study. This will help the researchers determine the most significant observed construct of coopetition explaining value creation in small firms. The analysis will also reveal the most significant observed measure of value creation, influenced by coopetition. Hence, the study utilises the partial least squares structural equation model (PLS-SEM) to explain the interactions and strength of the path, evaluate how best the models fit the data and test each hypothesis. To test the overall significance of each of the hypothesis, the F-statistics was employed. It makes it possible for the estimation of the cause-effect relationship between the latent variables. The confirmatory factor analysis will enhance the testing of a priori model of the measured variables. The SMARTPLS 3 statistical tool is used in the analysis of data.

3.1 Model Specification

Anchored on the Games Theory, it is expected that coopetition will be a direct antecedent of value creation in small firms. Based on the above premise, the following models were formulated.

For Hypothesis 1:

$$\text{Value Creation} = \beta_0 + \beta_1\,(\text{APM}) + \mu, \qquad (1)$$

where APM = Alliance Portfolio Management, β_0 is the constant, β_1 is the coefficient estimator, μ is the error term.

For Hypothesis 2:

$$\text{Value Creation} = \beta_0 + \beta_2\,(\text{EO}) + \mu, \qquad (2)$$

where EO = Entrepreneurial Opportunities, β_0 is the constant, β_2 is the coefficient estimator, μ is the error term.

Tab. 1: Operationalisation of Variables

Latent Variables	Observed Measurement	Studies
Coopetition	Alliance Portfolio Management	Bengtsson and Johansson (2014)
	Entrepreneurial Opportunities	and authors modifications
	Industries Specifics	
Value Creation	Sales	Markgraf (2020)
	New Markets	
	New Services Added	
	Value-Added Services	

For Hypothesis 3:

$$\text{Value Creation} = \beta_0 + \beta_3\,(\text{IS}) + \mu, \quad (3)$$

where IS = Industries Specifics, β_0 is the constant, β_3 is the coefficient estimator, μ is the error term.

Value Creation = sales, new markets, new service or product added and value-added services.

From the above discussion, it is expected that all the dimensions of coopetition will exhibit a positive relationship with the dimensions of value creation. Hence there will be a directly proportionate relationship coopetition and value creation in the above model.

Tab. 1 reveals the coopetition and value creation measurements used in the study adopted from existing literature.

3.2 Reliability and Validity

The Confirmatory Factor Analysis (CFA) was employed in the psychometric properties' evaluation. The dimensions of the explanatory variable (coopetition) and the explained variable (value creation) were tested, and items in the model restricted to the conditions established by Fornell and Larcker (1981). In other words, the latent variables and internal consistency of the items were > 0.5. The results obtained exhibit acceptable construct reliability and average variance. This is important in establishing content and construct validity. In ensuring face validity, the researchers' adopted the instruments utilised by previous while modifying them to reflect local dynamics. The questionnaires were administered twice at an interval of two weeks to the respondents in order to measure what it was intended to measure.

Tab. 2: Second-order Confirmatory Factor Analysis

Measurement	Construct Reliability	Average Variance Extracted
Coopetition	0.842	0.738
Alliance Portfolio Management	0.808	0.713
Employment Opportunities	0.854	0.726
Industry Specifics	0.792	0.683
Value Creation	0.824	0.732
Sales	0.843	0.761
New Markets	0.789	0.686
New Products and Services	0.886	0.715
Value Added Services	0.782	0.653

Notes: Goodness-of-fit indices: CMIN = 2.82; CFI = 0.97; IFI = 0.96; RMSEA = 0.05

The goodness-of-fit indices in Tab. 2 show that CMIN (chi-square/Degree of Freedom), Comparative Fit Index (CFI), Incremental Fit Indices (CFI) and Root Mean Square Error of Approximation (RMSEA) fall within the acceptable criteria established by Kline (2005). These indices are critical in testing each of the proposed models (hypothesis) in order to evaluate their confirmatory factor analysis and structural equation model. Hence, in establishing how best the explanatory variable and the dependent variable fit in this study, the goodness-of-fit indices would be employed in each hypothesis and their path analysis. According to Hair et al. (2010), the CMIN should be < 5, RMSEA < 0.005, CFI ≤ 0.90 and IFI ≤ 0.90.

Tab. 3: Sample Profile

Demographics	%
Gender (1119)	
Male	60.3
Female	39.7
Marital Status	
Singles	28.7
Married	48.0
Others (widowed and separated)	23.3
Education	
Secondary	19.3
Tertiary	80.3
Age of Respondents	
18–35	33.9
36–65	52.4
65 and above	13.7
Years of Firm Existence	
1–5	46.2
6–10	41.6
Above 10 years	12.2

Tab. 3 shows the profile of the sample respondents. The profile reveals that the majority of the respondents are male ($n = 675$; 60.3%). This shows that most of the small enters are owned/managed by men. The majority of the sampled respondents are married ($n = 537$; 48%). An implication of this is that most of the small firms are owned/controlled by married people. In terms of the respondents' educational level, the survey reveals that many respondents attended tertiary institutions ($n = 898$; 80.3%). Most of the owners/managers have at least a minimum of polytechnic or university education. The majority of the respondents are between the working-class age in Nigeria, while the highest age bracket of firm owners/managers falls between 36–65 ($n = 586$; 52.4%). The survey analysis shows that most small firms are between 1–5 years (of operations, while the small firms' average age = 5.56 years. This indicates that most of the sampled firms are above the 1–5 years liquidation period, as argued by Olaolu and Obaji (2020).

Tab. 4: Normality Analysis

Tests	Model 1	Model 2	Model 3
Skewness	0.464 (0.000)	0.682 (0.000)	0.598 (0.000)
Kurtosis	2.100 (0.000)	0.988 (0.000)	1.046 (0.000)
Cook Distance (Independence of Residual)	0.098	0.022	0.0744

The normality test in Tab. 4 shows that the variables meet the requirements has recommended by Kline (2005). To ascertain for any undue influence on the model results, the Cook Distance was used, and the value shows that there is no presence of undue influence on the model. The kurtosis and skew measures are used to see whether the metrics met the normality generalisations (Kline, 2005). The descriptive statistics used to examine skew and kurtosis. According to Brown (2006), when using the structural equation model, acceptable skewness values range from −3 to +3, and acceptable kurtosis values range from −10 to +10. Hence the values of the measurements fall within the acceptable criteria for analysis in this study.

4 RESULTS

Fig. 1 shows the nature of coopetition among small firms in the service and manufacturing industry. 29% of small firms in the service industry are in coopetition to enhance alliance portfolio management while 33% of the small firms in the manufacturing industry are in for the same reason. The result also shows that 44% of small firms in the service industry and 41% of small firms in the manufacturing industry coopete for entrepreneurial opportunities enhancement while 27% of the small firms in the service industry and 26% of the small firms in the service industry conclude that industry specifics influences the nature of coopetition amongst them. The result established the nature of coopetition among small

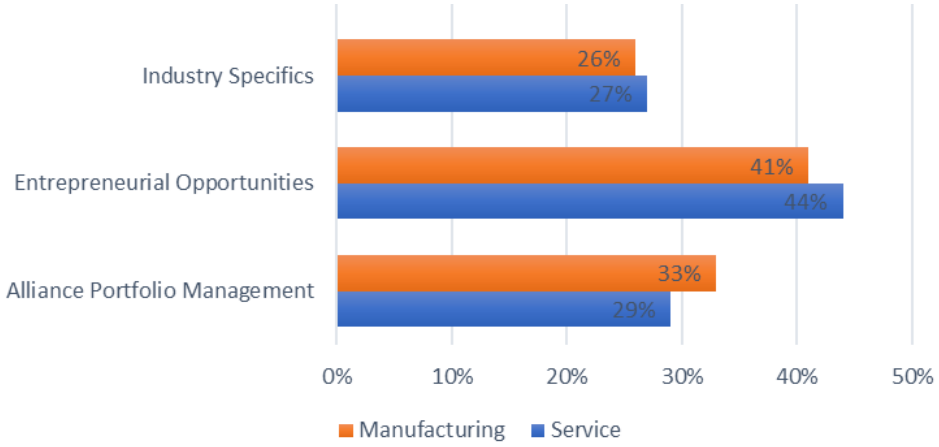

Fig. 1: Nature of Coopetition Among Small Firms in Nigeria

firms as being influenced by entrepreneurial opportunities. The result further reveals that the entrepreneurial opportunities drive for coopetition is more in the small firms' service industry than in the manufacturing industry.

4.1 Hypotheses Testing

Tab. 5: Hypothesis 1: The dimension of alliance portfolio management capabilities significantly affects value creation in small firms

Variable	B	SE	β	T-value	Sig
Alliance Portfolio Management	0.832	0.017	0.845	49.71	0.000
AdjR^2	0.74				
F-Stat	63.022				
p	0.000				

The results in Tab. 5 show that coopetition significantly influences small firms value creation. There is a significant and positive relationship between coopetition and value creation ($\beta = 0.845$). The adjusted coefficient of variation ($R^2 = 0.714$) shows that 71.4% variation in small firms value creation is caused by alliance portfolio management. The standard error (SE = 0.017) shows that the model is a good fit by indicating the extent alliance portfolio management accurately predicts value creation in small firms since the value falls between the accepted estimates 2.5. The unstandardised (B = 0.832) reveals that value creation in small firms increase by 0.832 units when alliance portfolio management increases by a unit. The T-value ($tc = 49.71$; $p = 0.000$) indicates that alliance portfolio management significantly predicts value creation in small firms. The F-stat ($Fc = 63.022$; $p = 0.000$) establishes that alliance portfolio management is reliable and significant in explaining value creation. The findings show that alliance portfolio management significantly drives value creation.

Fig. 2 reveals the estimates of the paths and the error variance of all the paths, estimating the influence of the alliance of portfolio management on coopetition. Hu and Bentler (1999) developed a combinational methodology for model fit evaluation using a GFI = 0.90, CFI = 0.90 and RMSEA = 0.05. Reporting these estimators is critical in testing the hypotheses. They evaluate the current fit and the inconsistency between the data set and the measurement model relevant to the sample size. Root Mean Square Error of Approximation (RMSEA) indicates if the causality between variables can be analysed, and a value closer to 0 indicates a good fit. The Goodness fit Index (GFI) and the Comparative Fit Index compare the target data's compatibility with the null model's alignment. The goodness fit of the structural equation model shows CMIN = 2.132, $p = 0.000$; GFI = 0.97, RMSEA = 0.06, IFI = 0.96, CFI = 0.95). The path coefficients show the interaction among

the latent, observed and explained elements. The results show that AMP4 (coopetition increasing revenue, $tc = 2.280$) is the most explained variable in portfolio management affecting value creation. The path analysis also shows that new product and services ($tc = 6.269$) are the most significant value creation construct explained by alliance portfolio management. NPS3 (Our products and services are customised, $tc = 5.830$) is the most significant explaining new product and services.

Tab. 6: Hypothesis 2: The dimension of entrepreneurial opportunities significantly affects value creation in small firms

Variable	B	SE	β	T-value	Sig
Entrepreneurial Opportunities	0.896	0.033	0.893	27.06	0.000
AdjR^2	0.798				
F-Stat	48.071				
p	0.000				

Tab. 6 result shows that entrepreneurial opportunities significantly influence small firms value creation. There is a significant and positive relationship between entrepreneurial orientation dimension and value creation ($\beta = 0.893$). The adjusted coefficient of variation ($R^2 = 0.798$) shows that 79.8% variation in small firms value creation is caused by the quest for entrepreneurial opportunities among coopeting firms. The standard error (SE = 0.033) shows that the model is a good fit by indicating the extent to which entrepreneurial opportunities predicts value creation in small firms since the value falls between the accepted estimates ≤ 2.5. The unstandardised (B = 0.896) reveals that value creation in small firms increase by 0.896 units when entrepreneurial opportunities increase by a unit. The T-value ($tc = 27.06$; $p = 0.000$) indicates that entrepreneurial opportunities significantly predict value creation in small firms. The F-stat ($Fc = 48.071$; $p = 0.000$) establishes that entrepreneurial opportunities is reliable and significant in explaining value creation. The findings of the result assert that entrepreneurial opportunities significantly influence value creation.

Fig. 3 reveals the estimates of the paths and the error variance of all the paths, estimating the influence of entrepreneurial opportunities on value creation. The goodness fit of the structural equation model shows CMIN = 1.532, $p = 0.000$, GFI = 0.96, RMSEA = 0.05, IFI = 0.97, CFI = 0.98). The path coefficients show the interaction among the latent, observed and explained elements. The results show that EO2 (Our alliance has brought about innovations in our operations, $tc = 3.359$) is the most explained variable in entrepreneurial opportunities affecting value creation. The path analysis also shows that new product and services ($tc = 6.332$) are the most significant value creation construct explained by alliance portfolio management. NPS3 (Our products and services are customised, $tc = 5.175$) is the most significant explaining new product and services).

Tab. 7: Hypothesis 3: The dimension of industries specifics significantly affects value creation in small firms

Variable	B	SE	β	T-value	Sig
Industry Specifics	0.825	0.041	0.811	19.780	0.000
AdjR^2	0.657				
F-Stat	44.231				
p	0.000				

The results in Tab. 7 show that industry-specifics has a significant influence on small firms value creation. There is a significant and positive relationship between industry specifics and value creation ($\beta = 0.811$). The adjusted variation coefficient ($R^2 = 0.657$) shows that industry specifics cause 65.7% variation in small firms value creation. The standard error (SE = 0.041) shows that the model is a good fit by indicating that industry-specifics accurately predict value creation in small firms since the value falls between the accepted estimates ≤ 2.5. The unstandardised (B = 0.825) reveals that value creation in small firms increases by 0.825 units when industry-specifics increases by a unit. The t-value ($tc = 19.780$; $p = 0.000$) indicates that industry specifics significantly predict value creation in small firms. The F-stat ($Fc = 44.231$, $p = 0.000$) establishes that industry specifics are reliable and significant in

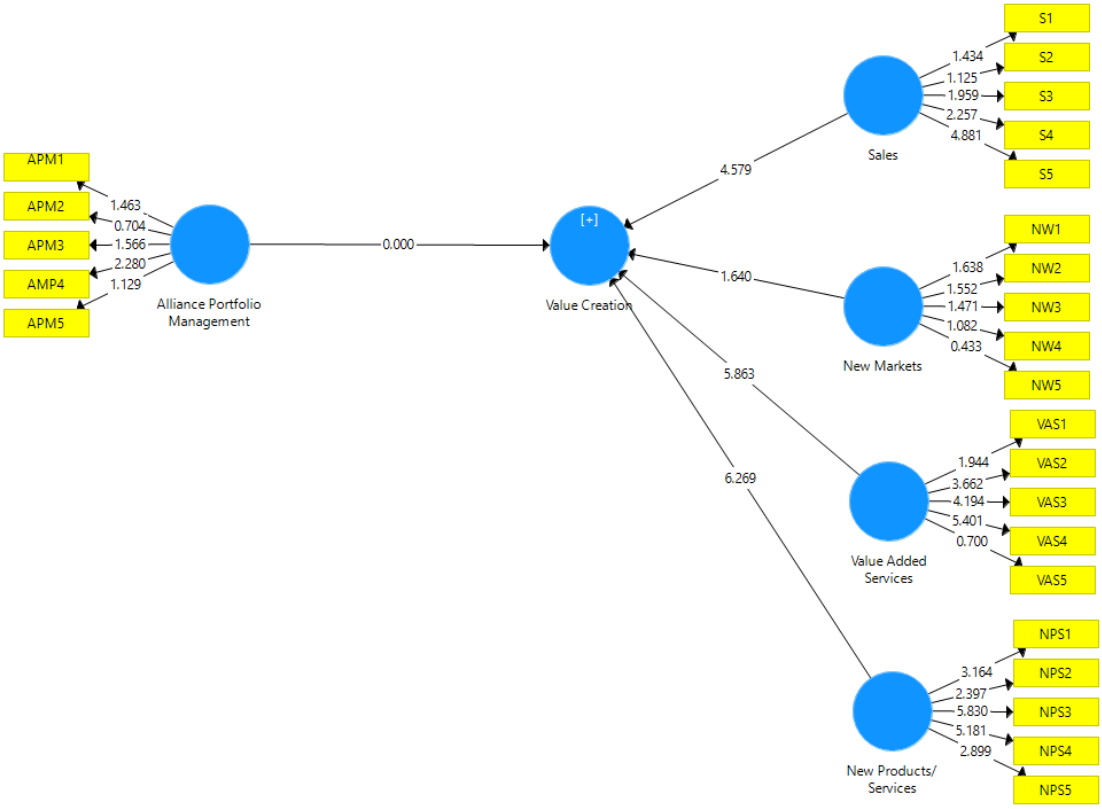

Fig. 2: Alliance of Portfolio Management on Coopetition

explaining value creation. The findings of the result assert that industry specifics drive value creation in small firms.

Fig. 4 reveals the estimates of the paths and the error variance of all the paths, estimating the effect of industry specifics on value creation. The goodness fit of the structural equation model shows CMIN = 1.677, p = 0.000, GFI = 0.98, RMSEA = 0.05, IFI = 0.96, CFI = 0.97). The path coefficients show the interaction among the latent, observed and explained elements. The results show that IS3 (The need for customisation brought about collaborating with our rivals, tc = 3.502) is the most explained variable in industry specifics influencing value creation. The path analysis also shows that new product and services ($tc = 6.617$) are the most significant value creation construct explained by industry specifics. NPS4 (Our products and services are unique to each type of customer, $t = 5.858$) is the most significant explaining new product and services.

5 DISCUSSIONS

The survey analyses in figure 1 show the nature of coopetition prevalent in small firms. 29% of the service industry firms assert that they utilise the coopetition strategy to capture the difficult markets and manage their portfolio alliance. In comparison, 33% of small firms in the manufacturing industry indicate that they are coopetition for alliance portfolios. This implies that many small firms coopete with different industry rivals to access more resources and

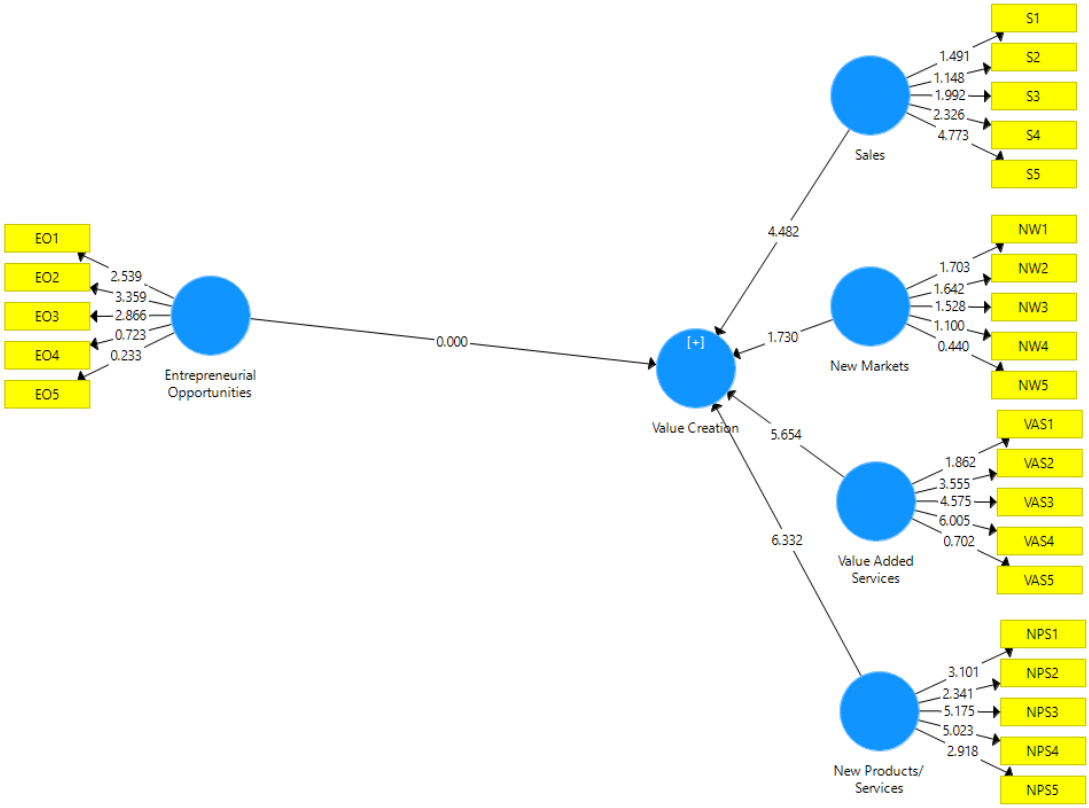

Fig. 3: Entrepreneurial Opportunities on Value Creation

information. However, in achieving the study's first objective, which determines the nature of coopetition among small firms in Nigeria, the findings reveal that most small firms are involved in coopetition because of entrepreneurial opportunities. Small firms explore and exploit coopetition as a strategy to create better services and products and achieve profitability. 44% of service firms and 41% of manufacturing small firms are involved in coopetition to access and utilise entrepreneurial opportunities. The result corroborates Bengtsson and Johansson (2014) and Worimegbe (2020) established that firms are involved in coopetition to take advantage of opportunities they would not have accessed as standalone firms.

Hypothesis one reveals the interactions between the dimensions of alliance portfolio management and value creation in small firms. The findings indicate that alliance portfolio management is a driver of value creation in small firms. The more firms are involved in alliance portfolio management, the more they can create values that will lead to better performance in the long run. The result also shows that the need to increase revenue in alliance portfolio management drives customisation in new products and services. It was also revealed that new product and services are the main essence of value creation in small firms. The findings support Czakon et al. (2020) and Dyer and Singh (1998) revealed that alliance portfolio management would enhance the firm's capacity and position in achieving competitiveness while increasing its networks and activities.

Hypothesis two indicates the degree of influence of entrepreneurial opportunities dimensions on value creation dimensions in small firms. The result shows that entrepreneurial opportunities significantly influence value creations. This implies that the need for the inter-firm network is driven by the need to explore

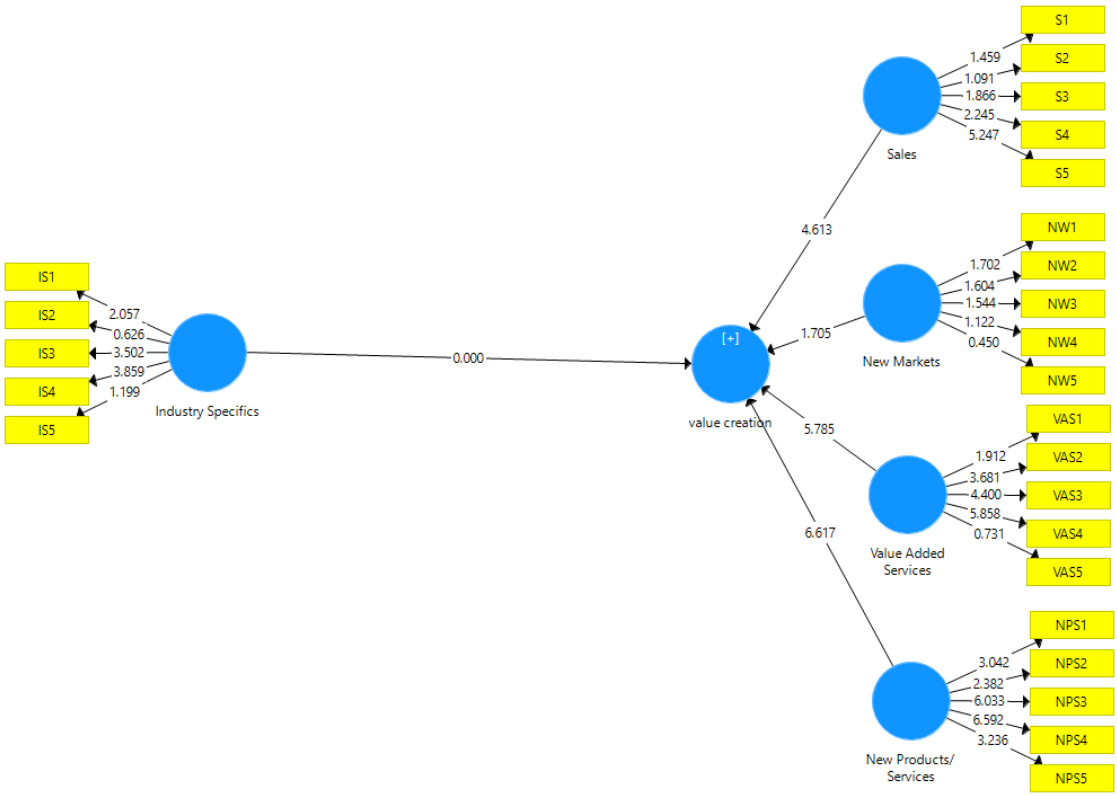

Fig. 4: Industry Specifics on Value Creation

and exploit entrepreneurial opportunities, and this leads to an increase in new product and services. The results show that alliance in coopetition has brought about innovations in small firms' operations, which has made it possible to create more opportunities leading to value creation. In terms of value creation, small firms need to exploit entrepreneurial opportunities to create new products and services to customise services and products. The result adds credence to the opinions of Klein (2010) and Ritala and Hurmelinna-Laukkanen (2009), who adds that entrepreneurial opportunities strategy is pivotal to creating value while supporting the arguments by Shane and Venkataraman (2000) that the strategies employed in pursuing opportunities could create more values for the firm.

The third hypothesis shows the degree of effect of industry specifics dimensions on small firms value creation. The result established that industry specifics significant affect value creation. The more industry-specific network increases, the more the small firms' capacity to create new product and services and stay profitable and competitive in the long run. The interaction of the individual dimensions reveals that the need for customisation by small firms has brought about coopetition, which greatly influences the uniqueness of product and services delivered to the different categories of customers. Bengtsson and Johansson (2014) and Machado (2016) suggest that participating in strategic alliances by small firms create values and compete with other firms in the market is strengthened by this finding.

The analysis also established coopetition and value creation dimensions a small should pursue par time. While the industry survey reveals that the entrepreneurial opportunities dimension is the most pursued by the service and manufacturing firms in the market, the inferential statistics reveal that alliance portfolio management is the most significant coopetition dimension ($t = 49.71$) which small firms should

pursue. The result also shows that new product and services are the most significant value creation measure in small firms. Hence, small firms should first explore and exploit ways to provide new products and services that meet the customers' needs. In comparison, this contradicts Jorgenson's (2015) opinion which suggests firms should consider revenue and cost of providing services first that value creation should be measured in terms of revenue and competitive cost of providing a service. This study's findings address key issues and provide direction for small firms in attaining competitiveness through the process of value creation. Small firms should be involved in coopetition strategy. Firms which operate simultaneous and direct relationships or networks will enjoy increased capacity and capture more markets. While coopetition is not the only strategy to capture new markets, this study provides a more robust strategy that makes the small firms collaborate with their rivals to capture access to a diversity of resources and information. Small firms also provide new product and services that will enable them to capture the market and compete favourably with the larger firms.

6 CONCLUSION

The study examined the influence of coopetition on small firm value creation. Extant literature provided the need to examine the nature of coopetition among small firms and determine the extent to which coopetition affects small firms' value creation and the dimension of coopetition and value creation small firms should pursue at a particular period of time. Utilising the dimensions of alliance portfolio management, entrepreneurial opportunities, and industry specifics for coopetition, the study established that coopetition dimensions significantly affect small firms' value creation (value-added services, new markets, new products and services, and sales. The study also reveals that alliance portfolio management is the most significant dimension of coopetition that small firms should first pursue, while the creation of new products and services should be the first form of value creation to be created by small firms. The study's path analysis shows that in the process of value creation, firms should not consider exploring new markets as these do not have any significant effect. Coopetition should be to achieve new products; value-added services and increase revenue through sales.

The study recommends that small firms integrate coopetition into their strategy to remain relevant, increase their revenue, customise their services through value-added services, and create new products and services. Small firms should be moved by the need to pursue alliance portfolio management before entrepreneurial opportunities and industry specifics. It is also pivotal for small firms to customise their product and services in sustaining their value in the market place.

7 REFERENCES

Ackerman, S. J. 1999. *Are Small Firms Important? Their Role and Impact*. Springer. DOI: 10.1007/978-1-4615-5173-7.

Aladejebi, O. 2020. Managing Small Firms in Nigeria During Covid-19 Crisis: Impact and Survival Strategies. *IOSR Journal of Business and Management*, 22 (8), 24–34. DOI: 10.9790/487X-2208012434.

Arndt, M., Grewe, I. and Unger, A. 2018. *Co-Opetition in the Banking Industry: Overcoming the Rift Between Financial Institutions and FinTechs* [online]. BearingPoint. Available at: `https://www.bearingpoint.com/files/WP_1084_EN_Coopetition_Banking_Industry.pdf?download=0anditemId=284371` [Accessed 2020, November 14].

Bengtsson, M. and Johansson, M. 2014. Managing Coopetition to Create Opportunities for Small Firms. *International Small Business Journal: Researching Entrepreneurship*, 32 (4), 401–427. DOI: 10.1177/0266242612461288.

Bengtsson, M. and Kock, S. 2000. Coopetition in Business Networks – to Cooperate and Compete Simultaneously. *Industrial Marketing Management*, 29 (5), 411–426. DOI: 10.1016/S0019-8501(99)00067-X.

Bengtsson, M., Raza-Ullah, T. and Vanyushyn, V. 2016. The Coopetition Paradox and Tension: The Moderating Role of Coopetition Capability. *Industrial Marketing Management*, 53, 19–30. DOI: 10.1016/j.indmarman.2015.11.008.

Bhuiyan, B. A. 2016. An Overview of Game Theory and Some Applications. *Philosophy and Progress*, 59 (1–2), 112–118. DOI: 10.3329/pp.v59i1-2.36683.

Bicchieri, C. 2007. Game Theory: Some Personal Reflections. In Hendricks, V. F. and Hansen, P. G. (eds.). *Game Theory: 5 Questions*. Copenhagen: Automatic Press.

Bicchieri, C. and Sillari, G. 2005. Game Theory and Decision Theory. In Borchert, D. (ed.). *The Encyclopedia of Philosophy*. 2nd ed. Detroit: Macmillan.

Bouncken, R. B. and Fredrich, V. 2016. Business Model Innovation in Alliances: Successful Configurations. *Journal of Business Research*, 69 (9), 3584–3590. DOI: 10.1016/j.jbusres.2016.01.004.

Bouncken, R. B., Gast, J., Kraus, S. and Bogers, M. 2015. Coopetition: A Systematic Review, Synthesis, and Future Research Directions. *Review of Managerial Science*, 9 (3), 577–601. DOI: 10.1007/s11846-015-0168-6.

Bouncken, R. B. and Kraus, S. 2013. Innovation in Knowledge-Intensive Industries: The Double-Edged Sword of Coopetition. *Journal of Business Research*, 66 (10), 2060–2070. DOI: 10.1016/j.jbusres.2013.02.032.

Brown, T. A. 2006. *Confirmatory Factor Analysis for Applied Research*. New York: Guilford Press.

Crick, J. M. and Crick, D. 2019. Developing and Validating a Multi-Dimensional Measure of Coopetition. *Journal of Business & Industrial Marketing*, 34 (4), 665–689. DOI: 10.1108/JBIM-07-2018-0217.

Crick, J. M. and Crick, D. 2020. Coopetition and COVID-19: Collaborative Business-to-Business Marketing Strategies in a Pandemic Crisis. *Industrial Marketing Management*, 88, 206–213. DOI: 10.1016/j.indmarman.2020.05.016.

Cygler, J., Sroka, W., Solesvik, M. and Dębkowska, K. 2018. Benefits and Drawbacks of Coopetition: The Roles of Scope and Durability in Coopetitive Relationships. *Sustainability*, 10 (8), 2688. DOI: 10.3390/su10082688.

Czakon, W. 2018. Network Coopetition. In Fernandez, A.-S., Chiambaretto, P., Le Roy, F. and Czakon, W. (eds.). *The Routledge Companion to Coopetition Strategies*. DOI: 10.4324/9781315185644-5.

Czakon, W. and Czernek, K. 2016. The Role of Trust-Building Mechanisms in Entering into Network Coopetition: The Case of Tourism Networks in Poland. *Industrial Marketing Management*, 57 (2), 64–74. DOI: 10.1016/j.indmarman.2016.05.010.

Czakon, W., Klimas, P. and Mariani, M. 2020. Behavioral Antecedents of Coopetition: A Synthesis and Measurement Scale. *Long Range Planning*, 53 (1), 79–123. DOI: 10.1016/j.lrp.2019.03.001.

Czakon, W. and Rogalski, M. 2014. Coopetition Typology Revisited – a Behavioural Approach. *International Journal of Business Environment*, 6 (1), 28–46. DOI: 10.1504/IJBE.2014.058022.

Davidow, M. 2018. Value Creation and Efficiency: Incompatible or Inseparable? *Journal of Creating Value*, 4 (1), 123–131. DOI: 10.1177/2394964318768904.

Di Benedetto, C. A., Lindgreen, A., Storgaard, M. and Clarke, A. H. 2019. How to Collaborate Really Well with Practitioners. *Industrial Marketing Management*, 82 (3), 1–8. DOI: 10.1016/j.indmarman.2019.08.001.

Dyer, J. H. and Singh, H. 1998. The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage. *Academy of Management Review*, 23 (4), 660–679. DOI: 10.2307/259056.

Fornell, C. and Larcker, D. F. 1981. Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18 (1), 39–50. DOI: 10.2307/3151312.

Gardete, P. M. 2016. Competing Under Asymmetric Information: The Case of Dynamic Random Access Memory Manufacturing. *Management Science*, 62 (11), 3291–3309. DOI: 10.1287/mnsc.2015.2297.

Geckil, I. K. and Anderson, P. L. 2010. Applied Game Theory and Strategic Behavior. 1st ed. London: CRC Press.

Georgescu-Roegen, N. 1971. *The Entropy Law and the Economic Process*. Harvard University Press.

Gnyawali, D. R. and Charleton, T. R. 2018. Nuances in the Interplay of Competition and Cooperation: Towards a Theory of Coopetition. *Journal of Management*, 44 (7), 2511–2534. DOI: 10.1177/0149206318788945.

Hair, J. F., Black, W. C., Babin, B. J. and Anderson, R. E. 2010. *Multivariate Data Analysis: A Global Perspective*. 7th ed. Upper Saddle River: Pearson.

Hamburg, M. 1985. *Basic Statistics: A Modern Approach*. Dryden Press.

Hayes, A. 2020. Coopetition. *Investopedia* [online]. Available at: https://www.investopedia.com/terms/c/coopetition.asp. [Accessed 2020, September 1].

Hoffmann, W. H. 2007. Strategies for Managing a Portfolio of Alliances. *Strategic Management Journal*, 28 (8), 827–856. DOI: 10.1002/smj.607.

Hu, L.-T. and Bentler, P. M. 1999. Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives. *Structural Equation Modeling*, 6 (1), 1–55. DOI: 10.1080/10705519909540118.

Jankowska, B. 2010. Coopetition and Internationalisation of a Company – the Case of Firms in the Wielkopolska Voivodeship. *Journal of International Studies*, 3 (1), 94–102. DOI: 10.14254/2071-8330.2010/3-1/10.

Jorgenson, E. 2015. Why Value Creation is the Foundation of Business: How to Define It, Measure It, and Manage It. *Evergreen* [online]. Available at: https://medium.com/evergreen-business-weekly/why-value-creation-is-the-foundation-of-business-how-to-define-it-measure-it-and-manage-it-147c92b87aca.

Klein, P. G. 2010. Opportunity and the Entrepreneur. *Mises Institute* [online]. Available at: https://mises.org/library/opportunity-and-entrepreneur. [Accessed 2020, September 1].

Kline, R. B. 2005. *Principles and Practice of Structural Equation Modeling*. 2nd ed. Methodology in the Social Sciences. Guilford Press.

Kylänen, M. and Rusko, R. 2011. Unintentional Coopetition in the Service Industries: The Case of Pyhä-Luosto Tourism Destination in the Finnish Lapland. *European Management Journal*, 29 (3), 193–205. DOI: 10.1016/j.emj.2010.10.006.

Le Roy, F. and Czakon, W. 2016. Managing Coopetition: The Missing Link Between Strategy and Performance. *Industrial Marketing Management*, 53 (1), 3–6. DOI: 10.1016/j.indmarman.2015.11.005.

Lieberman, M. B. and Balasubramanian, N. 2007. *Measuring Value Creation and Its Distribution among Stakeholders of the Firm* [online]. Available at: https://ssrn.com/abstract=2382099. DOI: 10.2139/ssrn.2382099.

Luo, Y. 2007. A Coopetition Perspective of Global Competition. *Journal of World Business*, 42 (2), 129–144. DOI: 10.1016/j.jwb.2006.08.007.

Machado, H. P. V. 2016. Growth of Small Firms: A Literature Review and Perspectives of Studies. *Gestão & Produção*, 23 (2), 419–432. DOI: 10.1590/0104-530X1759-14.

Markgraf, B. 2020. Introduction to Value Creation in Business. *Chron* [online]. Available at: https://smallbusiness.chron.com/introduction-value-creation-business-42606.html. [Accessed 2020, November 16].

McKelvie, A. and Wiklund, J. 2010. Advancing Firm Growth Research: A Focus on Growth Mode Instead of Growth Rate. *Entrepreneurship: Theory and Practice*, 34 (2), 261–288. DOI: 10.1111/j.1540-6520.2010.00375.x.

Merchant, K. A. and Sandino, T. 2009. Four Options for Measuring Value Creation. *Journal of Accountancy*, 208 (2), 34–37.

Moore, J. F. 1993. Predators and Prey: A New Ecology of Competition. *Harvard Business Review*, 71 (3), 75–86.

Morris, M. H., Koçak, A. and Özer, A. 2007. Coopetition as a Small Business Strategy: Implications for Performance. *Journal of Small Business Strategy*, 18 (1), 35-56. DOI:

Mugenda, O. M. and Mugenda, A. G. 2003. *Research Methods: Quantitative and Qualitative Approaches*. Nairobi: African Centre for Technology Studies.

Olaolu, D. and Obaji, N. O. 2020. An Assessment on the Influence of Entrepreneurial Training, Risk-Taking and Innovativeness on SMEs Development in Nigeria. *Journal of Economics and Business*, 3 (1), 254–269. DOI: 10.31014/aior.1992.03.01.195.

Ornstein, M. and Sandahl, M. 2015. *Coopetition and Business Models: How Can They Be Integrated, and What Effect Does It Have on Value Creation, Delivery and Capture?* Unpublished Thesis. Umeå School of Business and Economics.

Park, B.-J., Srivastava, M. K. and Gnyawali, D. R. 2014. Impact of Coopetition in the Alliance Portfolio and Coopetition Experience on Firm Innovation. *Technology Analysis and Strategic Management*, 26 (8), 893–907. DOI: 10.1080/09537325.2014.913016.

Randolph, R. V., Hu, H. and Silvernail, K. 2018. Knowledge Networking and Coopetition: The Role of Shared Technology in Promoting Goal Convergence. *2018 Western Academy of Management Conference*, 59, 9.

Ritala, P. and Hurmelinna-Laukkanen, P. 2009. What's in It for Me? Creating and Appropriating Value in Innovation-Related Coopetition. *Technovation*, 29 (12), 819–828. DOI: 10.1016/j.technovation.2009.07.002.

Ritala, P., Kraus, S. and Bouncken, R. B. 2016. Introduction to Coopetition and Innovation: Contemporary Topics and Future Research Opportunities. *International Journal of Technology Management*, 71 (1/2), 1–9. DOI: 10.1504/IJTM.2016.077985.

Ritala, P. and Sainio, L.-M. 2014. Coopetition for Radical Innovation: Technology, Market and Business-Model Perspectives. *Technology Analysis and Strategic Management*, 26 (2), 56–69. DOI: 10.1080/09537325.2013.850476.

Ritala, P. and Tidström, A. 2014. Untangling the Value-Creation and Value-Appropriation Elements of Coopetition Strategy: A Longitudinal Analysis on the Firm and Relational. *Scandinavian Journal of Management*, 30 (4), 498–515. DOI: 10.1016/j.scaman.2014.05.002.

Saebi, T. 2011. *Succesfully Managing Alliance Portfolios: An Alliance Capability View*. Universitaire Pers Maastricht.

Samuelson, P. A. and Nordhaus, W. D. 2010. *Economics*. New York: McGraw-Hill.

Seetharaman, M. and Gallucci, J. 2020. How Global 500 companies are Utilising Their Resources and Expertise During the Coronavirus Pandemic. *Fortune* [online]. Available at: `https://fortune.com/2020/04/13/global500-companies-coronavirus-response-covid-19-pandemic/`. [Accessed 2020, November 21].

Shane, S. and Venkataraman, S. 2000. The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, 25 (1), 217–226. DOI: 10.5465/amr.2000.2791611.

Sharma, P. and Carney, M. 2012. Value Creation and Performance in Private Family Firms: Measurement and Methodological Issues. *Family Business Review*, 25 (3), 72–89. DOI: 10.1177/0894486512457295.

SMEDAN. 2019. *National Survey Of Micro Small & Medium Enterprises (MSMEs)* [online]. Available at: `https://smedan.gov.ng/images/NATIONAL%20SURVEY%20OF%20MICRO%20SMALL%20&%20MEDIUM%20ENTERPRISES%20(MSMES),%20%202017%201.pdf`.

Soppe, C., Lechner, B. and Dowling, M. 2014. Vertical Coopetition in Entrepreneurial Firms: Theory and Practice. *Journal of Small Business and Enterprise Development*, 21 (4), 548–564. DOI: 10.1108/JSBED-03-2014-0052.

Stadtler, L. and Van Wassenhove, L. N. 2016. Coopetition as a Paradox: Integrative Approaches in a Multi-Company, Cross-Sector Partnership. *Organisation Studies*, 37 (5), 655–685. DOI: 10.1177/0170840615622066.

Thiel, P. and Masters, B. 2018. *Zero to One: Notes on Startups, or How to Build the Future*. Amazon, United Kingdom.

Thomason, S. J., Simendinger, E. and Kierman, D. 2013. Several Determinants of Successful Coopetition in Small Business. *Journal of Small Business and Entrepreneurship*, 26 (1), 15–28. DOI: 10.1080/08276331.2012.761800.

Turner, J. and Akinremi, T. 2020. *The Business Effects of Pandemics: A Rapid Literature Review* [online]. Enterprise Research Centre. Available at: `https://www.enterpriseresearch.ac.uk/wp-content/uploads/2020/04/ERC-Insight-The-business-effects-of-pandemics-%E2%80%93-a-rapid-literature-review-Final.pdf`. [Accesssed 2020, October 10].

Walley, K. 2007. Coopetition: An Introduction to the Subject and an Agenda for Research. *International Studies of Management and Organization*, 37 (2), 11–31. DOI: 10.2753/IMO0020-8825370201.

Wang, Y. and Krakover, S. 2008. Destination Marketing: Competition, Cooperation or Coopetition? *International Journal of Contemporary Hospitality Management*, 20 (2), 126–141. DOI: 10.1108/09596110810852122.

Windsor, D. 2013. Corporate Social Responsibility and Irresponsibility: A Positive Theory Approach. *Journal of Business Research*, 66 (10), 1937–1944. DOI: 10.1016/j.jbusres.2013.02.016.

Worimegbe, P. M. 2020. Coopetition and Customers' Experience in the Nigerian Banking Sector: The Moderating Effect of Technology. *Global Journal of Business, Economics and Management: Current Issues*, 10 (2), 111–123. DOI: 10.18844/gjbem.v10i2.4847.

Zgarni, B. 2019. Cooperation or Coopetition Strategy: What is the Best Strategy Face to Competition' Intensity and Strategic Capabilities? *International Review of Management and Marketing*, 9 (5), 114–124. DOI: 10.32479/irmm.8408.

AUTHOR'S ADDRESS

Adedeji Saidi Adelekan, Department of Business Administration, Dominican University, Oyo State, Nigeria, e-mail: elevatedej@gmail.com

James Olanipekun Ojo, Department of Business Administration, Mountain Top University, Ogun State, Nigeria

Powel Maxwell Worimegbe, Department of Business Administration, Olabisi Onabanjo University, Ago-Iwoye, Ogun State, Nigeria, e-mail: powelmaxwell@yahoo.com

DOES THE INVOLVEMENT OF "GREEN ENERGY" INCREASE THE PRODUCTIVITY OF COMPANIES IN THE PRODUCTION OF THE ELECTRICITY SECTOR?

Veronika Varvařovská[1], Michaela Staňková[1]

[1] *Mendel University in Brno, Czech Republic*

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ABSTRACT

This article evaluates the production possibilities of the electricity sector in selected EU countries. The estimates for production functions are based on the financial data of individual companies in the selected sector. The analysis was based on a linearized version of the two-factor Cobb-Douglas production function, which was subsequently modified to compare productivity results by company size and country. The countries were selected based on the results of a cluster analysis. The cluster analysis was performed using aggregated data on the shares of energy sources in production in the electricity sector. The results show that companies from countries with a high share of renewables (such as Denmark) perform the worst in terms of total productivity. Furthermore, it was found that large companies have significantly higher productivity when compared to their smaller competitors.

KEY WORDS

energy industry, productivity, Cobb-Douglas function, EU, cluster analysis

JEL CODES

D240, Q400, O130, C380, C320

1 INTRODUCTION

When it comes to energy sources, there is general pressure to use renewables. The decline in the popularity of "traditional" energy sources (non-renewable) is due to two reasons. The first is the limited reserves of fossil fuels and uranium. An estimation of when fossil fuel reserves will be depleted is very uncertain, and is therefore a topic that is constantly discussed. According to Speirs et al. (2015), uncertainty stems from five different areas. These include the uncertainty associated with inaccurate estimates of the volume of resources and reserves, uncertainty of technological progress, economic aspects, and the external environment in the

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form of national and international energy. The last area is the sustainability of fuels in the context of climate change legislation. Although it is not possible to completely eliminate these uncertainties, it is better to know their source and take them into account.

The second problem associated with non-renewable resources is carbon dioxide (CO_2), which is released into the air when fossil fuels are burned. Barbir et al. (1990) pointed out the problem of pollution. They identified populations, fauna, flora, agricultural production, the aquatic ecosystem, buildings, and air as the main areas where fossil fuel pollution has a negative effect. Mudway et al. (2020) mention that air pollution increases the number of people with respiratory disease, cardiovascular disease, diabetes, cancer, and dementia. In 2017, they estimated that pollution contributed to at least 5 million premature deaths. Pollution also accelerates natural processes that destroy various types of materials due to corrosion (Spezzano, 2021). Lanzi et al. (2018) estimated that the economic cost of inaction on air pollution will climb to 1% of world GDP by 2060. Increasing concentrations of CO_2 in the air are also directly related to climate change. The climate changes constantly and at relatively regular intervals during the Earth's existence. However, in the last few decades, the Earth has been warming for the first time in history due to human intervention. The consequences of climate change are discussed in more detail by van Aalst (2006). Air pollution is mostly associated with fossil fuels. Saidi and Omri (2020) write in their work that nuclear power generation together with renewable energy in OECD countries reduces CO_2 emissions in the long run. But across the world, there is a negative attitude towards the construction of nuclear power plants due to the experience of nuclear accidents. Danzer and Danzer (2016) dealt with the long-term effects of the Chernobyl accident on the local population.

Above mentioned risks are increasingly encouraging the world to use renewables in energy production, as they are associated with low CO_2 production. According to Dincer (2000), there is a direct relationship between the use of renewable resources and long-term sustainable growth. One of the key elements in achieving energy, economic and environmental benefits is the need to support research and development in renewable energy technologies. The growing share of renewables in energy production is also supported by the spillover effect analyzed by Shahnazi and Shabani (2020). Their study of a sample of EU countries between 1995 and 2016 concluded that increasing the share of renewable energy production in neighboring countries leads to an increase in renewable energy production in the monitored country. The effect is mainly due to the mechanism of disseminating knowledge, learning, and imitating successful policies. If renewable economies are successful, it is likely that this trend will gradually spread.

1.1 Theoretical Background

Since the creation of the EU, energy has been one of the key areas for future development for member states. The proof is that two of the three communities that created the EU were energy – the European Coal and Steel Community and the European Atomic Energy Community. Over the years, the EU has been actively developing common energy plans and ambitious targets. The current European strategy for 2021–2030 supports reducing greenhouse gas emissions by 40%, increasing the share of energy consumption from renewable sources to 27% and increasing energy efficiency by at least 30%, all compared to 1990 levels. Energy efficiency is the ratio of energy inputs to outputs and is closely linked to the energy production process and, in the long run, to economic growth. The issue of energy efficiency is analyzed, for example, by Rajbhandari and Zhang (2018) and Vlontzos et al. (2014). Vlontzos et al. (2014) in their research focusing on the impact of subsidies in the field of energy efficiency of EU countries in 2001–2008 found that many Eastern European countries achieve low efficiency due to low levels of implemented technologies in the production process. Likewise, energy efficiency differs significantly between the new and old member states. An

analysis of energy subsidies in EU countries for the period 2008–2018 was performed by Badouard and Altmann (2020). According to their results, subsidies for renewable energy increased by approximately 232% during the period under review. Badouard and Altmann (2020) also focused on an analysis of global subsidies for renewables and found that the EU 27 region subsidizes renewables the most with € 73 billion, followed by Japan with € 15 billion and the United States with € 9 billion. Connolly et al. (2016) focused their research on the EU's long-term goal of 2050, which is to become a fully dependent region based only on renewable energy, by presenting a scenario consisting of nine steps to achieve the set goal. They emphasized that research should be seen as a source of impact, not as a binding path. The results of their study suggest that achieving 100% renewables would increase total annual energy costs by 12% (compared to fossil fuels), but this radical change in technology would increase domestic investment leading to new job creation. Number of new jobs is estimated at up to 10 million. Despite the higher costs, this scenario would have a positive effect on the EU economy as a whole. Although several of the required technologies in connection with a given scenario can already be implemented, the authors suggest that the transition to 100% renewable resources largely depends on the capabilities and wishes of politicians and society.

Alataş et al. (2021) used data for the period 2000–2017 for energy and material productivity in the EU 28. Using a modified Cobb-Douglas production function, they concluded that while increasing energy productivity in the transition to a carbon-neutral economy by 2050, increasing material productivity should also be encouraged. In their analyses of productivity, they also found that technological advances increased both of these productivities. In relation to energy productivity, the research of Wan et al. (2015) can also be mentioned, where again using a linearized Cobb-Douglas production function, they analyzed data from the energy sector of the EU 15 in the period 1995–2005. Wan et al. (2015) found that promoting competition and disseminating knowledge stimulates trade and leads to higher energy productivity. Furthermore, countries with a higher dependence on trade have seen higher growth in energy productivity, so trade facilitation can improve energy efficiency across countries.

Radmehr et al. (2021) examined the relationship between economic growth, carbon emissions and energy consumption between 1995 and 2014 for EU countries. Rahman et al. (2020) similarly concluded in their work that there is not only a direct relationship between consumption and economic growth, but there is also a positive relationship between energy production and economic growth. These articles seek to provide empirical results that help policy makers to design adequate environmental and energy policies to meet the EU's economic development and sustainability goals. Research suggests that increasing energy productivity supports the achievement of the EU's goals, and increasing the share of energy from renewable sources increases economic growth and promotes a cleaner and healthier environment not only for the citizens.

1.2 Motivation and Contribution

The research carried out so far has typically relied on aggregated data for the whole energy sector (NACE code D). However, the use of this data aggregates the results of activities not only of energy production companies, but also, for example, of companies engaged in energy trade and distribution. Unlike other studies, this article focuses only on the financial data of companies within generation in the electricity sector (NACE code 35.11) in selected EU countries.

Based on the decisions of the EU's joint policies, but also thanks to the efforts of special interest groups, there is constant pressure to increase the share of renewable resources. The use of renewable energy sources generally has a longer payback period, and their implementation can be difficult at first. Therefore, the governments of individual countries use many different subsidy programmes in order to achieve sustainable development with regard

not only to the economic aspect, but also with regard to the natural environment. However, a "forced" shift to a higher share of renewables can have an impact on business productivity. It has not yet been clearly demonstrated whether this effect will be positive or negative. The main aim of this article is to find out whether those countries with a higher share of renewable resources are also the ones in which companies are the most productive.

The results of a cluster analysis will be used to select the representative countries for which the production function will be estimated. The countries will be clustered based on the share of the individual types of energy involved in electricity generation. From each cluster, one representative country will be selected according to the values corresponding to the average values of the cluster and with regard to the availability of the data needed to estimate the parameters of the production functions. In addition to comparing productivity by country, thanks to the micro dataset productivity will also be evaluated by company size.

2 METHODOLOGY AND DATA

Macro-level data of individual countries were obtained from the official European database Eurostat (under the name Complete energy balances – Gross electricity production). Micro-level data of individual companies were obtained from the international database Orbis. Due to the fact that the Orbis database contains the most current and complete data available from 2016, analyses at the level of macro data also focused on data from 2016.

Macro-level data for the cluster analysis represent cross-sectional data in the form of shares of energy types according to their share of total electricity production for EU 27. The original values were measured in GWh, but for the sake of an objective comparison of countries, the values were converted into shares. Each energy source (variable) is expressed as a percentage of the total electricity production. Therefore, the variables take values from the interval 1–100% with the sum of the values of all variables for each country always being equal to 100%. A list of variables used in the cluster analysis, including descriptive statistics, is included in Tab. 1.

Seven variables were used for the analysis: fossil fuels, biofuels, hydro energy, wind energy, solar energy, geothermal energy, and nuclear energy. Tab. 1 provides descriptive statistics in the form of minimum, maximum, average, and median values for all the EU 27. At least a small share of fossil fuels is used by each country, as well as biofuels and wind energy, because the minimum value of the variables is higher than 0%. On the other hand, there are countries that do not use hydro, solar, geothermal or nuclear energy in the production of electricity. According to the average values, it is clear that the largest share of electricity production in EU countries is represented by fossil fuels together with biofuels. It is also clear that even in 2016, significant differences in the energy mix persist between EU countries.

Several groups (clusters) of countries were created using the cluster analysis. For each cluster, one typical representative of this cluster was then selected, and an estimate of the production function was performed for it based on the individual data of the companies in the selected country. The production analyses were based on the linearized Cobb-Douglas production function:

$$\ln y_i = \alpha + \ln f(x_i, \beta) + \epsilon_i, \qquad (1)$$

where y_i is the product of each unit i and $i = 1, \ldots, I$; x_i is a vector of inputs, β is a vector of parameters estimated, $\alpha = \ln \beta_0$ (i.e., intercept), ϵ_i is error term. Two variables related to the transformation process were included in the models, namely the labor and capital factor.

In this case, the product is represented by added value, labor is represented by the cost of employees and in the case of capital, its real (physical) version is approached, which is represented by, for example, machines, buildings,

Tab. 1: Categories for the cluster analysis and descriptive statistics (%)

Category and variables	Min	Max	Average	Median
Fossil fuels (solid fossil fuels; manufactured gases; natural gas; oil and petroleum products; oil shale and oil sands; peat and peat products)	0.86	84.01	37.08	28.45
Biofuels (renewables and biofuels; primary solid biofuels; pure biodiesels; other liquid biofuels; biogases)	8.97	49.74	28.57	25.74
Hydro energy (hydro; tide, wave, ocean)	0.00	38.63	12.06	9.99
Wind energy	0.01	26.99	6.43	4.49
Solar energy (solar thermoval; solar photovoltaic)	0.00	12.87	2.17	1.31
Geothermal energy	0.00	1.60	0.07	0.00
Nuclear energy	0.00	60.83	13.61	0.00

materials, licenses, or know-how. Capital is therefore derived from the financial statements of companies, where the values of total assets are monitored. All values from the Orbis database are in thousands of euros.

In the case of two-factor Cobb-Douglas production function, three parameters are estimated. These parameters are usually referred to as A, α, and β. A is the level of technology; α and β correspond to the elasticity of production to labor and capital, under the conditions $\alpha, \beta > 0$. The condition of a positive value also applies to parameter A.

The original production model (according to Equation 1) was further additively extended with artificial variables representing company size and country, in order to determine which countries and which types of companies are the most productive. In a similar way, it is possible to add variables representing the ratio of renewable and non-renewable energy sources in a given country.

Due to the fact that it is possible to use a linearized version of the Cobb-Douglas production function (see Staňková, 2020; Staňková and Hampel, 2019, 2021) the parameter estimates were performed via the OLS method. Similarly to Zámková and Blašková (2013) and Adamec and Střelec (2012), t-tests were used to verify the statistical significance of the estimated parameters of the Cobb-Douglas production function model. The F-test was used to verify the significance of the model itself. Variance inflation factor (VIF) values were used to identify possible multicollinearity. The assumption about the correct specification of the model was checked using a RESET and LM tests. The White and Breusch-Pagan tests were used to detect possible heteroskedasticity of residues. Finally, the assumption of the normal distribution of the error term was verified using the Chi-square test. More detailed information about the assumption verification of regression analysis models can be found in Gujarati and Porter (2017).

In order for the estimates to be as consistent as possible, a requirement was introduced that the estimates of production functions be based on values from at least 30 companies. The following countries did not meet this requirement: Croatia, Ireland, Lithuania, Latvia, Luxembourg, the Netherlands, and Greece. Therefore, these countries were intentionally omitted from the estimation of production functions and were not taken into account as a possible representative of the cluster.

All of the above-mentioned calculations were performed in the Matlab computational system (version 2021a) and Gretl software (version 2021a).

3 RESULTS

The results of the differently set approaches to the calculation in the cluster analysis were similar. However, from a factual point of view, on closer examination, the Ward method seemed to be the most plausible, as in Staňková and Hampel (2017) and Stojanová et al. (2018). Fig. 1 shows a dendrogram, which identifies five clusters using a cut at a distance of 0.58. According to the dendrogram, the most numerous group is cluster 4 (i.e. red in Fig. 1), which includes seven European countries. On the contrary, cluster 3 (blue) has the fewest members. It is interesting to note that at first sight these are not clusters of countries with a close geographical location. However, individual clusters can be described from the point of view of the representation of energy sources in the production of electricity. The average values of the variables for each defined cluster are in Tab. 2, including the values for the countries that are selected to estimate production functions.

Cluster 1 (purple) includes Estonia, Cyprus, Malta, the Netherlands, and Poland. These countries have the highest share of fossil fuels in electricity generation in the EU. According to Tab. 2, the average value of fossil fuels for the whole of cluster 1 is 76.79%. The second largest share is represented by biofuels with 14.46%. Other renewable energy sources represent only a small share of the entire electricity production. The Netherlands is the only state in cluster 1 that uses nuclear energy to generate electricity. Cyprus and Malta have one of the highest values of fossil fuels, and also have the least subsidies for energy from renewable sources (Badouard and Altmann, 2020). Poland is another country with a high share of fossil fuels, which is justified by their large coal reserves and resources. The amount of coal ranks it among the 10 countries with the largest reserves and resources of coal in the world. Poland was chosen as the representative of cluster 1 for two reasons. Poland with its mean values is close to the average values for the whole of cluster 1, see Tab. 2, and also due to the fact that, compared to the other countries in cluster 1, there is a sufficient number of companies with available data.

Cluster 2 (yellow) is made up of countries where fossil fuels still make up the largest proportion of electricity generation. According to Tab. 2, Greece, Ireland, Italy, Germany, Bulgaria and the Czech Republic produce an average of 49.55% of electricity from fossil fuels. The remaining production is supplemented by biofuels and nuclear energy. Nuclear energy in cluster 2 is represented only by the Czech Republic, Bulgaria and a smaller share of Germany. However, the national policies of all three countries have a tendency to expand nuclear energy in the coming years. For example, since the Velvet Revolution (1989) the Czech Republic has strived to be more ecological in the field of energy production. However, it tends more towards nuclear energy with two nuclear power plants currently in operation – Temelín and Dukovany. Despite the fact that the future of nuclear energy in the EU is very uncertain, it plays an important role in the energy plan of the Czech Republic. This plan even promotes the construction of new nuclear reactors, especially in connection with the end of operations in the Dukovany nuclear power plant. The Czech Republic was selected for the production analysis due to it having values close to the average values of cluster 2 (see Tab. 2).

Cluster 3 (blue) is represented by countries in which nuclear energy is a significant part of electricity generation, as can be seen in Tab. 2. These countries are Slovakia, France, Hungary, and Belgium. The countries that gave birth to the European Community believed that nuclear energy was the main path for development. Among them is France, where nuclear energy accounts for 60.83% of electricity generation. Another of the founding countries that has retained nuclear energy as its main source is Belgium. The rationale for the remaining states participating in cluster 3 has little potential for the use of other renewables. For example, limited or no access to water, or a lack of sunlight and poor wind conditions may be to blame. Due to the negative attitude in the EU

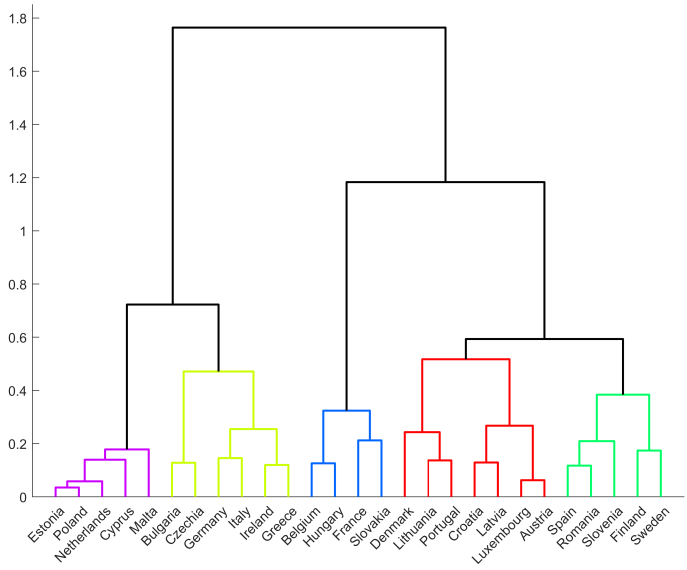

Fig. 1: Dendrogram with the five identified clusters

Tab. 2: Average values (in %) of variables for the individual clusters and selected representative countries

	Fossil fuels	Biofuels	Hydro energy	Wind energy	Solar energy	Geothermal energy	Nuclear energy
Cluster 1	76.79	14.46	0.34	4.36	3.41	0.00	0.63
Poland	75.44	16.47	1.38	6.64	0.07	0.00	0.00
Cluster 2	49.55	22.78	6.17	6.81	3.47	0.27	10.95
Czech Rep.	51.74	16.28	3.42	0.53	2.28	0.00	25.75
Cluster 3	21.15	19.22	6.47	2.69	1.68	<0.01	48.79
France	8.16	16.48	9.99	3.23	1.31	0.01	60.83
Cluster 4	19.76	45.26	23.82	10.10	1.04	0.03	0.00
Denmark	24.16	47.24	0.04	26.99	1.57	0.00	0.00
Cluster 5	19.42	33.77	18.84	5.90	1.37	0.00	20.70
Finland	14.75	42.28	16.13	3.13	0.02	0.00	23.69

towards nuclear energy, it may mean reducing the share of nuclear energy in the future in countries where it is possible to involve alternative sources in energy production. To estimate the production function, France is selected from cluster 3 as one of the countries that seeks to replace fossil fuels with a significant share of nuclear energy. Although France differs in some values from the averages in the cluster, it has shown another ecological path that can be followed in the future by other EU countries, including, the Czech Republic, Bulgaria and Germany.

Cluster 4 (red) is characterized by very low values for fossil fuels and high values for biofuels in combination with water and wind energy. Cluster 4 includes Austria, Luxembourg, Latvia, Lithuania, Croatia, Portugal, and Denmark. Cluster 4 has one of the largest shares of hydropower (see Tab. 2). This is probably due to the fact that most countries in cluster 4 have good access to the sea or a large number of watercourses. Luxembourg and Austria have one of the highest shares of hydropower in electricity generation. Both countries have favorable topographical conditions, and the use

of hydropower is also of traditional importance for Austria. The historical development of hydropower in Austria has been underway since 1840. But Wagner et al. (2015) point out that another large expansion of hydropower in Austria could have a negative impact on river ecology and the morphology of watercourses, which is contrary to European legislation. However, from the given cluster, Denmark was chosen as the representative for estimating the production function, primarily due to a lack of data for other countries in the cluster.

Cluster 5 (green) is formed by a group of countries that have similarly low values for fossil fuels as cluster 4, but high shares of biofuel in combination with nuclear energy. Namely, Finland, Sweden, Romania, Slovenia, and Spain. With the exception of nuclear energy, cluster 5 is very close to cluster 4 in Tab. 2. The typical representatives of cluster 5 are the two Nordic countries – Finland and Sweden, which are known for their emphasis on the use of renewable resources, as demonstrated by the low proportions of fossil fuels. Sweden uses only 0.86% of fossil fuels to generate electricity and Finland 14.75%. Sweden's national energy plan states that it wants to become the world's first country with zero fossil fuel use by 2045. A similar vision is shared by other countries in clusters 5 and 4. However, Finland was chosen to estimate production functions because Sweden has available data for less than 30 companies.

In the first step, a common model according to Equation 1 was estimated for five selected countries. Estimates of the parameters (always statistically significant parameters) are recorded in Tab. 3. Based on the values of the individual parameters of the common model, it can be stated that the "typical" company operates at the level of increasing returns from scale and capital have a greater influence on the size of the product compared to labour.

Subsequently, the common model was extended by an artificial variable representing the country in which the companies are located. The results of this model, recalculated for each country, are also included in Tab. 3. Based on the results of this first modified model, it can be stated that companies in the Czech Republic have a higher total productivity factor value compared to other selected countries. From this point of view, Denmark and France are in the worst positions.

Tab. 3: Estimated parameters for common model and modified model with recalculated results for individual country

Model	$\hat{A}$	$\hat{\alpha}$	$\hat{\beta}$
Common	0.5160	0.1569	0.7644
Poland	0.5845	0.1576	0.7630
Czech Republic	0.6178	0.1576	0.7630
France	0.4649	0.1576	0.7630
Denmark	0.4470	0.1576	0.7630
Finland	0.5285	0.1576	0.7630

Given that it is the Czech Republic that has the lowest share of renewables and, conversely, France has the lowest share of fossil fuels and Denmark has the lowest share of nuclear energy (see Tab. 2), it can be assumed that there will be a negative link between the use of renewable energy sources and total factor productivity. If we adjusted the original model by a variable representing the share of renewable and non-renewable energy sources (calculated on the basis of Tab. 2), then the variable of renewable sources with a negative parameter (specifically -0.0013) and a variable representing non-renewable sources with a positive parameter (0.0044) would actually be significant in the model.

Tab. 4: Estimated parameters for second modified model with recalculated results by company size

Model	$\hat{A}$	$\hat{\alpha}$	$\hat{\beta}$
Small companies	0.5522	0.1515	0.7542
Medium-sized companies	0.5750	0.1515	0.7542
Large companies	0.8878	0.1515	0.7542

If we focus instead of the geographical area on company size, it is possible to create another modified model with an artificial variable representing company size. The results of recalculated parameters by company size are recorded in Tab. 4. This analysis showed that the level of technology is the highest in the case of large companies. In general, it can be state that with

increasing company size, the total productivity factor increases.

Over 90% of the value-added (dependent variable) variability was explained by all the models mentioned. According to the verification test results, all models were correctly specified, and the residues showed the properties of a classical error term.

4 DISCUSSION

The Euclidean distance with Ward's method best divided countries into clusters. Based on the clarity and balance of the number of members, five clusters were interpreted. The countries in the clusters were sufficiently similar, although slight differences were found mainly in the distribution of shares between renewable energy sources. The cluster analysis identified cluster 1 as having countries with a fossil fuel share of over 75%. The countries in cluster 2 were very close to cluster 1, as these were countries where fossil fuels still accounted for the largest share. However, the share was in the lower range of 41–59%. These countries have further combined fossil fuels with renewables and nuclear energy. Cluster 3 connects countries that largely produce electricity from nuclear energy. Clusters 4 and 5 were formed by countries where biofuels contributed the most to electricity generation. The feature distinguishing clusters 4 and 5 was that countries in cluster 5 combined biofuels with nuclear energy, whereby countries in cluster 4 only combined biofuels with other representatives of renewable energy sources. The small distance between the two clusters was also indicated by the dendrogram (see Fig. 1). A common aspect of the countries in clusters 4 and 5 is the great potential for the use and expansion of renewable resources. This advantage is mainly provided by favorable geological conditions.

Parobek et al. (2016) dealt with a very similar topic. Their work focused on the use of renewable energy sources in total energy production and consumption in EU countries based on data from 2012. They used the same distance measurements using Euclidean metrics in combination with Ward's method. Their cluster analysis took into account variables that represented external influences, such as economic indicators and the availability of renewable resources in the country. They identified nine clusters in which significant similarities in member composition can be found compared to the results in this article. This highlights the fact that although this article focuses only on a selected part of the energy industry, it may be assumed that its results can outline the similarity of national energy sectors across EU countries. Even though Parobek et al. (2016) used an older and wider data set, they also included Cyprus, Malta, and Estonia in the same cluster as the countries with the lowest share of renewable energy sources in primary energy production. The grouping of Austria, Portugal, Sweden, and Finland also emerged as countries with the highest share of biomass use (here part of the biofuel variable). In the described work, the Czech Republic and Bulgaria are part of a similar cluster with an average share of the use of renewable resources, but below the average of biomass. By analogy, the Netherlands and Poland were included in the cluster with the lowest shares of renewable energy use, and Hungary and Belgium did not show any unique differences in the use of renewable energy sources, because both countries focus largely on nuclear energy. Based on EU regulations and strategic plans, it is possible to expect more intensive convergence of EU countries in the field of electricity generation in the future.

The production analysis included five countries representing the five identified clusters. The selection of individual countries was conditioned by two criteria. Firstly, a sufficient number of observations and the completeness of the data. Secondly, the values of the selected country correspond as much as possible to the average values of the cluster. The final selection included Poland, France, Finland, Denmark, and the Czech Republic.

The parameters of the elasticity of the output to the input factors indicate that in the electricity generation sector, capital always has a greater influence on the output, because the values of the parameter $\hat{\beta}$ estimates in all cases are significantly higher than the parameter $\hat{\alpha}$ estimates. The issue of returns to scale in electricity generation has so far been measured very rarely. Some older studies can be found, such as Smigel at al. (1974), Dhrymes and Kurz (1964) or Nerlove (1963).

Smigel et al. (1974) estimated the parameters of the production function of electricity generation in Pennsylvania in the period between 1956 and 1971 using the Cobb-Douglas function. However, they chose the average number of employees and the average number of hours worked as an indicator of the labor factor, the total installed capacity represented capital and the total amount of electricity produced in kWh represented the product. Despite these differences, our results came to a similar conclusion regarding the effect of labor and capital on total output. The smaller influence of the labor factor is probably caused by the high automation of the electricity generation process. Therefore, the workforce fulfills the function of supervision, maintenance, administration and similar matters related to operations. Smigel et al. (1974) add that labor demand increases in proportion to output and the number of production units in operation.

Nerlove (1963) chose the Cobb-Douglas functional form, whereas Dhrymes and Kurz (1964) leaned toward the CES production function in the analysis of steam power generation in the United States. In both cases, the chosen inputs were labor, capital and fuel. Nerlove (1963), Dhrymes and Kurz (1964) and Smigel et al. (1974) identified increasing returns to scale. In this respect, too, the productivity results of the selected countries in this article are in line with those of other countries. Unfortunately, no newer or older studies focusing on European countries are currently available, so it is not possible to make a closer comparison of the estimated parameters within the selected energy sector.

It is possible to state that if the selected countries had one unit of labor and capital, then the largest amount of electricity would be produced by the Czech Republic, followed by Poland, Finland, France, and the least by Denmark, see Tab. 5. Among the selected countries, the Czech Republic can be described as the most productive, because with the same number of inputs, it can produce the highest product. When monitoring the percentage increase in Tab. 5, Denmark took the imaginary first place, and the Czech Republic is last. The difference between countries can be explained by the different position on the total production curve.

Tab. 5: Calculation of production values for two levels of inputs for the models of selected EU countries

	$L = 1$ $K = 1$	$L = 2$ $K = 2$	**Change in %**
Czech Republic	1.5384	2.4590	159.8414
Denmark	1.3676	2.2882	167.3150
Finland	1.4491	2.3697	163.5291
France	1.3855	2.3061	166.4453
Poland	1.5051	2.4257	161.1654

Differences in national productivity are caused by various external factors, such as technological progress. The development of power plants using fossil fuels has been going on since the second half of the 19^{th} century. Nuclear power plants have been used since the middle of the 20^{th} century. During that time, some progress has been made in the area of electricity generation. Higher development in energy production in connection with both fossil fuels and uranium would then correspond to the results of Smigel et al. (1974), Nerlove (1963) and Dhrymes and Kurz (1964), who identified increasing returns to scale in the last century. At present, therefore, countries using fossil fuels or uranium (like Czech Republic) may have more technological development. However, thanks to the significant development of renewable energy sources in recent years, the technological progress of renewable energy sources could be currently more intensive.

Smigel et al. (1974) indicated that one of the most important factors in the technological progress of electricity generation is the large amount of installed capacity. However, the financial side of this problem must be considered. According to the IEA (2020), by 2019, wind

energy with nuclear energy was one of the cheapest sources of electricity generation. In Denmark, for example, wind farms are capable of generating 1 MWh of electricity for $ 29.18 in terms of lifespan. For a similar lifespan of nuclear power plants, France produces 1 MWh for $ 30.65. Of the available values, India produces the cheapest electricity from coal at $ 70.54 per 1 MWh, and the lowest costs of producing electricity is in Mexico at $ 40.32 per 1 MWh. Kåberger (2018) also suggests in his study that renewable energy sources are in many cases cheaper than fossil fuels today. The fact that most renewables do not need fuel for their service reduces their costs and, as a result, depends only on initial and operating costs.

Unfortunately, there are currently no more comprehensive studies that approach the focus of this problem. The lack of studies can be expected due to the limited availability of data at the level of individual companies, and the second possible explanation is the fact that European electricity generation sectors are often characterized by only a handful of large companies and, conversely, a large number of medium and small enterprises. However, according to Černohorský (2015), this market structure does not create sufficient space for competition and thus lacks motivation to evaluate productivity or efficiency like in Staňková (2020) or Gaebert and Staňková (2020).

Thanks to the use of micro-data for individual companies, it was possible to find out not only the fact that companies from countries with the lowest share of renewable resources are the most productive, but also the fact that large companies have the highest total productivity, see Tab. 6.

Tab. 6: Calculation of production values for two levels of inputs by company size

	$L = 1$ $K = 1$	$L = 2$ $K = 2$	**Change in %**
Small companies	1.4579	2.3636	162.1236
Medium-sized companies	1.4807	2.3864	161.1670
Large companies	1.7935	2.6992	150.4990

Both of these pieces of information are beneficial not only for energy industry regulators, but also for potential investors. Strategic plans focus on the appropriate ratio of renewable and non-renewable resources, but do not address the productivity of companies that will produce this energy. As mentioned above, this market sector consists mainly of small and medium-sized enterprises. But these enterprises have lower productivity. These findings could motivate companies to cooperate more towards greener electricity generation.

A detailed analysis of state subsidies provided could also be very beneficial. The differing effect of subsidies on the performance of companies has already been demonstrated in the agricultural sector; see for example Galanopoulos et al. (2011). If subsidies in the energy sector are distributed unevenly in terms of company size, then the state can indirectly support but also reduce differences in companies' productivity.

5 CONCLUSIONS

This article provides indicative evidence that despite the EU's efforts in the energy sector the use of renewable energy sources negatively affects the total product of the sector. In addition to differences in productivity from the perspective of individual countries, there are also statistically significant differences in the value of technological progress with respect to company size. In the future, however, it is possible to expect more intensive convergence of national electricity generation sectors. And differences between countries could therefore be reduced.

Estimates of the parameters of the elasticity of output to input factors in selected models indicate that in terms of production in the electricity sector, capital has a greater influence on the size of the product compared to labor. The smaller influence of the labor factor can probably be attributed to the high automation of the electricity production process, where the workforce fulfills the function of supervision, maintenance, etc.

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7 REFERENCES

Alataş, S. Karakaya, E. and Sari, E. 2021. The Potential of Material Productivity Alongside Energy Productivity in Climate Mitigation: Evidence from Convergence tests in the EU28. *Resources, Conservation & Recycling*, 167 (4), 105322. DOI: 10.1016/j.resconrec.2020.105322.

Adamec, V. and Střelec, L. 2012. A Study of Potential Output and Output Gap in the Czech Republic. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 60 (2), 9–16. DOI: 10.11118/actaun201260020009.

Barbir, F., Veziroğlu, T. N. and Plass, H. J. 1990. Environmental Damage Due to Fossil Fuels Use. *International Journal of Hydrogen Energy*, 15 (10), 739–749. DOI: 10.1016/0360-3199(90)90005-J.

Badouard, T. and Altmann, M. 2020. *Energy Subsidies: Energy Costs, Taxes and the Impact of Government Interventions on Investments*. Brussels: European Commission. DOI: 10.2833/546611.

Connolly, D., Lund, H. and Mathiesen, B. V. 2016. Smart Energy Europe: The Technical and Economic Impact of One Potential 100% Renewable Energy Scenario for the European Union. *Renewable and Sustainable Energy Reviews*, 60 (8), 1634–1653. DOI: 10.1016/j.rser.2016.02.025.

Černohorský, J. 2015. Koncentrace a ziskovost na bankovním trhu České republiky. *Scientific Papers of the University of Pardubice, Series D*, 22 (3), 30–41.

Danzer, A. M. and Danzer, N. 2016. The Long-Run Consequences of Chernobyl: Evidence on Subjective Well-Being, Mental Health and Welfare. *Journal of Public Economics*, 135 (3), 47–60. DOI: 10.1016/j.jpubeco.2016.01.001.

Dhrymes, P. J. and Kurz, M. 1964. Technology and Scale in Electricity Generation. *Econometrica: The Journal of the Econometric Society*, 32 (3), 287–315. DOI: 10.2307/1913038.

Dincer, I. 2000. Renewable Energy and Sustainable Development: A Crucial Review. *Renewable and Sustainable Energy Reviews*, 4 (2), 157–175. DOI: 10.1016/S1364-0321(99)00011-8.

Gaebert, T. and Staňková, M. 2020. Efficiency Development in the German Pharmaceutical Market. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 68 (5), 877–884. DOI: 10.11118/actaun202068050877.

Galanopoulos, K., Abas, Z., Laga, V, Hatziminaoglou, I. and Boyazoglu, J. 2011. The Technical Efficiency of Transhumance Sheep and Goat Farms and the Effect of EU Subsidies: Do Small Farms Benefit More Than Large Farms? *Small Ruminant Research*, 100 (1), 1–7. DOI: 10.1016/j.smallrumres.2011.05.008.

Gujarati, D. N. and Porter, D. C. 2017. *Basic Econometrics*. 5th ed. Boston: McGraw-Hill Education.

IEA. 2020. *Levelised Cost of Electricity Calculator* [online]. France: International Energy Agency. Available at: `https://www.iea.org/articles/levelised-cost-of-electricity-calculator`. [Accessed 2021, April 24].

Kåberger, T. 2018. Progress of Renewable Electricity Replacing Fossil Fuels. *Global Energy Interconnection*, 1 (1), 48–52. DOI: 10.14171/j.2096-5117.gei.2018.01.006.

Lanzi, E., Dellink, B. and Chateau, J. 2018. The Sectoral and Regional Economic Consequences of Outdoor Air Pollution to 2060. *Energy Economics*, 71 (3), 89–113. DOI: 10.1016/j.eneco.2018.01.014.

Mudway, I. S., Holgate, S., Forman, H. J. and Kelly, F. J. 2020. Air Pollution: Consequences for Cellular Redox Signaling, Antioxidant Defences and Disease. *Free Radical Biology and Medicine*, 151 (6), 1. DOI: 10.1016/j.freeradbiomed.2020.04.030.

Nerlove, M. 1963. Chapter 7. Returns to Scale in Electricity Supply. In Christ, C. et al. (eds.). *Measurement in Economics*. Stanford University Press, pp. 167–198.

Parobek, J., Paluš, H., Kalamárová, M., Loučanová, E., Šupín, M., Križanová, A. and Repková Štofková, K. 2016. Energy Utilization of Renewable Resources in the European Union – Cluster Analysis Approach. *BioResources*, 11 (1), 984–995. DOI: 10.15376/biores.11.1.984-995.

Radmehr, R., Henneberry, S. R. and Shayanmehr, S. 2021. Renewable Energy Consumption, CO_2 Emissions, and Economic Growth Nexus: A Simultaneity Spatial Modeling Analysis of EU Countries. *Structural Change and Economic Dynamics*, 57 (2), 13–27. DOI: 10.1016/j.strueco.2021.01.006.

Rahman, Z. U., Khattak, S. I., Ahmad, M. and Khan, A. 2020. A Disaggregated-Level Analysis of the Relationship among Energy Production, Energy Consumption and Economic Growth: Evidence from China. *Energy*, 194 (5), 116836. DOI: 10.1016/j.energy.2019.116836.

Rajbhandari, A. and Zhang, F. 2018. Does Energy Efficiency Promote Economic Growth? Evidence from a Multicountry and Multisectoral Panel Dataset. *Energy Economics*, 69 (1), 128–139. DOI: 10.1016/j.eneco.2017.11.007.

Saidi, K. and Omri, A. 2020. Reducing CO_2 Emissions in OECD Countries: Do Renewable and Nuclear Energy Matter? *Progress in Nuclear Energy*, 126 (9), 103425. DOI: 10.1016/j.pnucene.2020.103425.

Shahnazi, R. and Shabani, Z. D. 2020. Do Renewable Energy Production Spillovers Matter in the EU? *Renewable Energy*, 150 (6), 786–796. DOI: 10.1016/j.renene.2019.12.123.

Smigel, E., Krawiec, F. and Krawiec, S. 1974. A Study of Growth Factors of Electric Energy Production in Pennsylvania 1956–1971. *Eastern Economic Journal*, 1 (2), 155–165.

Speirs, J., McGlade C. and Slade, R. 2015. Uncertainty in the Availability of Natural Resources: Fossil Fuels, Critical Metals and Biomass. *Energy Policy*, 87 (12), 654–664. DOI: 10.1016/j.enpol.2015.02.031.

Spezzano, P. 2021. Mapping the Susceptibility of UNESCO World Cultural Heritage Sites in Europe to Ambient (Outdoor) Air Pollution. *Science of the Total Environment*, 754 (5), 142345. DOI: 10.1016/j.scitotenv.2020.142345.

Staňková, M. 2020. Efficiency Comparison and Efficiency Development of the Metallurgical Industry in the EU: Parametric and Non-Parametric Approaches. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 68 (4), 765–774. DOI: 10.11118/actaun202068040765.

Staňková, M. and Hampel, D. 2017. Identification of Bankruptcy Factors for Engineering Companies in the EU. In *Mathematical Methods in Economics 2017: Conference Proceedings*. Hradec Králové: Univerzita Hradec Králové, pp. 714–719.

Staňková, M. and Hampel, D. 2019. Efficiency of the Building Project Sector in the Czech Republic – Stochastic Frontier Analysis Approach. *AIP Conference Proceedings*, 2116 (1), 400007. DOI: 10.1063/1.5114421.

Staňková, M. and Hampel, D. 2021. On the Influence of Model Setting on Stochastic Frontier Analysis. *Mathematical Methods in the Applied Sciences*, 44 (1), 274–283. DOI: 10.1002/mma.6730.

Stojanová, H., Blašková, V. and Lněničková, M. 2018. The Importance of Factors Affecting the Entry of Entrepreneurial Subjects to Organic Farming in the Czech Republic. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 66 (4), 1017–1024. DOI: 10.11118/actaun201866041017.

van Aalst, M. K. 2006. The Impacts of Climate Change on the Risk of Natural Disasters. *Disasters*, 30 (1), 5–18. DOI: 10.1111/j.1467-9523.2006.00303.x.

Vlontzos, G., Niavis, S. and Manos, B. 2014. A DEA Approach for Estimating the Agricultural Energy and Environmental Efficiency of EU Countries. *Renewable and Sustainable Energy Reviews*, 40 (12), 91–96. DOI: 10.1016/j.rser.2014.07.153.

Wagner, B., Hauer, C., Schoder, A. and Habersack, H. 2015. A Review of Hydropower in Austria: Past, Present and Future Development. *Renewable and Sustainable Energy Reviews*, 50 (10), 304–314. DOI: 10.1016/j.rser.2015.04.169.

Wan, J., Baylis, K. and Mulder, P. 2015. Trade-Facilitated Technology Spillovers in Energy Productivity Convergence Processes Across EU Countries. *Energy Economics*, 48 (2), 253–264. DOI: 10.1016/j.eneco.2014.12.014.

Zámková, M. and Blašková, V. 2013. Identification of Factors Affecting Birth Rate in Czech Republic. *AIP Conference Proceedings*, 1558 (1), 1871. DOI: 10.1063/1.4825895.

AUTHOR'S ADDRESS

Veronika Varvařovská, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: xvarvar1@mendelu.cz

Michaela Staňková, Department of Statistics and Operation Analysis, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: michaela.stankova@mendelu.cz

HOUSEHOLD ENERGY DEMAND IN TYPICAL NIGERIAN RURAL COMMUNITIES

Olorunjuwon David Adetayo[1], Gbenga John Oladehinde[1], Samson A. Adeyinka[1], Adejompo Fagbohunka[2]

[1] *Obafemi Awolowo University, Ile-Ife, Nigeria*
[2] *Adekunle Ajasin University, Akungba-Akoko, Nigeria*

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ABSTRACT

This research investigates factors influencing domestic energy demand among rural households. Data were collected from 260 randomly sampled household heads in the study area. Descriptive statistics, ANOVA, and Tobit regression were used for the analysis. Tobit regression results revealed that gender, household size, income, occupation, farm size, and per capita expenditure were significant in influencing the use of fuelwood; age, gender, household size, occupation, education, and per capita expenditure for charcoal, while age, marital status, income, education and per capita expenditure were significant determinants in the use of kerosene. Also, income, occupation, and per capita expenditure were the factors influencing the use of electricity among rural households in the study area. The study concluded that apart from income, other household variables were significant in determining energy usage. The study, therefore, recommended that government and stakeholders should develop policies that will promote the use of safe, reliable, and clean energy sources in order to reduce the negative environmental consequences while also enhancing human life quality.

KEY WORDS

households' demand, domestic energy, fuel switching, fuel stacking, Nigeria

JEL CODES

I32, Q40, R20

1 INTRODUCTION

Energy is fundamental for social and economic growth as well as the development of any nation (Oyedepo, 2012; Chukwu et al., 2014). It is used as an essential input in most of the production processes. Provision, availability, and sustainable form of energy service are needed to increase human welfare and living standards. In the attainment of a certain level of comfort within the built environment, energy in different forms should be sufficient, economical,

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affordable, and reliable. People tend to live longer and healthier when there are sufficient and reliable energy services. Energy is required not only as a driving force for sustainable development but also in ensuring poverty reduction of any nation. According to Adetayo et al. (2020) power production and utilization are vital to development as most of the sectors of the economy rely on the availability of sufficient energy resources.

Household demand for energy is referred to as the utilization of energy, it involved energy that is used in the processing and production of food within a household (Adetunji et al., 2007). According to Emagbetere et al. (2016), household energy can be sub-divided into solid and non-solid fuel. While biomass (such as wood, animal dung, agricultural remains) and fossil fuel (such as coal) were examples of solid fuels, non-solid fuels include kerosene, gas, and electricity. The utilization of solid fuels such as biomass and fossil fuels through the provision of energy services has brought about different environmental-related issues. The occurrences of these environmental-related issues such as indoor and outdoor air pollution, urban air pollution, environmental degradation, deforestation, acid rain, and climate change among others have been on the increase in recent times.

Another alternative to biomass energy sources as identified by Modi et al. (2005) includes electricity, kerosene, liquefied petroleum gas (LPG), all of which were observed to be cleaner sources. However, scarcity of these alternative energy sources due to poor accessibility of rural community, as well as the unbearable prices which often exceeds their official pump prices has made most rural poor in the third world countries to depend on biomass such as wood, animal dung, and agricultural residue (Nnaji et al., 2012; Bisu et al., 2016). Kowsari and Zerriffi (2011) inserted that more than two and a half billion people in the world over depend on the traditional biomass fuel as their source of energy for cooking, lighting, and heating. Yamamoto et al. (2009) further added that biofuels are largely used particularly in developing countries. For example, Onoja and Idoko (2012) reported with evidence from China that considerable numbers of households are used to the utilization of traditional biofuel in spite of their access to electricity. In Africa, International Energy Agency (2014) stated that biofuels account for about 50% of Africa's energy needs. In Nigeria, it was estimated that 70% comprising 42% of urban households and 86% of rural households consumed biofuel for their domestic needs (Gwatkin et al., 2000). Oyedepo (2012) argued that 86% of households still depend on fuelwood as their source of energy. This shows that a huge number of people in Nigeria and other developing countries still rely on biofuels for their domestic requirements.

Over-dependent on biofuel energy source for indoor cooking especially in the rural community has been considered a dangerous activity that is responsible for the death of more than 4.3 million people every year (WHO, 2010). According to Bisu et al. (2016), it is accounted for the death of about 396,000 people in sub-Saharan Africa in 2002. Indoor cooking using solid fuels has negative effects on human health (WHO, 2006). Some of the health effects include asthma, and cataracts, chronic obstructive lung disease in adults among others (Edwards and Langpap, 2008). World health organization (2006) reported that 2.7% of the global deaths in 2002 were associated with air pollution and disease.

In order to respond to health and environmental related issues that are attributed to the energy consumption behaviour of households, international organizations such as World Health Organization (WHO), United Nations (UN), and World Bank among others have made concerted efforts to address these issues. For instance, the United Nations launched sustainable energy for all (SE4ALL) with three major targets. The first target was to ensure universal access to affordable, reliable, sustainable, clean, safe, and modern energy services, the second target was to double the global rate of improvement in energy efficiency while the third target was to double the share of renewable energy in the global energy mix for all by 2030 (United Nations, 2013; Wilson, 2012). World Bank also launched Africa Clean

cooking energy solutions to promote dissemination and adoption of clean cooking solutions for rural poor households in developing countries. Despite these efforts, however, the desired result has not been recorded as most rural households in sub-Saharan Africa still depend on unclean energy sources (Kichonge et al., 2014; Malla and Timilsina, 2014). Before these efforts can yield positive results, there is a need for empirical research that examines factors influencing energy demand among commonly used energy types (such as kerosene, fuelwood, charcoal, and electricity), especially due to the fact that household usage of any type of fuel for preparing and processing food varies across the globe.

Several studies have investigated factors influencing domestic energy choice and demand in a single study without considering the factors that are associated with each energy type (Ogwumike et al., 2014; Jan et al., 2012; Mekonnen and Köhlin, 2008). Apart from this, collapsing different energy types as a unit of analysis may be too broad and clumsy. It has been argued that different domestic energy sources have their peculiarity with regard to the associated determinants (Adepoju et al., 2012; Bisu et al., 2016). This study, therefore, investigates the factors that are influencing household demand of domestic energy types as well as the relationship between consumption behavior and fuel price. The domestic energy types such as firewood, charcoal, kerosene, and electricity were considered based on their availability and accessibility in the study area at the time of the survey. The goal of this study is to provide information on energy policy that could be adopted to ensure sustainable energy behaviour among rural households in Ese-Odo Local Government Area (LGA), Ondo State, Nigeria. The results of this study will contribute to the understanding of the consumption behavioural pattern of domestic energy with helpful recommendations that could ensure sustainable energy behaviour. This study will also be helpful in contributing to the literature on energy consumption of less considered areas in sub-Saharan Africa. The objective of this research is to examine the factors influencing domestic energy demand among rural households. In order to achieve the identified objective, this research provides answers to the following questions:

1. What is the socio-economic characteristics of the respondents?
2. What are the types of domestic energy and pattern of usage among rural households?
3. What are the factors affecting household choices of domestic energy usage?
4. Is there any significant relationship between fuel price and rate of consumption?

2 LITERATURE REVIEW

Energy is fundamental to sustainable development (Adamu et al., 2020; Güney and Kantar, 2020). It does not only accelerate social and economic progress but also enhances productivity. No society can develop without access to reliable and affordable energy. Other development goals may not be achieved without easy access to sustainable energy services. Energy has a direct impact on people, communities, and countries particularly in terms of economic growth, education, employment, and security (Rahmani et al., 2020; de Abreu et al., 2021). It also affects ecosystems which could be linked to climate change. According to United Nations (2013), the world faces complex challenges that are related to access, sustainability, and efficiency of modern energy services. In an attempted to address this, the UN SG's Sustainable energy for all (SE4ALL) initiative was launched with the aim of achieving three major objectives by 2030. These objectives include ensuring universal access to modern energy services, doubling the share of renewable energy in the global energy mix, and doubling the global rate of improvement in energy efficiency. This initiative is directly linked to the 7th Sustainable Development Goal (SDG) which is to ensure affordable, reliable, sustainable, and modern energy for all

by 2030. This goal was promoted by the United Nations in an attempt to support the increase of sustainable energy consumption (SDG 2018). Despite this initiative, it has been observed that there is still a wide gap between the level of achievement of the seventh Goal of the 2030 SDGs in developed and developing countries. While developed countries have achieved this goal in investing on the required infrastructure through subsidies and specific funding; developing countries particularly countries in sub-Saharan Africa and some parts of Asia, have not been able to achieve much. Most people especially in sub-Saharan Africa still lack access to reliable and clean energy supplies (Egaña del Sol and Flanders, 2020). World Energy Council (2016) estimated that three billion people around the world still rely on simple stoves or open fires that burn wood, animal dung, or coal to cook and heat their homes.

Evidence abounds in the literature that demands for household energy for cooking, heating, lighting, and transportation varies from country to country. For example, in China, Leiwen and O'Neill (2003) reported that electricity and biomass are common types of fuel among urban households. Firewood and Liquified Gas were mostly used in Urban areas of Guatemala (Energy Sector Management Assistance Program, 2000). In India, the use of biomass fuel stove was commonly practiced for making traditional bread among wealthy households (Saatkamp et al., 2000). In certain regions of Mexico, some households prefer to cook certain food (tortillas) with firewood rather than using Liquified Gas irrespective of their level of income due to the taste and texture provided by fuelwood (Masera et al., 2000). According to Bhattacharyya (2011), the reason for this variation is due to differences in the level of economic development, climatic condition, technological advancement, policies, and other factors. Apart from the variation in the demand for household energy, it has been observed that most households in developing countries depend majorly on biomass fuel as their source of energy for different purposes especially cooking, heating, and lighting (Adamu et al., 2020). De Abreu et al. (2021) and Bonjour et al. (2013) argued that demand for cooking fuels is estimated to fall because of fuel switching towards modern fuels. It was reported that the percentage of households that solely use solid fuels has reduced globally, particularly from 62% in 1980 to 41% in 2010. Nevertheless, the number of persons using solid fuels among low-income households in developing countries is still increasing. In rural communities of developing countries, IEA (2013) reported that more than one billion people do not have access to electricity and over two billion people still rely on traditional biomass (fuelwood, charcoal, agricultural residues, and dung). In recent times, such traditional biomass is largely used among rural households in sub-Saharan Africa especially Nigeria. Several studies have identified income as one of the major drivers of energy choice made by households (Barnes and Floor, 1996; ESMAP, 2000; ESMAP, 2003; Elias and Victor, 2005; Onyekuru and Eboh, 2011; Wuyuan et al., 2008; Pachauri, 2004). For example, while Wuyuan et al. (2008) suggested that there is a strong correlation between an increase in household income and usage of modern fuels, Onyekuru and Eboh (2011) observed a positive correlation between household income and domestic energy demand. Babanyara and Saleh (2010) discovered that situational factors influencing the choice of fuelwood at the expense of kerosene were poverty and hikes in the price of kerosene. Song et al. (2012) reported that family size and household income were the critical factors influencing the demands of fuelwood in the USA. However, in the study of Jan et al. (2012), it was submitted that there are still other factors that determine the demand for household energy apart from income. These include household characteristics (such as age, gender, level of education, and type of employment), energy price, location, access to alternative energy sources, consumer preferences (such as food tastes and cooking practices), ownership status, per capita expenditure, sociocultural and environmental factors (Jan et al., 2012; Lee, 2013; Svoboda and Brčák, 2013; Nlom and Karimov, 2015; Eakins, 2013; Mensah and Adu, 2013; Heltberg, 2005; Leth-Petersen, 2002; Warsco, 1994; Naibbi and Healey, 2013;

Emagbetere et al., 2016; Yu et al., 2012; Kuhe and Bisu, 2019). Despite the availability of studies on factors affecting the choice of household energy, it has been observed that most of these studies were focused on urban centers while rural areas were not considered. Motivating factors that influence demand for household energy in rural areas may be different from urban centres due to the difference in socio-economic status, culture, and geographical location.

A good number of theories have been reported on household energy choice and basic factors influencing their preference. One of the theories that have been adopted in investigating household energy choice is the 'Energy Ladder Model'. Energy Ladder Model according to Heltberg (2004) is classified into three, namely; traditional fuel (such as wood, dung, agricultural residue); transitional fuel (such as kerosene and coal), and modern fuel (such as natural gas and electricity). This model emphasized more on income in explaining fuel choice across three stages linear switching process, by switching completely to a higher level of fuel as income increases (Farsi et al., 2007; Osiolo, 2009). The model assumes that low-income households tend to use traditional fuels that are cheap and available locally, but switch towards transitional fuel as their income improves. The household would further switch from transition to modern fuel as household income increases. Although energy ladder model assumed income as the only factor that makes household to switch fuel from one ladder to another, the model has neglected the interaction of other factors that characterize energy transition such as household preference, cultural factor among other. In developing countries, it has been observed that households do not switch to modern fuel but rather consume different fuels which may include a combination of solid fuels with non-solid fuels (Buba et al., 2017). Hence, rather than moving up the ladder as the income improves, households choose different fuels based on their needs, preferences, and budgets (World Bank, 2003). This leads to the model of fuel stacking (multiple fuel use), an alternative to the energy ladder model. Fuel stacking assumes multiple fuel usage instead of switching fuel as indicated by the energy ladder model (van der Kroon et al., 2013; Herington and Malakar, 2016). The fuel stacking model has been preferred by many researchers such as Ogwumike et al. (2014), Malla and Timilsina (2014), and Yonemitsu et al. (2015) who observed that household energy use pattern is not only dependent on income but is a function of several factors such as cultural, economic, social or even personal preferences (Pachauri and Spreng, 2004).

3 METHODS AND MATERIALS

3.1 Study Area

Ese-Odo local government is located in the riverine area of the southern Ondo State. It shares boundaries in the south to the large Local Government, lrele Local Government Areas in the North East, Okitipupa Local Government Area to the North West. The local government also shares boundaries with Delta and Edo State of the South East. The Local Government is within the equatorial evergreen swampy forest which is drained by important rivers: Oluwa, Urogbo, Out, Oputoru, and Opuakpatakubu, among others. which of transportation between the people and other areas. Ese-Odo Local Government was created out of the defunct Ilaje-Ese-Odo Local Government Area on 2nd January 1997, with headquarters at lgbekebo, Ondo State by General Sani Abacha's administration. The bitumen and oil-rich Local Government is made up of two major ethnic groups: the ljaw Apoi and Arogboljaw, who have similar historical antecedents. The local government has a population of 154,978 with a large landmass and water. It consists of more than one hundred and twenty towns and villages covering an area of over 1,600 km^2. Primary data were used for the study. They were collected from a cross-sectional survey of 260 households using structured questionnaires.

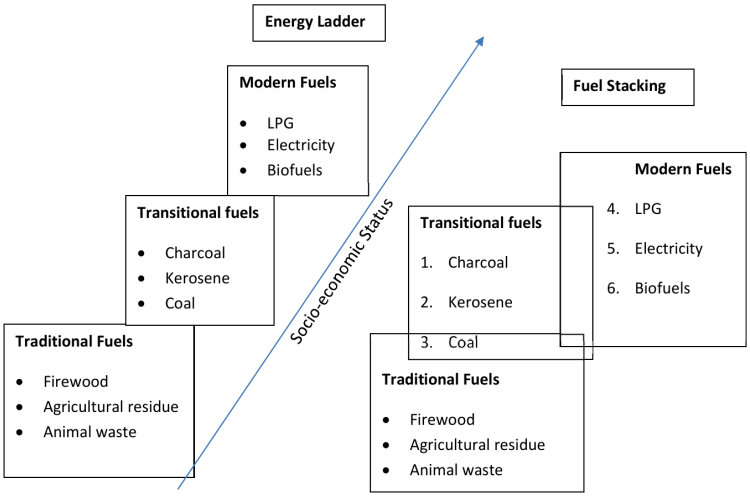

Fig. 1: Energy Transition Process (adopted from Schlag and Zuzarte, 2008)

A multi-stage sampling procedure was employed in selecting representative households. The first stage involved the division of the local government area into the ten (10) existing political wards as delineated by Independent National Electoral Commission. All the wards such as Arogbo 1, Arogbo 2, Arogbo 3, Ukparamo 1, Ukparamo 2, Apoi 1, Apoi 2, Apoi 3, Apoi 4, and Apoi 5 were selected for the study. The second stage involved the random selection of thirteen (13) households from each of these wards. This makes a total of 260 respondents that were selected for the survey.

3.2 The Econometric Model

Descriptive statistics: Descriptive analysis such as tables (frequency and percentage) and bar graph to analyse the socio-economic characteristics of the respondents in the study area. It was also used for other variables (such as land ownership, farm size, land tenure system, and types of domestic energy) of the study.

Inferential statistics: Inferential statistics such as Tobit regression and ANOVA. While Tobit regression analysis was used to estimate the factors influencing household choices for different domestic energy types, ANOVA analysis was used to explore the causal relationship between fuel price and consumption rate.

Tobit Regression Model: Tobit regression model is a statistical model which was proposed by Tobin in 1958. It is used to explain the causal relationship between a non-negative dependent variable and an independent one assuming that there is a latent variable which linearly depends on the independent variable through a parameter (beta) that determines the relationship between the independent and latent variable. Tobit model is the most common censored regression model appropriate for analysing dependent variables with upper or lower limits (Mazibuko and Antwi, 2019). Verbeek (2004) observed that Tobit regression is usually the best model when the dependent variable is continuous and has a constrained rage, represents a positive variable. This statistical model has previously been used in studies such as Olagunju and Ajiboye (2010); Hussainey and Al-Najjar (2011); Odah et al. (2017); Amore and Murtinu (2019). Tobit model answers both the question on factors influencing a decision and the factors that determine such a decision. Generally, the Tobit model uses Maximum Likelihood Estimation (MLE) method to estimate the parameters assuming normality and homoscedasticity conditions.

The model is specified as:

$$\begin{aligned} &y_i^* = \beta^t x_i + e_i, \quad i = 1, 2, \ldots, n, \\ &y_i = y_i^* \text{ if } y_i^* > 0, \text{ and } y_i = 0 \text{ otherwise,} \end{aligned} \tag{1}$$

where n is the number of the observations, y_i is the observed contingent valuation by individual i, which is also known as dependent variable (usage of different energy types such as fuelwood, charcoal, kerosene, and electricity), x_i is a vector of the independent variable. These are explanatory variables such as socio-economic characteristics, demographic characteristics, per capita expenditure, and farm size (acre), β denotes the vector of estimated parameters or coefficients, $\beta^t x_i$ is the scalar product of two vectors, and e_i is a normally and independently distributed error term with zero mean and constant variance (σ^2). It is assumed to be an implicit, stochastic index (latent variable) equal to y_i^* which is observed only when positive. According to the equation ($I_i = \beta^t x_i$), y_i^* is produced by a conventional linear regression model based on the estimates that was put forward by Odah et al. (2017).

Then, y_i, x_i is generally referred to as the independent variable and the dependent variables known for each is $i = 1, 2, \ldots, n$. In overall, it is specifically defined in this way:

$$y_i = \beta^t x_i + e_i \quad \text{if RHS} > 0 \tag{2}$$

According to Odah et al. (2017) and Amore and Murtinu (2019) were is familiar with Tobit Regression Model, proposed the dependent variable observer y_i for observers $i = 1, 2, \ldots, n$ and this could be arrived at based on the following:

$$y_i = \max\left(y_i^*, 0\right) \tag{3}$$

If y_i and x_i are not noted when $y_i^* \leq 0$ then perhaps the model is recognized as truncated regression model, in other phrase, the data y_i^* and x_i are noted only when $y_i^* \leq \gamma$. The coefficients was arrived at through Tobit model using STATA computer software (STATA 15) (Mazibuko and Antwi, 2019; Odah et al., 2017).

The study uses a Tobit regression analysis to estimate the factors influencing household choices for different domestic energy types. The selection of Tobit regression analysis was determined due to zero expenditure recorded by some households on the domestic energy types. Using Tobit regression analysis in this study was also supported by Adepoju et al. (2012) who inserted that Tobit regression is used when there is a record of zero expenditure by some households on their energy types. It was further established by Adepoju et al. (2012) that zero expenditure makes parameter computation from conventional Ordinary Least Square (OLS) regression to be inefficient. The Tobit model was implemented with Maximum Likelihood Estimation (MLE) and censoring at the lowest (zero) expenditure level. Tobit regression analyses were carried out for the four types of domestic energy identified in the study area, namely firewood, charcoal, kerosene, and electricity. For this study, the Tobit regression model is expressed as follows in functional forms:

$$Y_i = f\left(X_1, X_2, X_3, X_4, X_5, X_6, X_7\right)$$

The variables in the model were presented below:

- Y_i = Usage of different energy types (such as fuelwood, charcoal, kerosene, and electricity)
- X_1 = Age of the respondents
- X_2 = Level of education
- X_3 = Monthly income
- X_4 = Gender
- X_5 = Marital Status
- X_6 = Per capita expenditure
- X_7 = Household size
- X_8 = Farm size
- X_9 = Occupation of the household heads

Choice of ANOVA (analysis of variance). In the process of exploring the causal relationship between variables, ANOVA can use be used to compare the means of two or more groups on the dependent variable (Green and Salkind, 2010). It is used to determine whether there are any statistically significant differences between the means of two or more independent (unrelated) groups. ANOVA is used for understanding whether different levels of factors have an impact on the responses, in a factor-response model. The assumption for ANOVA is that (i) independent random sample. The sample must contain observations independently chosen from each other. In order words, sampling one observation must not influence the sampling of another observation. (ii) The numerical variable

must be normally distributed in each group. (iii) The residuals must be normally distributed. (iv) All groups must not suffer from heterogeneity. The variance must be equal in all groups included in the large samples (Hair et al., 2006). ANOVA analysis was used to explore the causal relationship between fuel price and consumption rate (Bisu et al., 2016). It was used to show the level of significance between the rate of consumption and the price of each fuel type.

4 RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of the Respondents

Tab. 1 shows the socio-economic attributes of the respondents in the study area. The result reveals that 66.5% of the household heads were males while 33.3% were female. It could be inferred that there were more men than women household heads. This is probably due to their role and responsibility in the family especially in the provision of domestic energy for indoor cooking, heating, and lighting. It was also observed that the majority of the respondents (71.5%) were between 31 and 60 years of age, 3.5% were above 60 years old, while 25.0% were below 30 years. This shows that there was more active population compared to other age groups in the study area. The proportional representation of more active population is an indication that demand for domestic energy might high in rural communities. Moreover, 29.2% of the households had between 1 to 5 members, 68.5% had between 6 and 10 members, while 2.3% of the respondents' household size had more than 10 members. This means that more than half of the household heads had 6 to 10 members that depend on them. This could probably increase the demand for domestic energy. The result of this study corroborates the findings of Adepoju et al. (2012) who observed that most of the household heads in traditional society have more than 6 family members. Findings in Tab. 1 show that most of the respondents (52.3%) had no formal education, 33.1% had primary education, 12.7% had secondary education while only 1.9% had tertiary education. It could be deduced that more than half of the respondents were not formally educated and their level of education can influence the type of domestic energy that is used for cooking, heating, and lighting.

Tab. 1: Distribution of socio-economic characteristics of the respondents

Socio-economic characteristics	Frequency	Percentage
Gender		
Male	173	66.5
Female	87	33.5
Age		
Below 30	65	25.0
31–60	186	71.5
Above 60	9	3.5
Household Size		
1–5	76	29.2
6–10	178	68.5
Above 10	6	2.3
Education		
No formal education	136	52.3
Primary education	86	33.1
Secondary education	33	12.7
Tertiary education	5	1.9
Marital Status		
Married	184	70.8
Divorced	27	10.4
Widowed	17	6.5
Separated	32	12.3
Occupation		
Farming	195	75.0
Artisan	18	6.9
Trading	39	15.0
Salary earners	8	3.1
Monthly Income (₦)		
Below ₦18,000 ($47.1)	78	30.0
₦18,001–55,000 ($47.1–143.9)	174	67.0
₦55,001–74,000 ($143.9–193.7)	4	1.5
₦74,001 ($193.7) above	4	1.5

Further analysis in Tab. 1 also shows that 70.8% of the respondents were married, 10.1% were divorced, 6.5% were widowed, while 12.3% were separated. This is an indication that the majority of the respondents were married as more importance was attached to marriage and singleness. The proportional representation of those that are married may influence the level of usage of domestic energy compared to those that are single, divorced, or widowed. Moreover, 75.0% of the respondents were farmers, 6.9% were artisan, 15.0% were into trading, while 3.1% were salary earners. It could be inferred that the majority of the household heads had farming as their primary occupation. This finding truly reflects the common occupation of the study area. The table also shows that 97.0% of the respondents earned below ₦55,000 ($143.9) while only about 3.0% earned above ₦55,001 ($143.9) per month with an average income of ₦26,896.15 ($70.4). (1 USD = ₦382 as at when data was collected). It suggests that the majority of the respondents earned below the Nigerian minimum wage despite the fact that they are in the rural area. The monthly income of the household heads might influence the type of energy usage as households with higher income tend to use clean and safe energy while low-income households tend to use energy that might have a negative effect on human health and the environment.

4.2 Land Ownership, Farm Size, and Land Tenure System

Analysis of land ownership, farm size, and land tenure system is presented in Tab. 2. The findings confirmed that 74.6% of the respondents owned a farm, while 25.4% did not. This result corroborates earlier findings that most of the household heads were engaged in farming activities as either primary occupation. The table also reveals that 25.4% of the respondents had no farmland, 68.8% had less than 2 acres, while 5.8% had more than 2 acres. It can be observed that most of the respondents had less than 2 acres of land, an indication that they are small landholders. Analysis in Tab. 2 shows that the predominant land tenure system was through freehold system (50.8%), followed by leasehold system (23.8%) and communal system (2.3%) while others that were unidentified were accounted for 3.1%. This implied that the freehold system especially through inheritance was generally practiced in the study area.

Tab. 2: Land ownership, farm size, and land tenure system

Description	Frequency	Percentage
Own Land		
Yes	194	74.6
No	66	25.4
Farm Size		
None	66	25.4
< 1 acre	95	36.5
1–2 acres	84	32.3
> 2 acres	15	5.8
Land Tenure System		
Communal	58	22.3
Freehold	132	50.8
Leasehold/tenants	62	23.8
Others	8	3.1

4.3 Types of Domestic Energy and Pattern of Usage among Rural Households

In order to examine the types of energy sources in the study area, four predominant types of domestic energy can be identified. These include firewood, charcoal, kerosene, and electricity. These types of domestic energy were adopted in this study. Three major uses were also observed in the study area, namely cooking, heating, and lighting. Respondents were asked to choose their common sources of energy with reference to what the energy is been used for. Findings on the types of energy and pattern of usage were presented in Tab. 3. The table revealed that 48.1% of the respondents used kerosene for cooking, 40.3% used it for heating while 37.7% used it for lighting. It can be inferred that the majority of the respondents used kerosene for cooking. Also, 38.5% of the respondents used fuelwood for cooking, 33.3% used it for heating and 5.7% used it for lighting. Fuelwood was commonly used for heating especially at night.

Tab. 3: Sources of energy and modes of usage

Fuel types	Cooking		Heating		Lighting		Total	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Fuel wood	52	38.5	24	33.3	3	5.7	84	32.2
Charcoal	12	8.9	10	13.9	1	1.9	23	8.8
Kerosene	65	48.1	29	40.3	20	37.7	109	41.9
Electricity	6	4.4	9	12.5	29	54.7	44	16.9

About 8.9% of the respondents used charcoal for cooking, 13.9% used it for heating while 1.9% used it for lighting. Electricity was commonly used for lighting (54.7%), other ways of usage were for cooking (4.4%) and lighting (12.5%). The study also reveals that households spent an average of ₦176.07 and ₦138.61 respectively on fuelwood and charcoal while ₦843.30 and ₦1,209.48 were the average amounts spent on kerosene and electricity respectively per month. A general summary of this finding was that charcoal was the least used especially for lighting while electricity was the least used for cooking. This could probably be as a result of the high cost of electricity bill which may quite be expensive on the part of the respondents and also due to its erratic supply. This finding agrees with Bisu et al. (2016), Mekonnen and Köhlin (2008).

4.4 Household Per Capita Expenditure and Energy Ladder Model

As earlier explained 'energy ladder model' assumes that households tend to switch their fuel usage from biofuel to advance energy sources as income improves or increases. Nevertheless, this study used per capita expenditure instead of household income (Ogwumike et al., 2014). Based on the energy ladder model, it is expected that households with a higher per capita expenditure category would use electricity as their main fuel while middle-income earners would consider the use of kerosene. The low-income households would use charcoal and firewood as their main fuel.

Fig. 2 reveals the pattern of energy usage among the households in different per capita expenditure groups. While the horizontal axis shows the per capita expenditure categories in Naira, the vertical axis shows the percentage of energy usage across the types. The analysis in Fig. 2 shows that usage of fuelwood and charcoal as the main fuel decreases as per capita expenditure increases among the households. While the proportion of households that were using kerosene as their main fuel increase as per capita expenditure improves, the proportion of those that were using electricity also rose as per capita expenditure moves higher. This pattern of energy demand is in agreement with the transition stage of the energy ladder model, whereby low-income households used traditional biomass, middle-income households used transition fuel while high-income households used advanced or modern fuel. It was further observed that some fuels were not abandoned totally. While some households switched from one type of fuel to another, others adopted energy sacking (multiple use of fuel). Instead of switching lower energy types as expenditure increases, households prefer to stack different forms of energy. This is in agreement with household preferences. Depending on different reasons, some households at higher per capita expenditure group were still able to consider fuelwood energy source. This is an indication of multiple fuel usage (fuel stacking). Multiple usages of different types of fuel among high per capita expenditure group could be explained by different factors other than income as established by Jan et al. (2012), Pachauri and Spreng (2004), and Démurger and Fournier (2011).

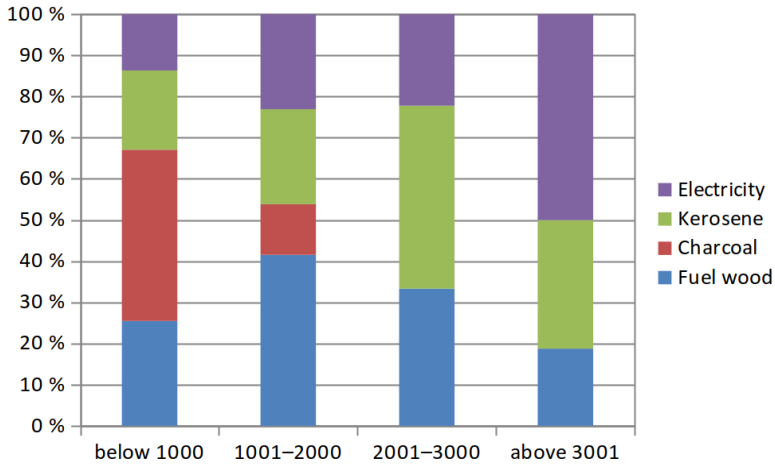

Fig. 2: Energy usage and per capita expenditure categories

4.5 Factors Affecting Household Choices of Domestic Energy Usage

Tobit regression analysis in Tab. 4–7 was carried out to determine the factors that influence household choices of domestic energy in the study area. Four regression models were estimated separately for the types of domestic energy, namely; fuelwood, charcoal, kerosene, and electricity. Explanatory variables that were considered in each of the models included age, level of education, monthly income, gender, marital status, farm size, per capita expenditure, household size, and occupation of the household heads.

4.5.1 Determinants of Fuel Wood

The result of Tobit regression model as shown in Tab. 4 was used to test the determinants of fuelwood. The variance inflation factor (VIF) was used to determine the multicollinearity between the explanatory variables. As a rule of thumb, multicollinearity is a potential problem when VIF is greater than 4; and, a serious problem when it is greater than 10 (Oke et al., 2019). The output in Tab. 4 below shows that VIF values were less than 4. This indicates that the model was free from collinearity. The diagnostic statistics in Tobit regression analysis in Tab. 4 reveals that the chi-square value (LR-statistics) for the model is significant at 1% and 5% level which means that the independent variables jointly influence respondents' likelihood of using fuelwood. The Pseudo R-squared indicates that 57.3% of the variance was explained by the independent variables. The result from the study showed that the coefficients of most of the variables hypothesized to influence the household choices of domestic energy have the expected signs. The signs show the direction of change in the likelihood of using fuelwood over other sources of domestic energy. While a positive sign shows an increase in the probability of usage, a negative sign explains the converse. The results showed that out of the 9 variables that were included in the model, the coefficients of six variables were statistically significant at 1% and 5% in influencing household choices of domestic energy.

The results of Tobit regression model shows that gender ($t = 1.99$; $p < 0.05$), household size ($t = 0.82$; $p < 0.05$), monthly income ($t = -0.26$; $p < 0.05$) and farm size ($t = 1.44$; $p < 0.05$) were significant at 5% level while occupation ($t = 4.50$; $p < 0.01$) and per capita expenditure ($t = -4.64$; $p < 0.01$) were significant at 1% level. The result means that probability of using fuel wood varied between male and female household head, as female household head tend to use fuel wood than male household head. Household size is positively signed which means that large household has higher probability of using fuel wood than small household size.

Tab. 4: Tobit regression results of factors influencing demand for fuelwood

Fuelwood	Coefficient	Standard error	t-value	95% conf. interval		Collinearity Statistics Tolerance	VIF
Age	−0.0040661	0.0064517	−0.63	−0.0167725	0.0086403	0.648	1.542
Gender	−0.2147976	0.1080795	1.99**	−0.4276559	−0.0019393	0.885	1.130
Marital status	−0.0115306	0.0616727	−0.19	−0.1329925	0.1099313	0.558	1.793
Household size	0.0181806	0.0221323	0.82**	−0.0254081	0.0617692	0.826	1.211
Income	1.01e−06	3.90e−06	−0.26**	−6.67e−06	8.68e−06	0.756	1.323
Occupation	0.0134072	0.0484389	4.50***	−0.0819913	0.1088056	0.702	1.424
Education	0.1049038	0.0662785	1.58	−0.0256291	0.2354367	0.815	1.227
Farm size	−0.1326777	0.0920570	−1.44**	−0.3139803	0.0486248	0.812	1.232
Per capita expenditure	−0.0003057	0.0000659	−4.64***	−0.0004356	−0.0001759	0.980	1.021
Constant	1.2099410	0.3182054	3.80	0.5832485	1.8366340		

Notes: *** Significant at 1%; ** Significant at 5%; Number of observations = 260; LR chi-square (9) = 113.45; Prob > χ^2 = 0.0002; Pseudo R^2 = 0.5730; Log likehood = −258.57471.

Household income is negatively signed which implies that as household income decreases, the demand for fuelwood increases. This means that an increase in respondents' income will decrease the likelihood of using fuelwood. This is probably because higher-income earners tend to go for safe and clean energy either for cooking or lighting.

Farm size and occupation are expected to influence the probability of using fuelwood. This is because the majority of the respondents were farmers and fuelwood used in cooking was gotten from their farm in the study area. The negative sign of per capita expenditure implies that lesser expenses incurred on fuelwood per month increase demand for fuelwood. This suggests that fuelwood is an 'inferior' energy source among households. This result is expected as fuelwood is predominantly used for cooking among rural dwellers. This study corroborates the findings of Babanyara and Saleh (2010). Other variables such as age, marital status, and education were not statistically significant in determining the demand for fuelwood. This implied that the age of the respondents, marital status, and level of educational attainment does not determine the household choice for fuelwood.

4.5.2 Determinants of Charcoal

The result of Tobit regression model as shown in Tab. 5 was used to test the determinants of charcoal. The variance inflation factor (VIF) was used to determine the multicollinearity between the explanatory variables. The VIF values were less than 4, which indicates that the model was free from collinearity. The diagnostic statistics of Tobit regression analysis in Tab. 5 reveals that the chi-square value (LR-statistics) for the model is significant at 1% and 5% level which means that the independent variables jointly influence respondents' probability of using charcoal. The Pseudo R-squared indicates that 72.2% of the variance was explained by the explanatory variables. The result showed that the coefficients of most of the variables hypothesized to influence the household choices of domestic energy have the expected signs. The results showed that out of the 9 variables that were included in the model, the coefficients of six variables were statistically significant at 1% and 5% in influencing household choices of domestic energy.

The result shows that gender ($t = 2.99$; $p < 0.01$), occupation ($t = 2.61$; $p < 0.01$), and per capita expenditure ($t = -4.78$; $p < 0.01$) were significant at 1% level while household size ($t = 2.55$; $p < 0.05$), level of education ($t = -0.55$; $p < 0.05$) and age ($t = -0.48$; $p < 0.05$) were significant at 5% level.

The positive sign of gender shows that tendency to use charcoal varied between male and female household heads. The choice of charcoal as the source of energy is determined

Tab. 5: Tobit regression results of factors influencing demand for charcoal

Charcoal	Coefficient	Standard error	t-value	95% conf. interval		Collinearity Statistics Tolerance	VIF
Age	0.0027059	0.0055792	−0.48**	−0.0082821	0.0136939	0.648	1.542
Gender	0.2819582	0.0944281	2.99**	0.0959858	0.4679307	0.885	1.130
Marital status	0.0202660	0.0532926	0.38	−0.0846917	0.1252237	0.554	1.805
Household size	0.0184805	0.0189642	2.55**	−0.0188689	0.0558298	0.825	1.212
Income	−3.16e−07	3.41e−06	−0.09	−7.04e−06	6.41e−06	0.756	1.323
Occupation	−0.1155311	0.0442686	2.61***	−0.2027164	−0.0283458	0.702	1.424
Education	−0.0321171	0.0586623	−0.55**	−0.1476501	0.0834160	0.815	1.227
Farm size	−0.1368407	0.0788789	−1.73	−0.2921897	0.0185082	0.812	1.232
Per capita expenditure	0.0002541	0.0000532	−4.78***	0.0001493	0.0003588	0.980	1.021
Constant	0.0979354	0.2819491	0.35	−0.4573520	0.6532229		

Notes: *** Significant at 1%; ** Significant at 5%; Number of observations = 260; LR chi-square (9) = 145.55; Prob > χ^2 = 0.0000; Pseudo R^2 = 0.7220; Log likehood = −247.61674.

by occupation. The reason for this is not farfetched from the fact that the majority of the respondents are farmers. The probability of using charcoal is therefore high among farmer households than other households that are not farmers. Average monthly expenditure on the usage of charcoal is negatively signed. This means that lesser expenses on the use of charcoal increase respondents' demand for charcoal and higher expenses on charcoal reduce the usage of charcoal. The negative sign of the level of education implies that lesser-educated households demand for more charcoal than households with more educated people. Moreover, the positive sign of household size reveals that larger household size tends to demand for more charcoal than smaller households.

Negative significance of respondents' age shows that demand for charcoal decreases as households head get older. Information from field observation in the study area reveals that charcoal is very scarce in the villages and the process involved in igniting charcoal fully is stressful. This may discourage the use of charcoal among older household heads.

Other variables such as marital status, income, and farm size were not statistically significant in determining the demand for charcoal. This implied that the marital status of the respondents, monthly income, and farm size does not influence the household choice for charcoal.

4.5.3 Determinants of Kerosene

The result of Tobit regression model as shown in Tab. 6 was used to test the determinants of Kerosene. The variance inflation factor (VIF) was used to determine the multicollinearity between the explanatory variables. The VIF values of the explanatory variables were less than 4. This indicates that the model was free from collinearity. The diagnostic statistics of Tobit regression analysis in Tab. 6 reveals that the chi-square value (LR-statistics) for the model is significant at 1% and 5% level which means that the independent variables jointly influence respondents' probability of using kerosene. The Pseudo R-squared indicates that 82.3% of the variance was explained by the explanatory variables. The results from the study showed that the coefficients of most of the variables hypothesized to influence household demand for kerosene have the expected signs. The results in Tab. 6 show that excluding the constant term, out of the 9 variables that were included in the model, the coefficients of five variables were statistically significant at 1% and 5% in influencing household demand for kerosene.

The result shows that income ($t = -0.38$; $p < 0.01$) was significant at 1% level while marital status ($t = 2.26$; $p < 0.05$), level of education ($t = 0.61$; $p < 0.05$) and age ($t = 1.66$; $p < 0.05$), per capita expenditure ($t = 2.77$; $p < 0.05$) were significant at 5% level.

Tab. 6: Tobit regression results of factors influencing demand for kerosene

Kerosene	Coefficient	Standard error	t-value	95% conf. interval		Collinearity Statistics Tolerance	VIF
Age	0.0078956	0.0047673	1.66**	−0.0014934	0.0172846	0.648	1.542
Gender	0.4254175	0.0807006	5.27	0.2664808	0.5843542	0.885	1.130
Marital status	−0.1039694	0.0459260	2.26**	−0.1944189	−0.0135199	0.554	1.805
Household size	−0.0105441	0.0161632	−0.65	−0.0423768	0.0212886	0.825	1.212
Income	−1.12e−06	2.95e−06	0.38***	−6.93e−06	4.68e−06	0.756	1.323
Occupation	0.0366367	0.0358896	1.02	−0.0340465	0.1073199	0.702	1.424
Education	−0.0305323	0.0497021	0.61**	−0.1284187	0.0673541	0.815	1.227
Farm size	0.1852857	0.0670048	2.77	0.0533223	0.3172491	0.812	1.232
Per capita expenditure	0.0001130	0.0000458	2.46**	0.0000227	0.0002033	0.980	1.021
Constant	−0.3967158	0.2431611	−1.63	−0.8756118	0.0821803		

Notes: *** Significant at 1%; ** Significant at 5%; Number of observations = 260; LR chi-square (9) = 156.55; Prob > χ^2 = 0.0000; Pseudo R^2 = 0.8235; Log likehood = −228.69065.

The implication of these is that household heads with an increase in monthly income tend to demand for more kerosene (for cooking and lightening) than household heads with lesser monthly income. Furthermore, changes in the marital status of respondents, from single to married tend to affect the demand for kerosene. Moreover, the positive sign of the level of education shows that educated household heads tend to demand for more kerosene than uneducated ones. It was further revealed that age of the respondents is positively significant. This means that as household heads grow older, their demand for kerosene increases. This could probably be due to fewer rigours and ease of operating kerosene stoves.

Monthly expenditure on kerosene is positively signed and statistically significant. This shows that household heads tend to spend more on kerosene for cooking and lighting. The reason for this is not farfetched from the fact that kerosene constitutes the major source of energy for cooking and lighting in rural communities of Nigeria, except when it is scarce and expensive. Variables such as gender, household size, occupation, and farm size were not statistically significant in determining the demand for kerosene. This implied that gender, household size, occupation, and farm size does not influence the household choice for kerosene.

4.5.4 Determinants of Electricity

The result of Tobit regression model as shown in Tab. 7 was used to test the determinants of electricity. The variance inflation factor (VIF) was used to determine the multicollinearity between the explanatory variables. The VIF values were less than 4. This means that there is no multicollinearity between the variables. The diagnostic statistics of Tobit regression analysis in Tab. 7 reveal that the chi-square value (LR-statistics) for the model is significant at 1% level which means that the independent variables jointly influence respondents' probability of using Electricity. The Pseudo R-squared indicates that 69.9% of the variance was explained by the explanatory variables. The results in Tab. 7 show that excluding the constant term, out of the eight. The results from the study showed that the coefficients of most of the variables hypothesized to influence household demand for electricity have the expected signs. The results in Tab. 6 show that excluding the constant term, out of the 9 variables that were included in the model, the coefficients of 3 variables were statistically significant at 1% in influencing household demand for electricity.

The result shows that income ($t = 4.54$; $p < 0.01$) and per capita expenditure ($t = 0.63$; $p < 0.01$) were negatively significant while occupation ($t = 3.36$; $p < 0.01$) was positively significant at 1% level. The implication of

Tab. 7: Tobit regression results of factors influencing demand for electricity

Electricity	Coefficient	Standard error	t-value	95% conf. interval		Collinearity Statistics Tolerance	VIF
Age	0.0041009	0.0075802	0.54	−0.0108281	0.0190298	0.648	1.542
Gender	0.4336050	0.1289842	0.09	0.1795758	0.6876343	0.885	1.130
Marital status	−0.1737767	0.0765924	−2.27	−0.3246223	−0.0229310	0.554	1.805
Household size	−0.0232719	0.0268146	−0.87	−0.0760822	0.0295384	0.825	1.212
Income	4.46e−06	4.62e−06	4.54***	−4.63e−06	0.0000136	0.756	1.323
Occupation	0.0052941	0.0594233	3.36***	−0.1117378	0.1223260	0.702	1.424
Education	−0.0684586	0.0791803	−0.86	−0.2244010	0.0874837	0.815	1.227
Farm size	0.4852631	0.1069254	0.97	0.2746779	0.6958484	0.812	1.232
Per capita expenditure	0.0000456	0.0000722	−0.63***	−0.0000967	0.0001879	0.980	1.021
Constant	−0.8495936	0.4050468	−2.10	−1.6473170	−0.0518701		

Notes: *** Significant at 1%; ** Significant at 5%; Number of observations = 260; LR chi-square (9) = 137.87; Prob > χ^2 = 0.0000; Pseudo R^2 = 0.6993; Log likehood = −254.4022.

this is that increase in the monthly income of the respondents will increase the demand for electricity for cooking and lighting while lower-income reduce the electricity demand. Also, an increase in actual expenditure on electricity may not really reflect demand due to the erratic nature of power supply in rural communities of Nigeria. However, it is expected that usage of electricity either for cooking or lighting will increase monthly electricity bills. Furthermore, household heads with better jobs could afford electricity as their major source of energy for cooking and lighting compared with those with lesser pay that could not afford it. Variables such as age, marital status, gender, household size, education, and farm size were not statistically significant in determining the demand for electricity. This implied that age, marital status, gender, household size, education, and farm size does not influence the household choice for electricity.

4.6 Relationship between Fuel Price and Consumption Rate

From the summary of F-statistics ANOVA (Analysis of Variance) presented in Tab. 8, results revealed that fuel price of fuelwood ($F = 6.159$; $p < 0.05$) and charcoal ($F = 8.827$; $p < 0.05$) is significantly related with consumption. This finding is similar to the results of Bisu et al. (2016), Lee (2013) and Oyedepo (2012) that lower prices of fuelwood and charcoal tend to increase consumption rate in developing countries especially among poorer households. On the other hand, increase in the rate of consumption is not significantly related to the price of kerosene ($F = 2.427$; $p > 0.05$) and electricity ($F = 1.759$; $p > 0.05$). This means that the consumption of kerosene and electricity is not a function of their prices. This is probably due to the recent increase in the price of kerosene and electricity charges which has reduced the consumption rate of kerosene and electricity among households in the study area. As a result of this, most of the residents in the study area switched to alternative means of domestic energy sources. This finding does not agree with the submission of Bisu et al. (2016) concerning the significant relationship between fuel price and the consumption rate of kerosene. The reason is probably due to an increase in the unit price of kerosene in the country. Nevertheless, this study agrees with Bisu et al. (2016) who observed no significant relationship between fuel price and consumption rate of electricity. It could be inferred that the consumption of kerosene and electricity is independent on price while the consumption of fuelwood and charcoal is dependent on price.

Tab. 8: Relationship between consumption rate and fuel price

		Sum of squares	df	Mean square	F	Sig.
Fuelwood	Between Groups	76849.794	3	25616.598	6.159	$p < 0.05$
	Within Groups	1064768.668	256	4159.253		
	Total	1141618.462	259			
Charcoal	Between Groups	84823.250	3	28274.417	8.827	$p < 0.05$
	Within Groups	820004.054	256	3203.141		
	Total	904827.304	259			
Kerosene	Between Groups	559959.690	3	186653.230	2.427	$p > 0.05$
	Within Groups	19685185.276	256	76895.255		
	Total	20245144.965	259			
Electricity	Between Groups	805318.060	3	268439.353	1.759	$p > 0.05$
	Within Groups	39064860.402	256	152597.111		
	Total	39870178.462	259			

4.7 Discussion

The above results reflected the existing situation among rural households in the study area. It could be observed that fuelwood, charcoal, and kerosene were dominantly used for cooking and heating while electricity was majorly used for lighting. Compared to the result of other studies (Bisu et al., 2016; Ogwumike et al., 2014), there is little improvement in the use of kerosene for cooking in the study area. Lack of access to electricity has caused no improvement in the use of electricity for cooking. Increase in the use of fuelwood and charcoal has resulted in deforestation in most parts of the study area. It has also contributed to indoor pollution. Overdependent on fuelwood and charcoal as noted by Adepoju et al. (2012), Nnaji et al. (2012), and Onyekuru et al. (2020) is not environmentally friendly and has a major effect on human health. The heavy use of wood and charcoal may be a result of low monthly income (see Tab. 3) as most of the rural households were left with no alternative than to source for cheap energy locally. It may also be a result of inconsistency in the supply of electricity. Little improvement in the use of kerosene for cooking and heating was as a result of its availability through investment in infrastructure such as filling station. However, the hike in price of kerosene has caused the majority not to rely heavily on the usage of kerosene for cooking and heating as well as lighting.

The results of the model further show that income is not the major factor influencing the use of kerosene, fuelwood, charcoal, and electricity, other factors were also affecting the choice of energy. It could be inferred that different domestic energy sources have their peculiarity with regard to the associated determinants. For example, factors such as gender, household size, income, occupation, farm size, and per capita expenditure were significant in influencing the use of fuelwood; age, gender, household size, occupation, education, and per capita expenditure for charcoal, while age, marital status, income, education and per capita expenditure were significant determinants in the use of kerosene. Also, income, occupation, and per capita expenditure were the factors influencing the use of electricity among rural households in the study area. The result of this model, therefore, negates the assumption of the energy ladder model which states that households tend to improve in the use of energy for cooking, heating & lighting as income increases. This study agrees with the assumption of fuel stacking model on the use of energy.

The results of this study corroborated the finding of Jan et al. (2012) who, in a study to investigate determinants of rural household energy choices, found out that income is not the only determinant of transition from traditional to more convenient form of energy, other factors also account for household energy choice. The

result is in agreement with the findings of Adamu et al. (2020) who examined household energy consumption and discovered that energy ladder theory only provides a limited view of reality in households. Beyond income, there are other closely interrelated socio-economic factors that drive household energy transition. This study, therefore, presents the need for further investigation into other factors which influence the choice of energy consumption in urban and rural area in one study. This could also be replicated in peri-urban of major cities of Nigeria.

5 CONCLUSION

This study has assessed factors influencing household energy demand in Ese-Odo Local government area of Ondo State, Nigeria. The study specifically investigates household energy use and the determinants of energy usage among rural households. The study employed descriptive statistics, ANOVA, and Tobit regression model to analyze data collected from 260 randomly sampled household heads in the study area. The results revealed that 66.5% of the household heads were males while 33.3% were female. Also, a larger proportion of the household heads (97.0%) earned earn below ₦55,000 (143.9$) while only 3.0% earned above ₦55,001 (143.9$) per month with an average income of ₦26,896.15 (70.4$). The study established that the majority of the respondents (71.5%) were between 31 – 60 years of age. The common usage of fuelwood was for cooking (38.5%), heating (33.3%), and lighting (5.7%) while charcoal was used for cooking (8.9%), heating (13.9%), and lighting (1.9%). Kerosene was widely used for cooking (48.1%), lighting (37.7%), and heating (40.3%). With reference to the determinants of household energy for lighting, heating, and cooking, the results of Tobit regression revealed that gender, household size, income, occupation, farm size, and per capita expenditure were significant in influencing the use of fuelwood; age, gender, household size, occupation, education and per capita expenditure for charcoal, while age, marital status, income, education and per capita expenditure were significant determinants in the use of kerosene. Also, income, occupation, and per capita expenditure were the factors influencing the use of electricity among rural households in the study area. It could be inferred that household income is not the only factor affecting household energy choices, other factors also contribute to it. This however negates the assumption of the energy ladder model on the income, being the central driver of energy choice. This study, therefore, agrees with Jan et al. (2012) and Adamu et al. (2020) that income is not the most important variable affecting the energy choice of households.

The study revealed that per capita expenditure on kerosene and electricity is high when compared with fuelwood and charcoal. The study also revealed that there is a relationship between the rate of consumption and fuel price of firewood and charcoal while there is no significant relationship between the rate of consumption and fuel price of kerosene and electricity. The study discovered that lesser fuel prices and per capita expenditure on firewood and charcoal were the major reasons that make households to prefer firewood and charcoal over other energy types in the study area. However, the observation of Adepoju et al. (2012) is that over-dependence on the usage of biofuel (such as fuelwood and charcoal) has contributed to the deforestation of rural communities and has the tendency to increase indoor environmental pollution. In order for rural communities of Nigeria to access 2030 SDGs more easily, there is need for the government or stakeholders to formulate and implement policies that will ensure easy access to safe, reliable, and clean modern energy services

The study, therefore, encourages the government to put in place sustainable modern energy that is reliable, affordable, and convenient for everyone with fewer implications to the health of the individual and the environment. The study concluded that apart from income, other household variables were significant in

determining energy usage. The study, therefore, recommended that government and stakeholders should develop policies that will promote the use of modern energy sources that is safe, reliable, and clean in order to reduce the negative environmental consequences while also enhancing human life quality. Efforts should also be made by the government or stakeholders in providing incentives for households that will encourage the consumption of sustainable energy sources. This will not only improve energy consumption in rural areas but will also make rural communities to access 2030 SDGs more easily.

6 REFERENCES

Adamu, M. B., Adamu, H., Ade, S. M. and Akeh, G. I. 2020. Household Energy Consumption in Nigeria: A Review on the Applicability of the Energy Ladder Model. *Journal of Applied Science, Environment and Management*, 24 (2), 237–244. DOI: 10.4314/jasem.v24i2.7.

Adepoju, A. O., Oyekale, A. S. and Aromolaran, O. 2012. Rural Households' Demand for Domestic Energy in Odeda Local Government Area (LGA) of Ogun State, Nigeria. *Journal of Human Ecology*, 40 (2), 115–123. DOI: 10.1080/09709274.2012.11906529.

Adetayo, O. D., Adeyinka, S. A. and Agbabiaka, H. I. 2020. Domestic Energy Usage and Its' Health Implication on Residents of the Ese-Odo and Okitipupa Local Government Areas of Ondo state, Nigeria. *Environmental Quality Management*, 29 (3), 51–61. DOI: 10.1002/tqem.21681.

Adetunji, M. O., Adesiyan, I. O. and Sanusi, W. A. 2007. Household Energy Consumption Pattern in Osogbo Local Government Area of Osun State. *Pakistan Journal of Social Sciences*, 4 (1), 9–13.

Amore, M. D. and Murtinu, S. 2019. Tobit Models in Strategy Research: Critical Issues and Applications. *Global Strategy Journal*, 1–25. DOI: 10.1002/gsj.1363.

Babanyara, Y. Y. and Saleh, U. F. 2010. Urbanization and the Choice of Fuelwood as a Source of Energy in Nigeria. *Journal of Humanities Ecology*, 31 (1), 19–26. DOI: 10.1080/09709274.2010.11906293.

Barnes, D. F. and Floor, W. M. 1996. Rural Energy in Developing Countries: A Challenge for Economic Development. *Annual Review of Energy and the Environment*, 21, 497–530. DOI: 10.1146/annurev.energy.21.1.497.

Bhattacharyya, S. C. 2011. *Energy Economics: Concepts, Issues, Markets and Governance.* London: Springer Verlag.

Bisu, D. Y., Kuhe, A. and Iortyer, H. A. 2016. Urban Household Cooking Energy Choice: An Example of Bauchi Metropolis, Nigeria. *Energy, Sustainability and Society*, 6 (1), 15. DOI: 10.1186/s13705-016-0080-1.

Bonjour, S., Adair-Rohani, H., Wolf, J., Bruce, N. G., Mehta, S., Prüss-Ustün, A., Lahiff, M., Rehfuess, E. A., Mishra, V. and Smith, K. R. 2013. Solid Fuel Use for Household Cooking: Country and Regional Estimates for 1980–2010. *Environmental Health Perspectives*, 121 (7), 784-790. DOI: 10.1289/ehp.1205987.

Buba, A., Abdu, M., Adamu, I., Jibir, A. and Usman, Y. I. 2017. Socio-Economic Determinants of Households Fuel Consumption in Nigeria. *International Journal of Research – Granthaalayah*, 5 (10), 348–360. DOI: 10.5281/zenodo.1046324.

Chukwu, P. U., Ibrahim, I. U., Ojosu, J. O. and Iortyer, H. A. 2014. Sustainable Energy Future for Nigeria: The Role of Engineers. *Journal of Sustainable Development Studies*, 6 (2), 242–259.

de Abreu, M. W., Ferreira, D. V., Pereira, A. O., Cabral, J. and Cohen, C. 2021. Household Energy Consumption Behaviors in Developing Countries: A Structural Decomposition Analysis for Brazil. *Energy for Sustainable Development*, 62, 1–15. DOI: 10.1016/j.esd.2021.03.001.

Démurger, S. and Fournier, M. 2011. Poverty and Firewood Consumption: A Case Study of Rural Households in Northern China. *China Economic Review*, 22 (4), 512–523. DOI: 10.1016/j.chieco.2010.09.009.

Eakins, J. 2013. *An Analysis of the Determinants of Household Energy Expenditures: Empirical Evidence from the Irish Household Budget Survey.* PhD thesis, University of Surrey, UK.

Edwards, J. H. and Langpap, C. 2008. *Fuel Choice, Indoor Air Pollution, and Children's Health.* Working Paper No. 0803. Tulane University.

Egaña del Sol, P. A. and Flanders, S. 2020. Platform Economy and Sustainable Energy. In Leal Filho, W., Azul, A., Brandli, L., Özuyar, P. and Wall, T. (eds.). *Affordable and Clean Energy.* Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. DOI: 10.1007/978-3-319-71057-0_36-1.

Elias, R. J. and Victor, D. G. 2005. *Energy Transitions in Developing Countries: A Review of Concepts and Literature*. Working Paper No. 40. Stanford University.

Emagbetere, E., Odia, J. and Oreko, B. U. 2016. Assessment of Household Energy Utilized for Cooking in Ikeja, Lagos State, Nigeria. *Nigerian Journal of Technology*, 35 (4), 796–804. DOI: 10.4314/njt.v35i4.14.

Energy Sector Management Assistance Programme (ESMAP). 2000. *Energy and Development Report 2000: Energy Services for the World's Poor*. Washington, DC.

Energy Sector Management Assistance Programme (ESMAP). 2003. *Household Fuel Use and Fuel Switching in Guatemala*. Joint UNDP/World Bank Energy Sector Management Assistance Project.

Farsi, M., Filippini, M. and Pachauri, S. 2007. Fuel Choices in Urban Indian Households. *Environment and Development Economics*, 12 (6), 757–774. DOI: 10.1017/S1355770X07003932.

Green, S. B. and Salkind, N. J. 2010. *Using SPSS for Windows and Macintosh: Analyzing and Understanding the Data*. 5th ed. Upper Saddle River, NJ: Pearson Education.

Güney, T. and Kantar, K. 2020. Biomass Energy Consumption and Sustainable Development. *International Journal of Sustainable Development & World Ecology*, 27 (8), 762–767. DOI: 10.1080/13504509.2020.1753124.

Gwatkin, D. R., Rutstein, S., Johnson, K., Pande, R. P. and Wagstaff, A. 2000. *Socio-Economic Differences in Health, Nutrition, and Population in Nigeria*. HNP/Poverty Thematic Group of the World Bank.

Hair, J. F., Black, W., Babin, B., Anderson, R. and Tatham, R. 2006. *Multivariate Data Analysis*. 6th ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Heltberg, R. 2004. Fuel Switching: Evidence from Eight Developing Countries. *Energy Economics*, 26 (5), 869–887. DOI: 10.1016/j.eneco.2004.04.018.

Heltberg, R. 2005. Factors Determining Household Fuel Choice in Guatemala. *Environment and Development Economics*, 10 (3), 337–361. DOI: 10.1017/S1355770X04001858.

Herington, M. J. and Malakar, Y. 2016. Who is Energy Poor? Revisiting Energy (In)security in the Case of Nepal. *Energy Research & Social Science*, 21, 49–53. DOI: 10.1016/j.erss.2016.06.025.

Hussainey, K. and Al-Najjar, B. 2011. Future-Oriented Narrative Reporting: Determinants and Use. *Journal of Applied Accounting Research*, 12 (2), 123–138. DOI: 10.1108/09675421111160691.

International Energy Agency (IEA). 2013. *World Energy Outlook 2013*.

International Energy Agency (IEA). 2014. *Developing Energy Efficiency Indicators to Track Efficiency Progress: Why?* IEA Energy Efficiency Market Report.

Jan, I., Khan, H. and Hayat, S. 2012. Determinants of Rural Household Energy Choices: An Example from Pakistan. *Polish Journal of Environmental Studies*, 21 (3), 635–641.

Kichonge, B., John, G. R., Mkilaha, I. S. N. and Hameer, S. 2014. Modelling of Future Energy Demand for Tanzania. *Journal of Energy Technology* and *Policy*, 4 (7), 16–31

Kowsari, R. and Zerriffi, H. 2011. Three Dimensional Energy Profiles: A Conceptual Framework for Assessing Household Energy Use. *Energy Policy*, 39 (12), 7505–7517. DOI: 10.1016/j.enpol.2011.06.030.

Kuhe, A. and Bisu, D. Y. 2019. Influence of Situational Factors on Households' Energy Consumption Behaviour: Towards an Effective Energy Policy. *International Journal of Energy Sector Management*, 14 (2), 389–407. DOI: 10.1108/IJESM-03-2019-0017.

Lee, L. Y.-T. 2013. Household Energy Mix in Uganda. *Energy Economics*, 39, 252–261. DOI: 10.1016/j.eneco.2013.05.010.

Leiwen, J. and O'Neill, B. C. 2003. *The Energy Transition in Rural China* [online]. International Institute for Applied Systems Analysis (IIASA), IR-03-070. Available at: `http://pure.iiasa.ac.at/7015`. [Accessed 2021, January 28].

Leth-Petersen, S. 2002. Micro Econometric Modelling of Household Energy Use: Testing for Dependence between Demand for Electricity and Natural Gas. *The Energy Journal*, 23 (4), 57–84. DOI: 10.2307/41323461.

Malla, S., Timilsina, G. R. 2014. *Household Cooking Fuel Choice and Adoption of Improved Cookstoves in Developing Countries: A Review*. Policy Research Working Paper No. 6903. The World Bank Development Research Group.

Masera, O. R., Saatkamp, B. D. and Kammen, D. M. 2000. From Linear Fuel Switching to Multiple Cooking Strategies: A Critique and Alternative to the Energy Ladder Model. *World Development*, 28 (12). 2083–2103. DOI: 10.1016/S0305-750X(00)00076-0.

Mazibuko, N. V. E. and Antwi, M. A. 2019. Socio-Economic Factors Influencing Smallholder Farmers Agricultural Infrastructure Availability, Accessilibility and Satisfaction: A Case on North West Province in South Africa. *OIDA International Journal of Sustainable Development*, 12 (5), 11–26.

Mekonnen, A. and Köhlin, G. 2008. *Determinants of Household Fuel Choice in Major Cities in Ethiopia*. Working paper in Economics No. 399. University of Gothenburg.

Mensah, J. T. and Adu, G. 2013. *An Empirical Analysis of Household Energy Choice in Ghana*. Working paper No. 6. Swedish University of Agricultural Sciences.

Modi, V., McDade, S., Lallement, D. and Saghir, J. 2005. *Energy Services for the Millennium Development Goals*. New York: Energy Sector Management Assistance Programme, United Nations Development Programme, UN Millennium Project, and World Bank.

Naibbi, A. I. and Healey, R. G. 2013. Northern Nigeria's Dependence on Fuel Wood: Insights from Nationwide Cooking Fuel Distribution Data. *International Journal of Humanities and Social Science*, 3 (17), 160–173.

Nlom, J. H. and Karimov, A. A. 2015. Modeling Fuel Choice among Households in Northern Cameroon. *Sustainability*, 7 (8), 9989–9999. DOI: 10.3390/su7089989.

Nnaji, C. E., Ukwueze, E. R. and Chukwu, J. O. 2012. Determinants of Household Energy Choices for Cooking in Rural Areas: Evidence from Enugu State, Nigeria. *Continental Journal of Social Sciences*, 5 (2), 1–11.

Odah, M. H., Bager, A. S. M. and Mohammed, B. K. 2017. Tobit Regression Analysis Applied on Iraqi Bank Loans. *American Journal of Mathematics and Statistics*, 7 (4), 179–182. DOI: 10.5923/j.ajms.20170704.06.

Ogwumike, F. O., Ozughalu, U. M. and Abiona, G. A. 2014. Household Energy Use and Determinants: Evidence from Nigeria. *International Journal of Energy Economics* and *Policy*, 4 (2), 248–262.

Oke, J. A., Akinkunmi, W. B. and Etebefia, S. O. 2019. Use of Correlation, Tolerance and Variance Inflation Factor for Multicollinearity Test. *Global Scientific Journals*, 7 (5), 652–659.

Olagunju, F. I. and Ajiboye, A. 2010. Agricultural Lending Decision: A Tobit Regression Analysis. *African Journal of Food Agriculture Nutrition and Development*. 10 (5), 2515–2541. DOI: 10.4314/AJFAND.V10I5.57897.

Onoja, A. O. and Idoko, O. 2012. Econometric Analysis of Factors Influencing Fuel Wood Demand in Rural and Peri-Urban Farm Households of Kogi State. *Consilience: The Journal of Sustainable Development*, 8 (1), 115–127.

Onyekuru, N. A., Ifejirika, C. A., Onuigbo, D. M., Mebo, R. A. and Eboh, E. C. 2020. Factors Affecting Households' Choice of Cooking Energy in Enugu State, Nigeria. *Agro-Science*, 19 (4), 6–13. DOI: 10.4314/as.v19i4.2.

Onyekuru, N. A. and Eboh, E. C. 2011. Determinants of Cooking Energy Demand in the Rural Households of Enugu State, Nigeria: An Application of the Bivariate Probit Model. *Asian Journal of Experimental Biology Science*, 2 (2), 332–335.

Osiolo, H. 2009. *Enhancing Household Fuel Choice and Substitution in Kenya*. KIPPRA Discussion Paper No. 102.

Oyedepo, S. O. 2012. Energy and Sustainable Development in Nigeria: The Way Forward. *Energy, Sustainability and Society*, 2 (1), 15.

Pachauri, S. 2004. An Analysis of Cross-Sectional Variations in Total Household Energy Requirements in India Using Micro Survey Data. *Energy Policy*, 32 (15), 1723–1735. DOI: 10.1016/S0301-4215(03)00162-9.

Pachauri, S. and Spreng, D. 2004. Energy Use and Energy Access in Relation to Poverty. *Economic & Political Weekly*. 39 (3). 272–278.

Rahmani, O., Rezania, S., Beiranvand Pour, A., Aminpour, S. M., Soltani, M., Ghaderpour, Y. and Oryani, B. 2020. An Overview of Household Energy Consumption and Carbon Dioxide Emissions in Iran. *Processes*, 8 (8), 994. DOI: 10.3390/pr8080994.

Saatkamp, B. D., Masera, O. R. and Kammen, D. M. 2000. Energy and Health Transitions in Development: Fuel Use, Stove Technology and Morbidity in Jarácuaro, México. *Energy for Sustainable Development*, 4 (2), 7–16.

Schlag, N. and Zuzarte, F. 2008. *Market Barriers to Clean Cooking Fuels in Sub-Saharan Africa: A Review of Literature*. Working paper. Stockholm Environment Institute.

Song, N., Aguilar, F. X., Shifley, S. R. and Goerndt, M. E. 2012. Factors Affecting Wood Energy Consumption by U.S. Households. *Energy Economics*, 34 (2), 389–397. DOI: 10.1016/j.eneco.2011.12.009.

Svoboda, P. and Brčák, J. 2013. Electricity Consumption Demand Model in Czech Households. *International Advances in Economic Research*, 19 (1), 63–64. DOI: 10.1007/s11294-012-9384-x.

UN (United Nations). 2013. *A New Global Partnership: Eradicate Poverty and Transform Economies through Sustainable Development*. The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda.

van der Kroon, B., Brouwer, R. and van Beukering, P. J. H. 2013. The Energy Ladder: Theoretical Myth or Empirical Truth? Results from a Meta-Analysis. *Renewable and Sustainable Energy Reviews*, 20, 504–513. DOI: 10.1016/j.rser.2012.11.045.

Verbeek, M. 2004. *A Guide to Modern Econometrics*. 2nd ed. John Wiley & Sons.

Warsco, K. 1994. Conventional Fuel Displacement by Residential Wood Use. *Forest Products Journal*, 44 (1), 68–74.

WHO. 2006. *Fuel for Life: Household Energy and Health* [online]. Available at: `https://www.who.int/publications/i/item/9789241563161`. [Accessed 2020, December 20].

WHO. 2010. *Household Air Pollution and Health* [online]. Available at: `http://www.who.int/mediacentre/factsheets/fs292/en/`. [Accessed 2020, December 20].

Wilson, E. 2012. *Energy Equity: Can the UN Sustainable Energy for All Initiative Make a Difference?* [online]. International Institute for Environment and Development. Available at: `https://www.iied.org/energy-equity-can-un-sustainable-energy-for-all-initiative-make-difference`. [Accessed 2020, June 15].

World Bank. 2003. *Household Energy Use in Developing Countries, a Multicountry Study*. UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP).

World Energy Council. 2016. *World Energy Resources* [online]. Available at: `https://www.worldenergy.org/assets/images/imported/2016/10/World-Energy-Resources-Full-report-2016.10.03.pdf`. [Accessed 2020, December 25].

Wuyuan, P., Zerriffi, H. and Jihua, P. 2008. *Household Level Fuel Switching in Rural Hubei*. PESD Working Paper No. 79.

Yamamoto, S., Sié, A. and Sauerborn, R. 2009. Cooking Fuels and the Push for Cleaner Alternatives: A Case Study from Burkina Faso. *Global Health Action*, 2 (1), 2088. DOI: 10.3402/gha.v2i0.2088.

Yonemitsu, A., Njenga, M., Iiyama, M. and Matsushita, S. 2015. A Choice Experiment Study on Fuel Preference of Kibera Slum Households in Kenya. *International Journal of Environment Science Development*, 6 (3), 196–200. DOI: 10.7763/IJESD.2015.V6.589.

Yu, B., Zhang, J. and Fujiwara, A. 2012. Analysis of the Residential Location Choice and Household Energy Consumption Behaviour by Incorporating Multiple Self-Selection Effects. *Energy Policy*, 46, 319–334. DOI: 10.1016/j.enpol.2012.03.067.

AUTHOR'S ADDRESS

Olorunjuwon David Adetayo, Department of Urban and Regional Planning, Obafemi Awolowo University, e-mail: kidex4real@yahoo.com

Gbenga John Oladehinde, Department of Urban and Regional Planning, Obafemi Awolowo University, e-mail: gbengom@gmail.com

Samson A. Adeyinka, Department of Urban and Regional Planning, Obafemi Awolowo University, e-mail: adeyinkasa@yahoo.co.uk

Adejompo Fagbohunka, Department of Geography and Planning Sciences, Adekunle Ajasin University, Akungba-Akoko, Nigeria, e-mail: adejompofagbohunka@gmail.com

THE EMPIRICAL LINKAGE BETWEEN OIL PRICES AND THE STOCK RETURNS OF OIL COMPANIES

Josef Pavlata[1], Petr Strejček[1], Peter Albrecht[1], Martin Širůček[1]

[1] *Mendel University in Brno, Czech Republic*

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ABSTRACT

This paper identifies the relationship between changes in oil prices and the returns of the world's highest-producing oil companies. Oil companies are divided into state-owned (national) and private companies. This paper focused on three different time periods to identify the relationship between changes in oil price and stock market returns by examining the specific backgrounds of each period. The results revealed that during oil's bearish market, it was more beneficial for investors to prefer state-owned companies to optimise their portfolios. The risk analysis focused on systematic risk, and the beta coefficients confirmed that state-owned companies are less sensitive to market shocks. State-owned companies are supported by governments during periods of downtrends in oil prices; therefore, they are less likely to go bankrupt. However, these companies do not have as much flexibility as private companies to cut their costs; therefore, they are more negatively affected by market movements not defined by shocks.

KEY WORDS

oil shock, stock markets, state-owned companies

JEL CODES

G12, G15, Q02

1 INTRODUCTION

The impact of oil price fluctuations on both the economy and the stock market returns has attracted the attention of politicians and economists alike (Alqattan and Alhayky, 2016). Individual stock prices in the oil and gas industry co-vary with oil price fluctuations (Higson et al., 2004). A lot of research has been conducted on the relationship between oil prices and the stock prices of oil mining companies (Alhayki, 2014; Arouri and Rault, 2012; Abdalla, 2013).The rising price of oil price increases total costs in most industries (Rogers,

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2008). This is reflected in falling profits and, with regard to stocks, whose value is estimated by investors based on future profit, their value drops. Refining companies are forced to adapt to the volatility in oil prices by inveting new technologies, which in turn affect oil prices (Hefner, 2014). This demonstrates the bi-causal relationship between oil prices and the returns of oil mining companies (Dhaoui and Khraief, 2014). There is evidence that oil prices impact stocks in both developed (Dhaoui and Khraief, 2014) and developing countries (Basher and Sadorsky, 2006).

However, the type and strength of the influence of oil on the price of oil mining stocks also depends on the level of a country's development (Shaharudin et al., 2009); developing countries are not as technologically advanced, thus they are more sensitive to fluctuations in oil prices. A study conducted by Zakaria (2005) revealed that the relationship is also affected by ownership structure. Private companies are more strictly managed; therefore, they can adapt faster during crises. These companies also develop new technologies and cut their costs. However, state-owned companies are less likely to default because they are supported by governments when shocks on the oil market occur (Gutiérrez et al., 2021). These studies have not examined the details of oil price development. The differences in the impact of oil prices on private and state-owned companies should be studied in more detail, with a focus on trends in oil prices. This would help those investing in oil mining companies' stocks to rebalance their portfolios according to oil price development and with respect to market cycle sensitivity.

This paper makes three main contributions. First, it identifies the differences in the impact of oil price changes between private and state-owned companies. Second, it defines the relationship between oil prices and oil mining stock returns for separate trends in oil prices. The evidence suggests that this relationship varies according to the characteristics of the period, and that individual factors can also have an influence. Third, and most importantly, it offers concrete investment recommendations.

The paper is structured as follows: Section 2 is the literature review, Section 3 provides a detailed overview of the methodology and data used, the Granger causality results are presented in Section 4, Section 5 confirms the results of the robustness analysis and Section 6 presents the conclusion.

2 LITERATURE REVIEW

Since 1965, global crude oil consumption has risen from 30 mil. bbl/day to 90 mil. bbl/day. Developing economies have raised the standard of living of their inhabitants as a result of the extraction and consumption of traditional hydrocarbons. Economic dependence on crude oil is indicated by the trends in oil market prices. Crude oil transfers wealth from oil-importing countries (the United States, China, and India) to oil-exporting countries (Saudi Arabia, Russian Federation). Global energy consumption growth averaged 1.7% p.a. from 2010 to 2020, with growth expected to decelerate gently beyond 2020. Non-OECD energy consumption will be 68% higher by 2030, averaging 2.6% p.a. from 2010, and it accounts for 93% of global energy growth. The fastest-growing fuels are renewable fuels, including biofuels, which are expected to grow at 8.2% p.a. 2010–2030 (BP, 2018). With gas selling at the equivalent of less than 25 USD/barrel of oil, and oil selling at approximately 100 USD/barrel, companies began applying the technologies they had successfully developed for gas extraction to extract oil from shale formations with low permeability, known in the industry as 'tight' reservoirs. The results were similarly impressive, and the United States is now the world's largest oil producer (International Energy Agency, 2021).

Current studies (Cuñado and Pérez de Gracia, 2005; Jiménez-Rodríguez and Sánchez, 2005) have emphasised the influence of oil prices on variables, such as rates of inflation, and interest, GDP and unemployment. A relationship

between oil prices and stock price returns has been identified in emerging markets. Basher and Sadorsky (2006) identified the impact of oil price changes on 21 emerging stock market returns. They revealed that oil price shocks have a significant impact on stock price returns in emerging markets. There is an inherent risk on emerging stock markets when oil prices change and there is a relationship between this risk and other risks, such as total and market risks (Alqattan and Alhayky, 2016). Other studies have focused on the relationship (long or short-term) between the reactions of the Gulf Cooperation Council stock market (Bahrain, Kuwait, Saudi Arabia, Qatar, Oman, UAE) and the changes in oil prices (Alhayki, 2014; Arouri et al., 2010; Arouri and Rault, 2012; Onour, 2007). Gulf equity markets receive volatility from the oil market, but stock market volatility only spills over into the oil market in the case of Saudi Arabia (Malik and Hammoudeh, 2007). An increase in oil prices leads to higher stock market return volatility (Abdalla, 2013).

Oil price volatility and stock price fluctuations in emerging markets have two different negative ramifications on a company's profitability (Masih et al., 2011). First, there is a direct negative impact as production costs increase. increase. Second, there is an indirect negative effect as investors foresee the decline in a company's profit margins and make decisions that affect the stock market indices.

Cong et al. (2008) monitored the relationship between oil prices and the Chinese stock market, considering several variables, including short-term rate of return, industrial production, oil price, consumer price index, and return on stock. The authors did not find any statistically significant effect on the return on stock, or any evidence of asymmetric effects caused by increased oil price volatility. Moreover, a strong negative relationship between oil prices and stock market returns has been identified in seven developed countries (Dhaoui and Khraief, 2014). Hasan and Mahbobi (2013) used the Granger causality test to show that the impact of oil prices on the Toronto stock exchange has been more significant than it was years ago (their research covered the period from January 1990 to August 2011). Another study concluded that the changes in the stock price of 96 American oil extraction companies correlated positively with changes in both oil prices and the entire stock market (Scholtens and Wang, 2008). Another highlighted how companies that are more engaged in oil refining and the sale of refined products (downstream) may profit from price fluctuations while companies that extract only (upstream) tend to lose their value (Lis et al., 2012). One of the most recent studies into the influence of oil prices on the share prices of oil companies was conducted by Garcia (2016). The sample consisted of 26 global oil producing companies divided into three groups: mining, refining, and mining, and refining. The development of stock prices for refining companies could be used as a leading indicator for further changes in oil prices. The study also highlighted that additional leading indicators could be identified in the future.

The relationship between oil prices and oil stock prices has been identified by several studies; however, there are several aspects that are worthy of further research. Research conducted by Shaharudin et al. (2009) has shown that there are different dissimilarities according to the level of a country's development. When the emphasis is put to on dividing countries into from developed, emerging or semi-developed or semi-emerging countries, there are interesting results when profitability is compared by state-owned and private companies' stocks. Zakaria (2005) found similar results, concluding that private companies are more adaptable; however, the author did not study the relationship with a focus on different oil price trends. It is known that state-owned companies are less flexible because they did not optimise their wells due to oil price volatility and they were not as motivated to innovate as private companies (Hefner, 2014). However, a recent study by Gutiérrez et al. (2021) found that state-owned companies are not as sensitive to oil shocks as states do not manage these companies effectively; therefore, even if they suffer from economic problems, governments fund them. This aspect of the dissimilarities between state-owned and private oil mining companies should be analysed in more detail, with a focus on specific oil trends.

3 METHODOLOGY AND DATA

The dataset for this study included data from six companies and two indices. Daily data of returns, including dividend reinvestment, covering 19 years was used. The entire time period is subdivided into three subperiods representing structural breaks in oil price trends. The first subperiod was from 01/2002 to 07/2008, representing a period of stable price rises. The second subperiod was from 08/2008 to 07/2014, characterised by the steepest oil price drop, followed by rising prices for two years and then three years of increasing volatility. The oil price was in range from the beginning of the period. The third period is from 08/2014 to 10/2021, representing the downtrend in oil prices. The oil price and its development utilised were expressed by the West Texas Intermediate Cushing (WTI) as it is the main benchmark used to evaluate crude oil (Fattouh, 2011).

BP, ExxonMobil (XOM) and Lukoil (LUK) were chosen as representatives of private companies and PetroChina (PTR), Equinor (EQNR), and Petrobras (PBR) as representatives of state-owned companies. These companies were chosen to compare the impact of oil shocks on private and state-owned companies separately. Although Lukoil is a private company there are some concerns about the independence of Lukoil. Therefore Lukoil may have more similarities with state-owned companies (Gorst, 2007). Such a company would be good for the validation of results. Another criterion for choosing these companies was that they are listed on the same stock exchange. All of these companies are oil miners and they represent both developed and developing countries. Both their market capitalisation and share of the global market were considered (see Tab. 1 and 2).

The analyses included two indices to check and assess the results. The first was the ARCA Oil & Gas Index (ticker XOI), which represents and averages the oil companies' stock prices, and the second was the S&P 500 Index. Both indices are used for risk analysis. The data was transformed by logarithmic difference.

Tab. 1: Selected oil companies

Private companies	Revenue	Market cap.
BP	303.73	90.40
ExxonMobil	290.20	268.46
Lukoil	127.70	58.74
PetroChina	392.90	139.95
Equinor	79.60	85.42
Petrobras	95.60	73.50

Note: Revenue is in billion USD; Market cap. shows estimated market capitalisation in billion USD.
Source: Yahoo Finance (2021b, 2021d, 2021e, 2021f, 2021g, 2021h).

One of the characteristics observed by various authors is that reactions to oil prices are not solely dependent on contemporary oil price changes since it has been proven that lagged prices also possess explanatory power (Sill, 2007). Although there may be a strong correlation between the variables considered, it does not necessarily mean causation between them. Consequently, the Granger causality test was conducted at the end to demonstrate the dependence or independence between the trends in oil price, measured by the WTI price development and the stock prices of the oil companies.

To demonstrate causal dependencies, two regression equations were used (Mahdavi and Sohrabian, 1991):

$$\mathrm{STOCK}_t = a_1 + \sum_{i=1}^{m} \beta_i \, (\mathrm{STOCK})_{t-i} + \sum_{j=1}^{m} \gamma_j \, (\mathrm{WTI})_{t-1} + e_t, \tag{1}$$

$$\mathrm{WTI}_t = a_1 + \sum_{i=1}^{m} \gamma_i \, (\mathrm{WTI})_{t-i} + \sum_{j=1}^{m} \beta_j, (\mathrm{STOCK})_{t-j} + e_t, \tag{2}$$

where STOCK represents the stock price of selected oil companies, WTI represents WTI oil prices, γ and β are the regression coefficients of the equation, e_t is a random error, and i, j is a lag (m is the maximum order of lag).

Tab. 2: Selected companies

Company	Shareholders	Country	Oil production	Ranking in world's production
BP	< 1% state	UK	1.99	9
ExxonMobil	< 6% state	US	2.35	2
Lukoil	50% management	Russia	1.64	18
PetroChina	86% state	China	2.45	5
Equinor	67% state	Norway	2.07	11
Petrobras	50% state	Brazil	1.99	16

Note: Shareholders states the shareholder with higher share; production is in thousand bbl/day; ranking shows the position of the country in the oil production by country rankings. Source: Yahoo Finance (2021b, 2021d, 2021e, 2021f, 2021g, 2021h).

During the monitored period (from 01/2002 to 10/2021), two situations significantly affected oil prices: the financial crisis of 2008 and the expansion into unconventional supplies followed by a shift in OPEC's policy in 2014. These structural breaks were identified by the Chow test (Brooks, 2008). The first equation expressed that the current stock price was set by both past oil prices and the past prices of the stocks under review while the second equation identified whether the current oil price was determined by past stock prices, i.e. previous oil prices.

4 RESULTS

The analysis of the relationship between oil prices and the stock development of oil companies – companies extracting and processing crude oil – was conducted using a sample of six companies, three state-owned and three private.

In the selected time period (the past 19 years), crude oil has shown increased volatility, with oil prices ranging from a low of 8 USD/bbl. to a high of 140 USD/bbl. The market had to cope with the Iraq war, and price slumps that correlated with the drop in the financial markets, before experiencing a post-war twist in the form of steady growth and stable periods, which ended in a drop caused by excess supply over demand.

The reserve and production positions of national oil companies may be cause for concern if they operated similarly to the private international oil companies, and state ownership was simply a matter of how the stock shares of the company were held (Pirog, 2007). However, it is likely that the objectives of many national oil companies, as well as the characteristics of their operations, differ across companies in the oil industry. Tab. 2 shows the companies according to the country in which their stocks are issued, their ownership and their ranking on the oil production by country ranking.

The paper aimed to determine the interdependence of oil prices and stock prices of oil-extraction companies, which will help both in making investment decisions and in determining whether the companies' stock prices react differently to trends in oil prices depending on whether a government has a stake or the company is private.

The selected benchmarks were the ARCA Oil & Gas Index and the S&P 500 Index. The ARCA Oil & Gas Index is used to track the development of the oil industry through the price changes of oil companies dealing with extraction, refining and development. According to internal regulations, companies listed in the index can change; currently, the index comprises 21 companies, five of which were examined in this study (all except for Lukoil).

The S&P 500 Index is considered to be the best indicator of the stock trends of the largest US companies. The energy sector in the index covers 6.3% of the value, and only ExxonMobil was included in the sample of companies used in this study.

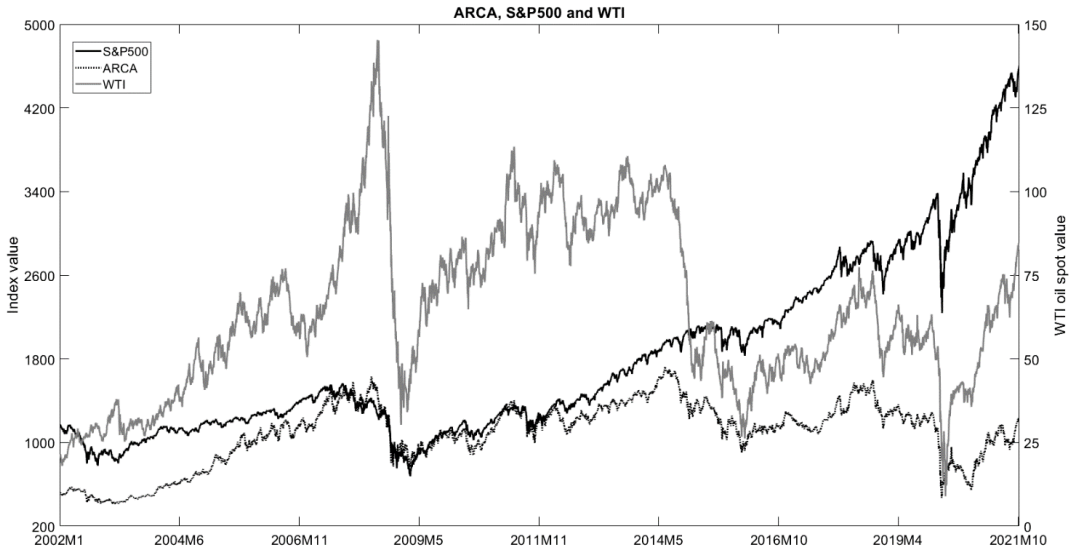

Fig. 1: Oil price and stock/oil index development. Source: Yahoo Finance (2021a, 2021c, 2021i)

Tab. 3: Granger causality, entire period

Causality	F-statistics
PTR ⟶ WTI	2.80**
WTI ⟶ PTR	2.11*
EQNR ⟶ WTI	3.50***
WTI ⟶ EQNR	14.53***
S&P500 ⟶ WTI	2.64**
WTI ⟶ S&P 500	2.69**
BP ⟶ WTI	7.65***
WTI ⟶ BP	3.55***
XOM ⟶ WTI	4.60***
WTI ⟶ XOM	3.78***
LUK ⟶ WTI	2.85***
WTI ⟶ LUK	2.49***
PBR ⟶ WTI	2.93**
WTI ⟶ PBR	3.15***
ARCA ⟶ WTI	7.40***
WTI ⟶ ARCA	2.74***

Note: The calculations show a Granger causality test of the relationship between WTI oil returns and selected oil-producing company stock returns in the VAR model during the entire period. The F-based Wald test statistics indicate the rejection of the null hypothesis; that there was no causal relationship (WTI returns affect selected stock returns or vice versa) in the VAR model. The significance at the 10% level is denoted by *, 5% level by ** and 1% level by ***. The companies are presented by their tickers.

As shown in Fig. 1, before the 2008 financial crisis the S&P 500 and WTI indices loosely followed each other, but began to move in opposition during the record-high oil prices in the summer of 2008. However, since January 2009, both measures have followed each other in near lockstep, breaking only in the months surrounding the Arab Spring uprisings after another price spike.

The interdependence between the oil price trends and the stock price of the oil extraction companies was analysed first over the whole time period. The relationship between stocks and oil prices was found to be volatile, with the correlation between the returns of stocks and oil swinging between positive and negative values. In other words, the stock and oil prices sometimes moved in the same direction, and sometimes in opposite directions (Bernanke, 2016).

As is evident from Tab. 3, there was a bi-causal relationship for almost all selected companies. The stock prices of the oil-producing companies were not only affected by oil prices but they also affected the oil prices. A slightly less significant causality could be found for state-owned companies. The interpretation of this result was in accordance with Gutiérrez et al. (2021), who stated that state-owned

Tab. 4: Systemic risk (beta) of private companies

	LUK to		XOM to		BP to	
Period	**S&P 500**	**ARCA**	**S&P 500**	**ARCA**	**S&P 500**	**ARCA**
1.	0.16	0.26	0.49	0.83	0.42	0.80
2.	0.30	0.42	0.73	1.04	0.50	0.76
3.	0.23	0.54	0.42	1.02	0.32	0.85
EP	0.25	0.41	0.54	0.98	0.41	0.81

Note: The table presents the beta coefficients to the S&P 500 and ARCA indices; EP means entire period. The companies are presented by their tickers.

Tab. 5: Systemic risk (beta) of state-owned companies

	PTR to		ENQR to		PBR to	
Period	**S&P 500**	**ARCA**	**S&P 500**	**ARCA**	**S&P 500**	**ARCA**
1.	0.20	0.30	0.09	0.25	0.18	0.30
2.	0.48	0.64	0.37	0.59	0.34	0.49
3.	0.28	0.65	0.21	0.61	0.15	0.34
EP	0.33	0.53	0.22	0.49	0.21	0.38

Note: The table presents the beta coefficients to the S&P 500 and ARCA indices; EP means entire period. The companies are presented by their tickers.

companies might be less sensitive to market shocks as, when shocks appear on the market, they are better supported by governments and therefore are not so cycle sensitive. As other companies potentially go bankrupt, the state gives additional funds to these companies to protect them, even if this may not be economically effective.

Hasan and Mahbobi (2013) found the same results in their study on the Canadian market. However, these findings have to be validated by looking at the beta coefficients concerning market sensitivity, as well as at the subperiods separately, in the context of structural breaks in oil prices.

In order to obtain results that could be applied across the entire oil industry, the following parameters of the analysed companies with/without public shares would have to be met: (1) The geopolitical conditions must be identical. This can only be ensured for companies from a single region. as there are drawbacks to comparing companies that produce or extract oil in regions/areas or in the area near to certain conflicts or in risky countries to companies that do not; (2) There must be similar political systems in the producer countries, see Zakaria (2005); (3) There also should be differences between the majority and minority stockholders and their interests (Zakaria, 2005); (4) There should be similar levels of oil extraction; however, each company different other costs for mining. For example, companies' oil jacks' are located in remote permafrost landscapes, mining from very deep wells but with extreme climatic conditions. In contrast, the Arabic companies extract oil from shallow wells in inaccessible areas. Therefore, according to Statista (2018), the cost for extracting one barrel of oil in 2015 Kuwait was approximately 8.5 USD, approximately 9.9 USD in Saudi Arabia and approximately 17.2 USD in the Russian Federation. Thus, if the price of oil begins to decrease, companies will begin to close these extremely costly wells and focus their business on other activities, such as the production of natural gas; (5) There should be similar levels of integration, i.e. when conducting comparisons with companies that extract/buy oil and then carry out refining operations, the focus should not be solely on extraction and subsequent sales.

Tab. 4 and 5 show the beta coefficients calculated for all companies. These companies displayed different sensitivities to market and oil prices during different time periods.

From the viewpoint of systematic risk (the beta), the state-owned companies appeared to be less risky than the private companies over the entire monitored period.

The level of systematic risk was lower for the state-owned companies even if they conducted mining activities in developing countries that are associated with being a higher risk. The state-owned companies had very different beta-coefficients, mainly during the third period, which was characterised by a downtrend in oil prices. This can be explained by the fact that private companies are more business oriented; therefore, they are also more cyclical. However, state-owned companies are supported by their states, even if this is not economically efficient. Therefore, these companies' stocks are less affected in periods of oil price downtrends (Gutiérrez et al., 2021). Interesting results could be seen for the private Russian company Lukoil, which may act more like a state-owned company because of the control the Russian government exercises (Ediger et al., 2021). The impact was calculated using the S&P 500 Index and the ARCA Index. Due to the higher diversification of the S&P 500 Index, a lower beta was found. However, if the focus was on the risk profile (the beta), investors should expect higher profits.

4.1 Robustness Check

As was the case for the simple correlation, the Granger causality test was also performed for the subperiods. These subperiods were defined by the Chow test and represent three trends in oil prices. The period from 2002 to 2008 represents oil uptrend, the period from 2008 to 2014 represents a period when oil prices were in the same range as the beginning of the period. The third period is defined by an oil price downtrend as the highest value of oil was achieved at the beginning of the period. However, when analysing the subperiods, the results were different than those for the entire period under review even if the same lag duration was applied (see Tab. 6).

The first period (2002–2008) is characterised by a weak correlation between oil and stock prices. When the comparing coefficients of individual stocks, the low correlation rate was even more pronounced. Similar results appeared in a study by Norland (2017), which states that pre-2009, the correlation was close to zero and, at times, negative. Similar results were reported by Nguyen and Bhatti (2012), who found that the Chinese market was not affected by oil prices from 2000 to 2009. This can be explained by the tranquil period in the stock markets, steadily rising oil prices and GDP, and the general independence of stock markets from oil prices (as shown by the value of the S&P 500).

Tab. 6: Granger causality, subperiods, F-statistics

Casuality	01/2002 to 07/2008	08/2008 to 07/2014	08/2014 to 10/2021
PTR ⟶ WTI	0.61	6.90***	1.29
WTI ⟶ PTR	0.35	3.48***	0.82
EQNR ⟶ WTI	0.11	1.92**	4.40***
WTI ⟶ EQNR	66.75***	6.87***	5.43***
PBR ⟶ WTI	4.46**	9.66***	0.67
WTI ⟶ PBR	0.18	5.19***	2.31*
XOM ⟶ WTI	5.29**	4.38***	6.21***
WTI ⟶ XOM	0.24	4.55***	2.44***
LUK ⟶ WTI	1.04	6.17***	5.43***
WTI ⟶ LUK	0.24	5.41***	1.19
BP ⟶ WTI	1.69	1.93*	7.85***
WTI ⟶ BP	2.41	2.77**	2.62***

Note: The calculations show a Granger causality test of the relationship between WTI oil returns and selected oil-producing company stock returns in the VAR model during the chosen subperiod. The F-based Wald test statistics indicate the rejection of the null hypothesis; that there was no causal relationship (WTI returns affect selected stock returns or vice versa) in the VAR model. The significance at the 10% level is denoted by *, 5% level by **, and 1% level by ***. The companies are presented by their tickers.

For the second period, the S&P 500 Index and the oil price began to correlate This can be explained by the period of the Great Recession, which saw an unprecedented and sustained fall in oil prices, a significant decrease in oil market-specific demand shocks and the collapse of the financial markets, i.e. a clear co-movement in the same direction (Broadstock and Fillis, 2014). Another plausible explanation for this positive relationship between the oil market-specific shocks and stock market returns can be interpreted in agreement with the fact, that

apart from uncertainty regarding the future availability of oil, financial speculation in the oil market also drove oil-market specific shocks (Kilian and Lee, 2014; Kilian and Murphy, 2014).

From 2009, the co-movement increased. It was affected by the ongoing quantitative easing by purchasing trillions of USD worth of (default) risk-free assets, such as government bonds, and low-risk assets, such as AAA-rated mortgage-backed securities. Additionally, the Federal Reserve would force investors into risky assets, such as stocks (Norland, 2017). QE also squeezed capital out of the US and redirected it to emerging markets, which increased demand for all commodities, including oil.

The relationship stayed at a similar level during the third period (2014–2021). It was later characterised by stable oil prices without fluctuations, and the levels of the correlation coefficients between all companies and the ARCA index were at all-time high. Although the dependence of the oil extraction companies' stock prices and the oil price trends was confirmed, the causal dependence and its direction must be verified using Granger causality. The Granger causality test was provided by using Formula (2).

When the oil price rose, the profitability of state-owned companies was higher than at the time of fall prices. During the third period, Petrobras generated a significant profit of 428.9% p.a. This was due to a loan from the China Development Bank of up to 10 billion USD to pay nearly all its 12 bil. USD in maturing obligations in 2016. In the second period, when the oil price was stable, and all other companies realised a profit of approximately 20% p.a., Petrobras made a loss of 14% p.a. There were several reasons for this, including a large-scale price-fixing, bribery and political kick-back scandal. It led to record Petrobras losses and write-downs in 2014 and related arrests continue to be made in Brazil and abroad. Additionally, its formerly investment-grade debt rating has been downgraded to junk status as a result, limiting its access to capital markets and increasing finance costs.

The overall results of robustness check reveal that the state companies show lower co-movement with oil prices; it was in agreement with the results for the entire period. Additionally, more state-owned companies were affected by oil prices during the oil price uptrend. The second period was quite similar for both private and state-owned companies. However, interesting differences could be seen for the third period, the oil downtrend. Most of the selected private companies had bi-causal relationship with oil prices, while state-owned companies were not as affected by falling oil prices. This could be explained by the fact that the state-owned companies are less sensitive during oil drops as they are better supported by the state, which was in line with Gutiérrez et al. (2021). Interesting is also the fact that the WTI didn't have an impact on Lukoil during the third subperiod what is dissimilarity with other private companies. The reason of it provides Gorst (2007) who identified the impact of the state in Russia on private companies also. This finding contributes to our robustness analysis.

5 DISCUSSION AND CONCLUSIONS

Based on oil price trends over selected time periods, it is advisable to consider investing in stocks of oil companies according to their ownership structure. State-owned companies are less motivated to cut their costs or invest in new technologies. This statement was confirmed by the analysis conducted in this study, which identified private-companies as having more significant bi-causal relationships with oil prices.

However, this bi-causal relationship was more significant during periods of oil price downtrends. Analyses focusing on each period were more informative and will enable investors to make a better assessment as to what action is best suited to their needs. This paper provided evidence that state-owned companies are less sensitive to oil cycles and, as oil prices drop, they are supported by governments. Private

companies are managed more effectively from an economic point of view. Due to the support given by states during oil price shocks, the stock returns of state-owned companies are less risky to hold (Gutiérrez et al., 2021). Another piece of evidence is a private company Lukoil, which has reported results similar to the state-owned companies because of more strict state control (Ediger et al., 2021). Because of the loyalty to the state (Gorst, 2007), the Lukoil company was less influenced by oil price downtrends.

A limiting factor in assessing the influence of state-owned companies on the development and response of their stocks was the dissimilarity of these companies. When the oil price was stable, the profitability of the state-owned companies was very similar to the private companies. Investors must also consider that the profit of state-owned companies does not need to be reinvested by the company in new technologies for example.

In summary, it can be concluded that there are differences between the stock returns of state-owned and private companies, which is manifested mainly according to oil price trends. Therefore, investors are recommended to hold more state-owned oil stocks during oil price decreases.

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7 REFERENCES

Abdalla, S. Z. S. 2013. Modelling the Impact of Oil Price Fluctuations on the Stock Returns in an Emerging Market: The Case of Saudi Arabia. *Interdisciplinary Journal of Research in Business*, 2 (10), 10–20. ISSN 2046-7141.

Alhayki, Z. J. 2014. The Dynamic Co-Movements between Oil and Stock Market Returns in the Case of GCC Countries. *Journal of Applied Finance & Banking*, 4 (3), 103–113.

Alqattan, A. A. and Alhayky, A. 2016. Impact of Oil Prices on Stock Markets: Evidence from Gulf Cooperation Council (GCC) Financial Markets. *Amity Journal of Finance*, 1 (1), 1–8. ISSN 2455–9741.

Arouri, M. E. H., Lahiani, A. and Bellalah, M. 2010. Oil Price Shocks and Stock Market Returns in Oil-Exporting Countries: The Case of GCC Countries. *International Journal of Economics and Finance*, 2 (5), 132–139. DOI: 10.5539/ijef.v2n5p132.

Arouri, M. E. H. and Rault, C. 2012. Oil Prices and Stock Markets in GCC Countries: Empirical Evidence from Panel Analysis. *International Journal of Finance & Economics*, 17 (3), 242–253. DOI: 10.1002/ijfe.443.

Basher, S. A. and Sadorsky, P. 2006. Oil Price Risk and Emerging Stock Markets. *Global Finance Journal*, 17 (2), 224–251. DOI: 10.1016/j.gfj.2006.04.001.

Bernanke, B. 2016. The Relationship Between Stocks and Oil Price. *Brookings* [online]. Available at: `http://www.brookings.edu/blog/ben-bernanke/2016/02/19/the-relationship-between-stocks-and-oil-prices/`.

BP. 2018. *Energy Outlook* [online]. Available at: `https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/energy-outlook/bp-energy-outlook-2018.pdf`.

Broadstock, D. C. and Filis, G. 2014. Oil Price Shocks and Stock Market Returns: New Evidence from the United States and China. *Journal of International Financial Markets, Institutions and Money*, 33 (C), 417–433. DOI: 10.1016/j.intfin.2014.09.007.

Brooks, C. H. 2008. *Introductory Econometrics for Finance*. Cambridge University Press. ISBN 978-0-521-69468-1.

Cong, R.-G., Wei, Y.-M., Jiao, J.-L. and Fan, Y. 2008. Relationships between Oil Price Shocks and Stock Market: An Empirical Analysis from China. *Energy Policy*, 36 (9), 3544–3553. DOI: 10.1016/j.enpol.2008.06.006.

Cuñado, J. and Pérez de Gracia, F. 2005. Oil Prices, Economic Activity, and Inflation: Evidence for Some Asian Economies. *The Quarterly Review of Economics and Finance*, 45 (1), 65–83. DOI: 10.1016/j.qref.2004.02.003.

Dhaoui, A. and Khraief, N. 2014. *Empirical Linkage between Oil Price and Stock Market Returns and Volatility: Evidence from International Developed Markets* [online]. Economics Discussion Paper No. 2014-12. Kiel Institute for the World Economy. Available at: http://www.economics-ejournal.org/economics/discussionpapers/2014-12.

Ediger, V. Ş., Bowlus, J. V. and Dursun, A. F. 2021. State Capitalism and Hydrocarbon Security in China and Russia. *Energy Strategy Reviews*, 38, 100725. DOI: 10.1016/j.esr.2021.100725.

Fattouh, B. 2011. *An Anatomy of the Crude Oil Pricing System*. Working Paper. The Oxford Institute for Energy Studies. ISBN 978-1-907555-20-6.

Garcia, J. P. 2016. Financial Performance in Upstream, Downstream, and Integrated Oil Companies in Response to Oil Price Volatility. *Finance Undergraduate Honors Theses*, 34 [online]. Available at: https://scholarworks.uark.edu/finnuht/34.

Gorst, I. 2007. *Lukoil: Russia's Largest Oil Company* [online]. James A. Baker III Institute for Public Policy. Available at: https://www.bakerinstitute.org/media/files/page/993b42c4/noc_lukoil_gorst.pdf.

Gutiérrez, D. S., Paz, M. J. and Vite, A. M. 2021. Factors That Explain the Results of the National Oil Companies: The Impact of the Fiscal Role on Pemex's Results. *Resources Policy*, 74, 102280. DOI: 10.1016/j.resourpol.2021.102280.

Hasan, S. and Mahbobi, M. 2013. The Increasing Influence of Oil Prices on the Canadian Stock Market. *The International Journal of Business and Finance Research*, 7 (3), 27–39.

Hefner, R. A. 2014. The United States of Gas: Why the Shale Revolution Could Have Happened Only in America. *Foreign Affairs*, 93 (3), 9–14.

Higson, C., Holly, S., Kattuman, P. and Platis, S. 2004. The Business Cycle, Macroeconomic Shocks, and the Cross-Section: The Growth of UK Quoted Companies. *Economica*, 71 (282), 299–318.

International Energy Agency. 2021. *Crude Oil Production (EJ). Atlas of Energy* [online]. Available at: http://energyatlas.iea.org/#!/tellmap/-1920537974.

Jiménez-Rodríguez, R. and Sánchez, M. 2005. Oil Price Shocks and Real GDP Growth: Empirical Evidence for Some OECD Countries. *Applied Economics*, 37 (2), 201–228. DOI: 10.1080/0003684042000281561.

Kilian, L. and Lee, T. K. 2014. Quantifying the Speculative Component in the Real Price of Oil: The Role of Global Oil Inventories. *Journal of International Money and Finance*, 42, 71–87. DOI: 10.1016/j.jimonfin.2013.08.005.

Kilian, L. and Murphy, D. P. 2014. The Role of Inventories and Speculative Trading in the Global Market for Crude Oil. *Journal of Applied Econometrics*, 29 (3), 454–478. DOI: 10.1002/jae.2322.

Lis, B., Nessler, C. and Retzmann, J. 2012. Oil and Cars: The Impact of Crude Oil Prices on the Stock Returns of Automotive Companies. *International Journal of Economics and Financial Issues*, 2 (2), 190–200. ISSN 2146-4138.

Mahdavi, S. and Sohrabian, A. 1991. The Link Between the Rate of Growth of Stock Prices and the Rate of Growth of GNP in the United States: A Granger Causality Test. *The American Economist*, 35 (2), 41–48. DOI: 10.1177/056943459103500206.

Malik, F. and Hammoudeh, S. 2007. Shock and Volatility Transmission in the Oil, US and Gulf Equity Markets. *International Review of Economics & Finance*, 16 (3), 357–368. DOI: 10.1016/j.iref.2005.05.005.

Masih, R., Peters, S. and De Mello, L. 2011. Oil Price Volatility and Stock Price Fluctuations in an Emerging Market: Evidence from South Korea. *Energy Economics*, 33 (5), 975–986. DOI: 10.1016/j.eneco.2011.03.015.

Nguyen, C. C. and Bhatti, M. I. 2012. Copula Model Dependency Between Oil Prices and Stock Markets: Evidence from China and Vietnam. *Journal of International Financial Markets, Institutions and Money*, 22 (4), 758–773. DOI: 10.1016/j.intfin.2012.03.004.

Norland, E. 2017. *Economics of Oil-Equity Correlations* [online]. Available at: https://www.cmegroup.com/education/files/why-are-equities-moving-in-tandem-with-oil.pdf.

Onour, I. A. 2007. Impact of Oil Price Volatility on Gulf Cooperation Council Markets' Return. *OPEC Review*, 31 (3), 171–189. DOI: 10.1111/j.1468-0076.2007.00182.x.

Pirog, R. L. 2007. *The Role of National Oil Companies in the International Oil Market* [online]. CRS Report for Congress. Available at: https://pdfs.semanticscholar.org/e1c9/2675def6ea527370f9aaf1cbe7441556e7cd.pdf.

Rogers, J. 2008. *Žhavé komodity: Jak může kdokoliv investovat se ziskem na světových trzích*. Praha: Grada. ISBN 978-80-247-2342-6.

Sill, K. 2007. The Macroeconomics of Oil Shocks. *Business Review*, Q1, 21–31.

Shaharudin, R., Samad, F. and Bhat, S. 2009. Performance and Volatility of Oil and Gas Stocks: A Comparative Study on Selected O&G Companies. *International Business Research*, 2 (4), 87–99. DOI: 10.5539/ibr.v2n4p87.

Scholtens, B. and Wang, L. 2008. Oil Risk in Oil Stocks. *The Energy Journal*, 29 (1), 89–111. DOI: 10.5547/ISSN0195-6574-EJ-Vol29-No1-5.

Statista. 2018. *Average Price to Produce One Barrel of Oil in Top Oil Producing Countries Worldwide in 2015* [online]. Available at: http://www.statista.com/statistics/597669/cost-breakdown-of-producing-one-barrel-of-oil-in-the-worlds-leading-oil-producing-countries/.

Yahoo Finance. 2021a. *Arca Oil Index* [online]. Available at: https://finance.yahoo.com/quote/%5EXOI/history?p=%5EXOI.

Yahoo Finance. 2021b. *BP* [online]. Available at: https://finance.yahoo.com/quote/BP/history?p=BP.

Yahoo Finance. 2021c. *Crude Oil* [online]. Available at: https://finance.yahoo.com/quote/CL%3DF/history?p=CL%3DF.

Yahoo Finance. 2021d. *Equinor ASA* [online]. Available at: https://finance.yahoo.com/quote/EQNR.OL/history?p=EQNR.OL.

Yahoo Finance. 2021e. *Exxon Mobil Corporation* [online]. Available at: https://finance.yahoo.com/quote/XOM/history?p=XOM.

Yahoo Finance. 2021f. *PJSC Lukoil* [online]. Available at: https://finance.yahoo.com/quote/LUKOY/history?p=LUKOY.

Yahoo Finance. 2021g. *PetroChina* [online]. Available at: https://finance.yahoo.com/quote/PTR/history?p=PTR.

Yahoo Finance. 2021h. *Petróleo Brasileiro* [online]. Available at: https://finance.yahoo.com/quote/PBR/history?p=PBR.

Yahoo Finance. 2021i. *S&P 500* [online]. Available at: https://finance.yahoo.com/quote/%5EGSPC/history?p=%5EGSPC.

Zakaria, F. 2005. *Budoucnost svobody: Neliberální demokracie v USA i ve světě*. Praha: Academia.

8 ANNEX

Tab. 7: Descriptive Statistics

Variables	Obs.	Mean	Std. Dev.	Min	0.25	Mdn	0.75	Max	Skewness	Kurtosis
S&P500	4870	1789.40	848.28	676.53	910.45	1418.10	1925.75	4605.40	0.47	0.89
ARCA	4870	1082.80	309.78	411.09	951.82	11143.10	1334.38	1726.20	−0.55	−0.49
WTI	4870	64.21	24.62	8.91	42.42	60.81	79.21	145.31	−0.39	−0.51
BP	4870	26.72	5.54	14.27	22.37	26.37	30.38	39.82	0.02	−0.58
ExxonMobil	4870	50.88	16.17	16.95	41.74	54.47	67.20	77.25	−0.49	−0.91
Lukoil	4870	39.86	20.15	6.32	28.31	38.51	48.71	106.94	0.59	0.26
Equinor	4870	98.59	41.76	24.60	71.49	93.82	116.15	235.71	0.42	−0.02
Petrobras	4870	15.78	11.36	1.50	6.63	13.07	19.50	59.96	1.18	0.86
PetroChina	4870	62.14	28.59	8.36	40.00	62.19	84.37	164.18	−0.08	−0.63
S&P500. log dif	4869	0.00	0.01	−0.13	−0.01	0.00	0.01	0.11	−0.45	12.21
ARCA. log dif	4869	0.00	0.02	−0.24	−0.01	0.00	0.01	0.16	−0.69	15.93
WTI. log dif	4869	0.00	0.03	−0.72	−0.01	0.00	0.01	0.43	−2.08	91.63
BP. log dif	4869	0.00	0.02	−0.21	−0.01	0.00	0.01	0.20	−0.50	14.97
ExxonMobil. log dif	4869	0.00	0.02	−0.15	−0.01	0.00	0.01	0.16	−0.05	10.85
Lukoil. log dif	4869	0.00	0.03	−0.40	−0.01	0.00	0.01	0.23	−0.99	20.31
Equinor. log dif	4869	0.00	0.02	−0.20	−0.01	0.00	0.01	0.17	−0.21	6.72
Petrobras. log dif	4869	0.00	0.03	−0.37	−0.02	0.00	0.02	0.26	−0.53	9.58
PetroChina. log dif	4869	0.00	0.02	−0.15	−0.01	0.00	0.01	0.14	−0.01	5.41

AUTHOR'S ADDRESS

Josef Pavlata, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: 44977@node.mendelu.cz

Petr Strejček, Department of Finance, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: petr.strejcek@mendelu.cz

Peter Albrecht, Department of Finance, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: peter.albrecht@mendelu.cz

Martin Širůček, Department of Finance, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: martin.sirucek@mendelu.cz

IS THE CATEGORY OF MICRO-UNDERTAKINGS IN THE VISEGRAD GROUP COUNTRIES RELEVANTLY DEFINED?

Milena Otavová[1], Jana Gláserová[1], Pavel Semerád[1]

[1] *Mendel University in Brno, Czech Republic*

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ABSTRACT

This paper deals with the definition of micro-undertakings in the Visegrad Group countries (V4). To define micro-undertakings is a task of EU Member States with effect from 1 January 2016. The goal of the Directive is to create better conditions for undertakings and make them more competitive, in particular by reducing the administrative burden. The aim of this paper is to evaluate the level of criteria adopted for defining micro-undertakings in the V4 in relation to the intended reduction in their administrative burden. In addition to the V4, Germany is also researched as a representative of an advanced economy. The study was based on data from the Amadeus database and it was found out that most companies in the V4 belong to the category of micro-undertakings. To achieve the goal of the Directive, it is necessary to reduce their number. As the submitted proposals suggest, their number should be reduced to a level comparable to that of Germany.

KEY WORDS

administrative burden, average number of employees, balance sheet, micro-undertakings, net turnover, V4 countries

JEL CODES

M20, M40

1 INTRODUCTION

The adoption of 2013/34/EU Directive and the introduction of relating changes to the national accounting regulations of the V4 countries led to the creation of a new categorization of undertakings and this brought a new task: simplification of administration mainly for micro and small undertakings. EU Member States had an obligation to incorporate this Directive into their national accounting regulations with effect from no later than 1 January 2016. Some V4

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countries implemented the Directive gradually (e.g., Slovakia in as early as 2014), others (e.g., the Czech Republic) by 1 January 2016.

In this paper the main issues are related to the categorization of undertakings themselves. The paper discusses in more detail the impacts of the implementation of the Directive in the V4 countries and presents a comparison of these impacts. At the same time, Germany is examined as a country representing a more developed economy within the EU. The adoption of the Directive raises a question whether the implementation of the Directive was meaningful or whether there is a need to consider some changes. These may concern the accepted value criteria, according to which the categorization of undertakings was performed. The undertakings classified as micro-undertakings must not exceed two of the established criteria. A specific number of value criteria for the countries under study are shown in Tab. 1.

The Directive requires a reduction in the administrative burden on micro-undertakings. It offers micro and small undertakings the possibility of using an abridged version of a balance sheet statement and a profit and loss statement. At the same time, Mošnja-Škare and Galant (2013) mention the need for generally comparable and comprehensible financial statements. Now that accounting is done by accounting software, there is a question as to whether this will effectively reduce the administrative burden placed on micro-undertakings. In this context, Collis and Jarvis (2000) and Harvie and Lee (2005) emphasize that for micro-undertakings aimed at minimizing tax costs, financial statements are not the most important source of information, especially for owners and managers.

If micro-undertakings decide to prepare an abridged version of their financial statements, they may find themselves in a situation where they will have to prepare full accounts, for example, if they decide to apply for a loan or credit from the bank. The process of implementing the Directive into national regulations varied from country to country. Some countries made several amendments, for example, Slovakia. The amendments were made to their accounting regulations throughout 2014–2016. Other countries, for example, the Czech Republic implemented the Directive only once through the Accounting Act, as mentioned by Gláserová et al. (2017). Due to the differences in the implementation of the Directive between individual EU Member States concerning the timing and the use of alternative options of the Directive, one of the goals of the Directive – the comparability of financial statements appears to be unattainable, as also reported by Deac (2014) and Manová et al. (2018).

2 THEORETICAL BACKGROUND

Directive 2013/34/EU of the European Parliament and of the Council of 26 June 2013 on the annual financial statements, consolidated financial statements and related reports of certain types of undertakings (hereinafter the Directive) repealed Council Directives 78/660/EEC and 83/349/EEC. To comply with the new Directive, a new classification of undertakings was created. It was based on three criteria (net turnover, balance sheet total and the number of employees) which determine whether the undertaking is large, medium-sized, small or micro. EFAA (2014) states that before the adoption of the Directive, small and medium-sized undertakings formed the majority of undertakings in the EU and suffered from the excessive administrative burden. The Directive introduced a new category of micro-undertakings, which became the smallest size category. Most undertakings in the EU now fall in this category.

Hýblová (2017) points out that of the total number of undertakings in the European Union 92% are micro-undertakings that create about 22% of added value. According to Baiocco et al. (2020), micro and small undertakings are essential for the European economy. Undertakings with fewer than 50 employees are responsible for 52% of jobs and 39% of economic activity in the European Union.

The Directive incorporates Directive 2012/6/EU on micro-entities, which allows these entities to prepare a very simple balance sheet and also a very simple profit and loss statement with practically zero notes to the financial statements. The changes brought about by the adoption of the said Directive, as mentioned by Hýblová (2019), Müllerová (2014) and Stojilkovič (2016), included mainly improving the business environment in general by reducing the administrative burden placed on micro-undertakings, removing the obligation for micro-undertakings to publish a profit and loss statement, changes in the valuation of asset and liability items and in the formal arrangement of items in financial statements.

The Directive thus simplifies the rules for the preparation of annual financial statements and consolidated financial statements of micro and small undertakings by reducing and limiting the amount of information in the notes to the financial statements. This Directive differs significantly from the original directives mostly in its philosophy and by introducing a specific regime for micro and small undertakings in order to significantly reduce the administrative burden of preparing financial statements.

In many respects the Directive provides EU Member States with certain, sometimes considerable, "room for manoeuvre". Its text contains a number of alternative accounting procedures, rules, and possible concessions from which EU Member States can choose. This may, however, have a negative impact on the comparability of accounting data across countries. EU Member States should not impose any additional requirements on micro-undertakings and this should reduce their administrative burden in comparison with undertakings in higher size categories (Žárová, 2013).

The Directive was to be incorporated into the laws of EU Member States with effect from no later than 1 January 2016. Some EU Member States adopted the Directive in several steps, others only in one. In the Czech Republic there was an amendment made to Act 563/1991 Coll. on Accounting. After the Directive was implemented by EU Member States, there appeared some differences in the criteria according to which undertakings were classified. It was due to the fact that the level of value criteria was only recommended by the Directive. Some EU Member States adopted the values exactly as recommended by the Directive; others partially adjusted these values.

Some differences also arose in connection with the conversion of values into national currencies in non-euro area countries (Broz, 2010; Ozimkovska and Kubielas, 2013). The values in euros valid as of 1 January 2016 are given in Tab. 1. According to Zager and Decman (2016), there is a tendency to make the scope and content of external financial reporting proportionate to the size of the undertaking.

As mentioned above, micro-undertakings account for the majority of the total number of undertakings. A study whose aim was the quantitative and qualitative assessment of the application of a simplified regime of reporting for micro-undertakings, as defined in the Directive, found that at the end of 2016 there were 16.8 million limited liability companies in the EU. Among these undertakings were 14.2 million undertakings (84.4%) that would be classified as micro-undertakings according to the maximum criteria set out in the Directive and 11.7 million undertakings (69.7%) according to the national size criteria in the 22 EU Member States that introduced a very simplified regime (De Groen et al., 2019). According to Martyniuk and Martyniuk (2020), in almost all countries of Central and Eastern Europe about 90% of undertakings can prepare condensed financial statements, but it has some limitations for decision-making. Challinor (2019) explains that simple accounting procedures for micro-undertakings are those that do not need to contain any detailed information but must be comprehensible to users.

This can save time and reduce administrative costs of the smallest undertakings. For these undertakings, the burden of financial reporting may be disproportionate, compared to other small undertakings. In reality, however, there are advantages and disadvantages to the application of reduced requirements in the accounting of micro-undertakings, especially in the area of disclosure. According to Poniatowska (2015),

the usefulness and applicability of financial statements of micro and small undertakings for external and internal users are debatable. Krzysztof (2015) pointed out that the scope of information (especially for micro-undertakings) is too limited and could cause problems in practice, e.g., making capital less accessible. Therefore, he suggests a cautious approach to simplification and selection according to the needs of a particular entity, in particular because there are a large number of these entities.

White (2018) notes that the simplified regime for micro-undertakings is generally not recommended for audited undertakings. He states that under the simplified regime, if accounting rules differ, the economic result may vary. Nowadays, the economic impact of the pandemic is being monitored; it has already been felt by micro and small undertakings which often operate in the sectors which have been hit very hard. It is expected that these undertakings will suffer significantly from liquidity constraints compared to the undertakings which belong to higher size categories. In this context, more than ever, there is a need to support micro-undertakings by reducing their administrative burdens, as stated in the study by Baiocco et al. (2020). At this point, however, it is necessary to emphasize the results of the study by De Groen et al. (2019) that most micro-undertakings are not aware of the possibilities of reducing their administrative burden. The reason for this is the lack of information about these possibilities in the Directive or the non-adoption of simplification in their accounting systems and the very limited perception of financial statements.

3 METHODOLOGY AND DATA

The aim of the paper is to evaluate the level of the criteria adopted for defining micro-undertakings in the V4 in relation to the intended reduction in their administrative burden. The impetus for this research was the fact that in the Czech Republic most companies are categorized as micro undertakings. The administrative burden, however, cannot be reduced for all existing micro undertakings because the informative value of their financial statements would be significantly reduced. A more significant reduction in the administrative burden can therefore be made for the smallest ones. The paper has the ambition to recommend criteria that would be adopted for the definition of micro undertakings just with regard to the above-mentioned facts.

An analysis was carried out of the introduction of micro-undertakings on the basis of the criteria and their values adopted by the V4 countries. The data for this study came from the Amadeus database and the micro-undertakings were filtered for the V4 countries and Germany. Germany was selected as a representative of advanced countries within the EU and as a country which has close economic connections with Czech undertakings. As stated by Albu et al. (2013), developed economies also tend to have high quality financial statements. Data filtration was based on the criteria values accepted by all states and on the condition that there were always two arbitrary criteria that micro-undertakings could not exceed, which was exactly in line with the logic of the Directive. The total number of undertakings in the V4 countries and in Germany filtered from the Amadeus database was used to calculate the share of micro-undertakings in the total number of undertakings. Then the adjusted number of these micro-undertakings was determined and some meaningless values such as the negative balance or the negative net turnover were ignored. The undertakings were organized in ascending order according to the values of the criteria examined (balance sheet total, net turnover, and the average number of employees) and then the number of micro-undertakings corresponding to the third quartile in this data set was established. Then, it was possible to determine the value of the criteria corresponding to the 75th percentile of data in EUR. Some proposals for a reduction in

the number of micro-undertakings in relation to a possible reduction in their accounting requirements were made. With regard to the results of the filtered data, a reduction in the implemented criteria values to half was proposed. Further tightening meant that none of the criteria must be exceeded.

The methods of scientific work used in this study were mainly methods of description, analysis, synthesis, induction, deduction and modelling. Of specific financial reporting methods, the method of recognition of the main elements of financial statements and the method of valuation of the elements of financial statements were applied. In the Czech Republic and Slovakia, a questionnaire survey was also conducted. Its purpose was to examine whether the goal of the Directive was achieved. The goal was to improve the conditions for micro-undertakings, namely to reduce the administrative burden while increasing the competitiveness of these undertakings. Some 645 micro-undertakings in the Czech Republic and 300 micro-undertakings in Slovakia were asked to participate in the questionnaire survey whose purpose was to investigate the characteristics of micro-undertakings and to find out whether the implementation of the Directive brought the expected benefits.

4 RESULTS

4.1 The Categorization of Undertakings

Tab. 1 shows the categorization of undertakings on the basis of recommended values in accordance with Directive 2013/34/EU and also adjusted values in the V4 countries and in Germany. The undertakings were categorized into four size groups, namely micro, small, medium-sized and large.

The following conclusions can be drawn from Tab. 1. The criteria values which were recalculated by rates are approaching the levels recommended by the Directive. The Czech Republic is the only member of the V4 that in agreement with the Directive implemented a breakdown of undertakings and categorized them as micro, small, medium-sized and large. The other V4 countries did not include the category of medium-sized undertakings in their national legislation.

The absence of this category shows that the values of the criteria for large undertakings do not match the criteria in the Czech Republic. The Slovak Republic, Poland and Hungary include more undertakings in the category of large undertakings in comparison with the Czech Republic. The difference can also be seen in the criterion of the average number of employees. The V4 countries set the value of the criterion for large undertakings to 50.

So, the average number of employees for a large category is substantially smaller than the value recommended by the Directive, which is set to 250 employees. This recommended value was implemented only in the Czech Republic. The criterion of net sales for micro-undertakings in all V4 countries is lower than that set by the Directive. However, this difference cannot be considered to be significant. As for micro-undertakings, Germany used the value proposed by the Directive and did not take advantage of the opportunity to change the values of the criteria. However, the category of small undertakings deviated from the Directive.

The criteria in each country are converted from domestic currencies using the exchange rate of the Czech National Bank as of 1 January 2016.

4.2 Micro-Undertakings in the V4 Countries

This section analyzes micro-undertakings in the V4 countries using the data from the Amadeus database. The filtered sample was 78,821 micro-undertakings for the Czech Republic, 149,277 for the Slovak Republic, 284,778 for Hungary, and 23,777 for Poland.

The small number of micro-undertakings in Poland is the result of the publication of financial statements required of micro-undertakings.

Tab. 1: The categorization of undertakings of the V4 countries and Germany (Balance sheet total and Net turnover in thousands of EUR)

Category of undertakings	Criterion*	Czech Rep. (CZ)	Slovakia (SK)	Poland (PL)	Hungary (HU)	Germany (GE)	Directive
Micro	Balance sheet total	0–333	0–350	0–352	0–316	0–350	0–350
	Net turnover	0–666	0–700	0–704	0–633	0–700	0–750
	Average number of employees	0–10	0–10	0–10	0–10	0–10	0–10
Small	Balance sheet total	333–3,700	350–4,000	352–3,987	316–3,798	350–6,000	350–4,000
	Net turnover	666–7,401	700–8,000	704–7,974	633–7,595	700–12,000	750–8,000
	Average number of employees	10–50	10–50	10–50	10–50	10–50	10–50
Medium-sized	Balance sheet total	3,700–18,501				6,000–20,000	4,000–20,000
	Net turnover	7,401–37,003				12,000–40,000	8,000–40,000
	Average number of employees	50–250				50–250	50–250
Large	Balance sheet total	18,501+	4,000+	3,987+	3,797+	20,000+	20,000+
	Net turnover	37,003+	8,000+	7,974+	7,595+	40,000+	40,000+
	Average number of employees	250+	50+	50+	50+	250+	250+

Source: Based on Directive 2013/34/EU and national accounting legislation.
*) The condition: On the balance sheet, the undertaking does not exceed more than one criterion.

They are required to disclose financial statements only if the proceeds (up to the last balance sheet date) exceed €2,000,000. Therefore, Poland's results will be highlighted as they are rather distorted.

In the survey, the number of micro-undertakings from the Amadeus database was filtered for the countries surveyed for the criteria examined. Some meaningless values such as the negative balance or the negative turnover were ignored. The values of the criteria were organized in ascending order and the number of micro-undertakings corresponding to the third quartile was determined.

Then it was possible to determine the value of the criteria corresponding to the 75th percentile of data in EUR. The values corresponding to the 75th percentile were used in accordance with European Commission (2012), which states that micro-undertakings account for 75% of the total number of undertakings in the European Union. Our study based on the data from the Amadeus database showed that micro-undertakings in the Czech Republic only account for 68%. However, according to the study by Skálová (2011), micro-undertakings constitute about 96% of all undertakings. It is necessary to consider the inaccuracy of this data, which results from the

Tab. 2: The categorization of undertakings of the V4 countries and Germany

		Adjusted number of micro-undertakings			Number of micro-undertakings in the third quartile of adjusted number			Value of the criterion (EUR) in the 75th percentile		
Country	Number of micro-undertakings	Balance sheet total	Net turnover	Average number of employees	Balance sheet total	Net turnover	Average number of employees	Balance sheet total	Net turnover	Average number of employees
CZ	78,821	64,839	59,107	48,614	48,630	44,331	36,461	67,000	78,000	3
SR	149,277	123,369	119,038	79,610	92,758	90,779	59,708	34,000	85,000	3
HU	284,778	234,161	193,960	193,960	175,621	145,470	145,470	31,000	40,000	4
PL	23,777	23,596	23,580	999	17,697	17,685	749	67,000	297,000	5

Source: Based on Amadeus database data.

Tab. 3: The categorization of undertakings of the V4 countries and Germany

Country	Directive/ Proposal	Definition of undertakings	Number of undertakings	Share in the total of undertakings (%)	Micro-undertakings 1 share (%)
CZ	Directive	Undertakings total	115,536	100.00	–
		Micro-undertakings 1	78,821	68.22	100.00
		Micro-undertakings 2	28,396	24.58	36.03
	Proposal	Undertakings total	115,536	100.00	–
		Micro-undertakings 1	68,340	59.15	100.00
		Micro-undertakings 2	16,645	14.41	21.12
SR	Directive	Undertakings total	240,769	100.00	–
		Micro-undertakings 1	149,277	62.10	100.00
		Micro-undertakings 2	55,810	23.18	37.39
	Proposal	Undertakings total	240,769	100.00	–
		Micro-undertakings 1	137,551	57.13	100.00
		Micro-undertakings 2	38,595	16.03	25.85
HU	Directive	Undertakings total	395,060	100.00	–
		Micro-undertakings 1	284,778	72.08	100.00
		Micro-undertakings 2	125,674	31.81	44.13
	Proposal	Undertakings total	395,060	100.00	–
		Micro-undertakings 1	262,076	66.34	100.00
		Micro-undertakings 2	103,709	26.25	36.41
PL	Directive	Undertakings total	99,314	100.00	–
		Micro-undertakings 1	23,596	23.76	100.00
		Micro-undertakings 2	453	0.46	1.92
	Proposal	Undertakings total	99,314	100.00	–
		Micro-undertakings 1	18,175	18.30	100.00
		Micro-undertakings 2	368	0.37	1.56

Source: Based on Amadeus database data.

inclusion of only one criterion (average number of employees) in determining the proportion of micro-undertakings. The results of this analysis are summarized in Tab. 2.

The data in Tab. 2 show that the micro-undertakings in the V4 countries have criteria values significantly lower than those implemented in their national adaptations under the Directive. The question therefore arises as to whether it would be appropriate to reduce these values or possibly to introduce a breakdown of micro-undertakings into several categories in the light of the considerations of reducing their administrative burden.

For all countries, it would be appropriate to tighten the condition of categorization, e.g., to reduce the criteria. The proposal, as shown in Tab. 3, reduces the values of criteria to half of their implemented value. Tightening is examined in Micro-undertakings 1, which under the Directive may exceed a maximum of one criterion, and in Micro-undertakings 2, where no criterion must be exceeded. This applies to all countries and proposals in Tab. 3.

It is clear from Tab. 3 that with the exception of Poland (with regard to the non-disclosure of financial statements it has no informational value for comparison) the micro-undertakings account for more than 50% of all undertakings in the other V4 countries. So, the changes to reduce the administrative burden placed on these undertakings should reflect their large number.

Under the change proposed (none of the accepted criteria can be exceeded), the share of micro-undertakings in the total number of undertakings in all the V4 countries would fall. At the same time, this would reduce the number of micro-undertakings by about 60% in all the V4 countries (with the exception of Poland).

If the proposal to reduce the value criteria by half was accepted, micro-undertakings would again represent a smaller group of all undertakings. If the condition that no criterion must be exceeded was imposed, the share of micro-undertakings in all undertakings would be 14.41% in the Czech Republic, 16.03% in Slovakia, and 26.25% in Hungary. Tab. 3 shows a potential reduction in the number of micro-undertakings in individual V4 countries.

Tab. 4: The categorization of undertakings of the V4 countries and Germany

Number of micro-undertakings	58,987
Adjusted number of micro-undertakings	
Balance sheet total	51,434
Net turnover	24,963
Average number of employees	58,553
Number of micro-undertakings belonging to the third quartile from the adjusted ones	
Balance sheet total	38,576
Net turnover	18,723
Average number of employees	43,915
Value of the criterion (EUR) in the 75th percentile	
Balance sheet total	214,000
Net turnover	700,000
Average number of employees	6

Source: Based on Amadeus database data.

4.3 Micro-Undertakings in Germany

For further comparison, Germany was selected as a representative of advanced countries within the EU. It also has close economic ties with Czech undertakings. As in the case of the V4 countries, the data and the results shown in Tab. 4 and 5 were filtered in the same way.

From Tab. 4 and 5 it is clear that the setting of the criteria values according to the Directive is logical for this country with respect to the filtered number. The proportion of micro-undertakings in line with the Directive is about 15% of all undertakings. In this case, reducing the values would be meaningless.

5 RESEARCH OF A QUESTIONNAIRE SURVEY

Some 645 micro-undertakings in the Czech Republic and 300 in Slovakia were asked to participate in the questionnaire survey. The response rate of the questionnaires was only 10% in the Czech Republic and 12% in Slovakia. The low response rate can be explained by the sensitivity of the information required.

The questions in the questionnaire focused on the characteristics of the micro-undertakings and on finding out whether the administrative burden was reduced after the implementation of the Directive.

In both countries the most frequently mentioned legal form of micro-undertakings is a limited liability company and the most frequently represented business activity is providing services. Within the size criteria (the average number of employees, balance sheet total and net turnover) it was found out that in the Czech Republic almost 78% of micro-undertakings have the number of employees in the range of 0 to 4. It can also be stated that almost 82% of micro-undertakings reach the balance sheet total of not more than 65 thousand euros. Net turnover of not more than 110 thousand euros was in more than 86% of micro-undertakings. These percentages are considered significant as they represent over 75% of occurrence. Thus, it can be concluded that the aforementioned intervals gathered from the responses of the respondents refer to a typical representative of micro-undertakings in the Czech Republic. A typical micro-undertaking in Slovakia is an undertaking with one to four employees, the net turnover of not more than 80 thousand euros and the balance sheet total of not more than 50 thousand euros.

Tab. 5: Micro-undertakings in Germany in accordance with the Directive and the proposal

Directive/ Proposal	Definition of undertakings	Number of undertakings	Share in the total of undertakings (%)	Micro-undertakings 1 share (%)
Directive	Undertakings total	404,366	100.00	–
	Micro-undertakings 1	58,987	14.59	100.00
	Micro-undertakings 2	8,217	2.03	13.93
Proposal	Undertakings total	404,366	100.00	–
	Micro-undertakings 1	33,131	8.19	100.00
	Micro-undertakings 2	3,550	0.88	10.72

Source: Based on Amadeus database data.

The second part of the questionnaire examined in what form the micro-undertakings prepare their balance sheets and whether they publish their profit and loss statements voluntarily. It also explored whether in connection with the new Accounting Act the micro-undertakings noticed a reduction in the administrative burden and whether they experienced a competitive advantage as a result of being classified as micro-undertakings.

It was found out that in the Czech Republic 80% of the accounting entities surveyed prepare the abridged balance sheet for micro-undertakings; however, only 62% of them believe that this form is sufficient. As for the publishing of financial statements in the Collection of Deeds, the alarming fact was that only 28% of micro-undertakings comply with the obligation to file financial statements. However, none of the undertakings that file the financial statements in the Collection of Deeds voluntarily disclose their profit and loss statements. A surprising finding was related to the reduction in the administrative burden. None of the entities noted the reduction. Some even stated (those applying for loans from banks) an increase in administrative duties. In order to get a loan, the undertakings have to prepare full financial statements.

It was also confirmed in the sample of the undertakings that they did not gain any competitive advantage compared to the undertakings of large size categories. Thus, one of the goals of the Directive was not confirmed, namely the reduction in the administrative burden and the simplification of the business environment for micro-undertakings in the Czech Republic. Similar results were achieved in Slovakia except for the publication of financial statements as all the undertakings surveyed meet this obligation. Like in the Czech Republic, none of them voluntarily publish their profit and loss statements. The result of the questionnaire survey is that one of the goals of the Directive was not confirmed, namely the reduction in the administrative burden and the simplification of the business environment for micro-undertakings both in the Czech Republic and in Slovakia, as it was also stated by De Groen et al. (2019).

6 DISCUSSION AND CONCLUSIONS

The main benefit of adopting the Directive was a reduction in the administrative burden on micro-undertakings. To create a framework for administrative simplification for micro-undertakings is certainly a step in the right direction; however, it is alarming that according to the current categorization, a majority of undertakings in the V4 countries fall into this category. This conclusion is based on the data filtered from the Amadeus database. The filtered sample was 78,821 micro-undertakings for the Czech Republic, 149,277 for the Slovak Republic, 284,778 for Hungary, and 23,777 for Poland. The values for the net turnover (700 thousand EUR), the balance sheet total (350 thousand EUR), and the average number of employees (10) are too high for these countries. The data in Tab. 2 show that the

micro-undertakings in the V4 countries have the criteria values significantly lower than those implemented in their national adaptations under the Directive. The question therefore arises as to whether it would be appropriate to consider reducing these values or, possibly, dividing micro-undertakings into several subcategories in the light of the considerations of reducing the administrative burden.

We believe that it is necessary to consider changes that would reduce the values of the benchmarks in the countries under study. This idea is also supported by the data filtered for Germany as a representative of advanced EU countries, where only 15% of the total number of undertakings (Tab. 5) are micro-undertakings, according to the values implemented by Germany in its accounting treatment under the Directive. One possible solution is that micro-undertakings should not exceed any of the criteria adopted. This would reduce their share in the total number of undertakings to around 25% in the Czech Republic, 23% in Slovakia, and 32% in Hungary. These findings come from Tab. 3. For the reasons outlined above, Poland is not mentioned. It is also possible to reduce the values of the accepted criteria in accordance with the Directive. The proposal in this paper reduces them to half.

If micro-undertakings could not exceed any of the criteria, their share in the total number of undertakings in the Czech Republic would be 14%, in Slovakia 16% and in Hungary 26%. The share of micro-undertakings would decrease by 79% in the Czech Republic, by 74% in the Slovak Republic and by 64% in Hungary. If we compare the newly defined micro-undertakings with the current ones, their number will be 21% in the Czech Republic, 26% in the Slovak Republic and 36% in Hungary. This is shown in Tab. 3. If the number of micro-undertakings was reduced, it would be possible to adopt some other options to reduce the administrative burden, even while respecting the fact that undertakings preparing financial statements may use a limited number of accounting methods which do not always record the economic transactions accurately, as also stated by Procházka (2015). The options are, for example, to reduce the administrative burden through the abolition of the accruals in accounting and to permit them to use the cash method. The advantage of the cash basis accounting method is that it is already legally regulated in the Czech Republic by the Accounting Act for selected non-state non-profit organizations. The possibility of using the cash basis accounting method would certainly be only limited to the smallest micro-undertakings. On the contrary, the removal of the requirement to use double-entry bookkeeping could lead to lower transparency and comparability of financial statements. This could result in information asymmetry.

The added value of the paper can be seen in the proposals for a new possible definition of micro undertakings. An important impetus for the creation of the submitted proposals was the results of a study carried out by CEPS (De Groen et al., 2019), which state that the implementation of the Directive in the V4 countries did not significantly reduce the administrative burden. This is also reflected in the results of the questionnaire survey conducted in the Czech Republic and Slovakia where the respondents said that they did not feel any reduction in the administrative burden. Nor did they see any competitive advantage. This may be due to the fact that most undertakings in the V4 countries under study are just micro-undertakings. A further reduction in the administrative burden placed on micro-undertakings can be considered only if there is a significantly smaller number of entities than now. To achieve this, it is important either to reduce the criteria values or to introduce an additional condition (as mentioned in the paper). It is also possible to consider introducing a finer categorization of micro-undertakings. A new group of micro-undertakings (the smallest ones that yet have to be defined) could be the micro-undertakings that would use simplified double-entry bookkeeping (that yet has to be newly and precisely defined) with simple and comprehensive rules, accounting methods and statements. In its current form, it is not suitable for the intended group of micro-undertakings because it does not reduce the administrative burden. For this reason, it is needed to find a comprehensive solution for these undertakings that would combine the approach of business law with accounting and taxation.

7 REFERENCES

Albu, C. N., Albu, N., Pali-Pista, S. F., Gîrbină, M. M., Selimoglu, S. K., Kovács, D. M., Lukács, J., Mohl, G., Müllerová, L., Paseková, M., Arsoy, A. P., Sipahi, B. and Strouhal, J. 2013. Implementation of IFRS for SMEs in Emerging Economies: Stakeholder Perceptions in the Czech Republic, Hungary, Romania and Turkey. *Journal of International Financial Management & Accounting*, 24 (2), 140–175. DOI: 10.1111/jifm.12008.

Baiocco, S., Simonelli, F. and Westhoff, L. 2020. *Study on Mapping Opportunities and Challenges for Micro and Small Enterprises in Offering Their Employees Up- or Re-Skilling Opportunities.* Final report. Vol. 1.

Broz, T. 2010. Introduction of the Euro in CEE Countries – Is It Economically Justifiable? The Croatian Case. *Post-Communist Economies*, 22 (4), 427–447. DOI: 10.1080/14631377.2010.518449.

Collis, J. and Jarvis, R. 2000. *How Owner-Managers Use Accounts*. London: Centre for Business Performance.

Deac, M. 2014. The New EU Accounting Directive – A Comparison of Reporting Requirements. *Annals of „Constantin Brâncuşi" University of Târgu-Jiu*, Economy Series, 2, 197–205.

De Groen, W. P., Alcidi, C., Musmeci, R., Baiocco, S., Busse, M. and Lenaerts, K. 2019. *Study on the Accounting Regime of Limited Liability Micro Companies*. Final study. CEPS Project Report.

European Commission. 2012. *Financial Reporting: Burden Reduction for Micro-Entities* [online]. Available at: `https://ec.europa.eu/newsroom/growth/item-detail.cfm?item_id=45692`. [Accessed 2021, June 30].

EFAA. 2014. *Implementing the New European Accounting Directive* [online]. Available at: `https://www.wpk.de/uploads/tx_news/EFAA_Implementing_the_New_European_Accounting_Directive.pdf`. [Accessed 2021, June 30].

EU. 2013. *Směrnice Evropského parlamentu a Rady 2013/34/EU o ročních účetních závěrkách, konsolidovaných účetních závěrkách a souvisejících zprávách některých forem podniků, o změně směrnice Evropského parlamentu a Rady 2006/43/ES a o zrušení směrnic Rady 78/660/EHS a 83/349/EHS* [online]. Available at: `https://eur-lex.europa.eu/legal-content/CS/TXT/?uri=celex%3A32013L0034`. [Accessed 2021, June 30].

Gláserová, J., Otavová, M., Bušovová, A. and Dřínovská, E. 2017. Impact of Transposition of the Directive 2013/34/EU into the National Laws of EU Member States Emphatically V4. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 65 (2), 631–639. DOI: 10.11118/actaun201765020631.

Harvie, C. and Lee, B. C. (eds.) 2005. *Sustaining Growth and Performance in East Asia: The Role of Small and Medium Sized Enterprises*. Studies of Small and Medium Sized Enterprises in East Asia series, vol. 3. Edward Elgar Publishing.

Hýblová, E. 2017. *Účetní výkaznictví malých a středních podniků*. 1st ed. Masarykova univerzita. DOI: 10.5817/CZ.MUNI.M210-8756-2017.

Hýblová, E. 2019. The Current Problems of Harmonization of Accounting for Small and Medium-Sized Enterprises. *Economic research/Ekonomska Istraživanja*, 32 (1), 604–621. DOI: 10.1080/1331677X.2018.1561317.

Challinor, J. 2019. *Micro-Entity Accounts: Your Questions Answered* [online]. Available at: `https://www.informdirect.co.uk/company-records/micro-entity-accounts-questions-answered/`. [Accessed 2021, June 30].

Krzysztof, J. 2015. Sprawozdania finansowe jednostek mikro i jednostek małych jako wyraz dążenia do uproszczenia sprawozdawczości finansowej. In Micherda, B. (ed.). *Sprawozdawczość i rewizja finansowa: uwarunkowania ekonomiczne, społeczne i regulacyjne*, pp. 144–156.

Manová, P., Oberreiterová, M., Otavová, M. and Gláserová, J. 2018. The Impact of the Amendment to the Accounting Act on the Financial Reporting of Micro Enterprises. In *Enterprise and Competitive Environment: Conference Proceedings*, pp. 404–414.

Martyniuk, O. and Martyniuk, T. 2020. The Application of Simplified Financial Reporting for Micro and Small Enterprises in Central and Eastern Europe. *Zeszyty Teoretyczne Rachunkowości*, 107 (163), 137–157. DOI: 10.5604/01.3001.0014.2469.

Mošnja-Škare, L. and Galant, A. 2013. The Quality of Notes Relating SME Revenues and Expenditures Disclosures: Empirical Study of Croatian Financial Reporting Standards (CFRS) Implementation. *Economic Research/Ekonomska Istraživanja*, 26 (sup1), 343–368. DOI: 10.1080/1331677X.2013.11517656.

Müllerová, L. 2014. Změní nová evropská směrnice české účetnictví? *Český finanční a účetní časopis*, 2014 (2), 131–140. DOI: 10.18267/j.cfuc.400.

Ozimkovska, V. and Kubielas, S. 2013. Deviation of the Ukrainian Hryvnia from the Equilibrium Exchange Rate. *Post-Communist Economies*, 25 (1), 18–36. DOI: 10.1080/14631377.2013.756616.

Poniatowska, L. 2015. Z miany w sprawozdawczości finansowej w regulacjach ustawy o rachunkowości. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 388, 314–321. DOI: 10.15611/pn.2015.388.32.

Procházka, D. 2015. *Ekonomické dopady implementace IFRS v Evropě*. Praha: Oeconomica.

Skálová, J. 2011. Regulace účetnictví mikropodniků na rozcestí. *Český finanční a účetní časopis*, 2011 (3), 79–92. DOI: 10.18267/j.cfuc.120.

Stojilković, M. 2016. New Accounting Directive with the Aim to Improve Financial Reporting in the European Union. *Teme – Časopis za Društvene Nauke*, 40 (1), 103–122.

White, K. 2018. *What Is a Micro-Entity?* [online]. Available at: `https://www.buzzacott.co.uk/insights/what-is-a-micro-entity`. [Accessed 2021, June 30].

Zager, K. and Decman, N. 2016. Guidelines and Recommendations for Improving the Micro Entities Model of Financial Reporting. *Procedia Economics and Finance*, 39, 451–457. DOI: 10.1016/S2212-5671(16)30348-3.

Zákon č. 563/1991 Sb., o účetnictví, ve znění pozdějších předpisů. In *Sbírka zákonů České republiky* [online]. Available at: `https://apps.odok.cz/kpl-detail?pid=KORN9N6EU93J`. [Accessed 2021, June 30].

Žárová, M. 2013. Zlepší nová účetní směrnice účetní výkaznictví v Evropě? *Český finanční a účetní časopis*, 8 (3), 4–5. DOI: 10.18267/j.cfuc.344.

AUTHOR'S ADDRESS

Milena Otavová, Department of Accounting and Taxes, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: milena.otavova@mendelu.cz

Jana Gláserová, Department of Accounting and Taxes, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: jana.glaserova@mendelu.cz

Pavel Semerád, Department of Accounting and Taxes, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: pavel.semerad@atlas.cz

COST-INDUCED UNMET NEED FOR HEALTH CARE AMONG EUROPE'S OLDER ADULTS – THE ROLE OF SPECIFIC DISEASES

Veronika Kočiš Krůtilová[1], Lewe Bahnsen[2]

[1] *Mendel University in Brno, Czech Republic*
[2] *Scientific Institute of Private Health Insurance, Cologne, Germany*

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ABSTRACT

Older adults are the most vulnerable group to suffer from health care cost burdens which may result in barriers to health care consumption. Aiming to evaluate the relationship between cost-induced unmet need and specific age-related health conditions among the European 50+ population we perform age-specific regressions using data from the Survey of Health, Ageing and Retirement in Europe. The results show that unmet need is strongly associated with emotional disorders, arthritis and heart attack across all age groups. High blood pressure, high blood cholesterol, chronic lung disease, stomach ulcers, and fractures are significant correlates for specific age groups. This highlights the importance of a health condition-specific as well as age-specific approach when reducing inequalities in access to health care. Policy makers therefore should pay more attention to financial barriers accessing health care for specific groups of the older population and consider complementary protective features for people with specific health conditions.

KEY WORDS

unmet need, access to health care, health conditions, older adults, Europe

JEL CODES

I12, I18, I31, J18

1 INTRODUCTION

Although the majority of European countries have based their health care systems on universal coverage and universal access to health care, limitations to access resulting in unmet need are observed (Baeten et al., 2018; Fjær et al., 2017; Guessous et al., 2012; Litwin and Sapir, 2009; Mielck et al., 2009; Röttger et al., 2016). Unmet need is the lack or missing opportunity of any health care service while having an objective need for care. In particular treatment costs, in other words out-of-pocket (OOP) payments, are often claimed by patients

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to be one of the decisive reasons for forgoing health care (Chaupain-Guillot and Guillot, 2015; Connolly and Wren, 2017; Guessous et al., 2012; Schokkaert et al., 2017). Moreover, a positive link between unmet health care need and OOP payments has been found (Chaupain-Guillot and Guillot, 2015).

Empirical evidence suggests that older people have higher OOP payments and face a higher financial burden compared to younger, healthier and economically active individuals (Palladino et al., 2016). Thus, with respect to the fact that age is an important correlate of the need for health care and the incidence of chronic conditions and multimorbidity increases with age (Nielsen et al., 2017; Prince et al., 2015), older people might be the group most vulnerable to unmet need because of costs.

Against this background, our study aims to evaluate the relationship between unmet need due to costs and specific age-related health conditions taking into account various subgroups of the population 50+ in Europe. In the context of our analysis, unmet need is defined as a need to see any type of doctor or qualified nurse, emergency room or outpatient clinic visit, which is not met because of health care costs.

We deal with the research question: Which age-related health conditions play a role in forgoing health care for financial reasons? Additionally, we extend our analysis with the research question: Are there differences between age categories among older people?

In this study, we contribute to findings of the available empirical studies exploring unmet need among older people in Europe (Bremer, 2014; Herr et al., 2014; Litwin and Sapir, 2009; Mielck et al., 2009) providing a new insight into the issue of unmet need and its association with age-related health conditions. The main motivation for this approach is that specific health conditions are usually not considered by policy makers when implementing protective health policies. Moreover, we are not aware of any comprehensive study of both health condition-related and cost-induced unmet need for Europe.

The remainder of this paper is as follows. Section 2 continues with a brief literature review, highlighting different aspects related to unmet need. The methodological aspects of our analyses including data and variables used are described in Section 3. Results of regression models estimating correlates of unmet need for the 50+ population and specific age groups are presented in Section 4. Finally, our findings are discussed and conclusions drawn in the concluding parts Section 5 and 6 of the paper.

2 LITERATURE REVIEW

Investigating unmet need we might derive from the conceptual approach to health care utilisation presented by Andersen and Newman (2005). They distinguish three categories of individual determinants influencing health care utilisation, namely predisposing, need and enabling factors. Predisposing factors exist prior to the presence of a certain illness and include the consumer's predictable characteristics such as age, gender, marital status, previous health behaviour, race or ethnicity, family size, religion, and region of the country and residence. These factors are extended by the beliefs health care consumers have (values concerning health, knowledge about disease and treatment, and attitudes towards health care services). Need factors represent the most urgent reason to utilise health care as they relate to the onset of illness. They distinguish subjective need (self-perceived health status, symptoms of illness and disability) and objectively recognised need (physician-rated urgency of present condition, stated diagnoses, symptoms, etc.). Enabling factors ensure the possibility of access to health care. Factors such as several sources of income, education, insurance coverage, the regular source of care and the price of health services are considered.

A relationship between unmet need and socio-economic characteristics, self-perceived health status, the presence of diseases in general and specific types of health care services has

been explored in several studies (Allin et al., 2010; Chaupain-Guillot and Guillot, 2015; Connolly and Wren, 2017; Cylus and Papanicolas, 2015; Fjær et al., 2017). However, little has been written about the relationship between objectively recognised need, i.e. diagnosed health conditions, and unmet need due to costs in Europe. This is a very important aspect as some studies have found a relationship between unmet need and a decline in health outcomes (Ko, 2016) and even between unmet need and mortality (Lindström et al., 2020).

As people age some health conditions are more common than in the earlier stages of life often defined as "age-related diseases/conditions" (Chang et al., 2019). Among them the highest disease burden measured by Disability-Adjusted Life Years (DALYs) for the 50+ population is related to cancer (24.3%) and cardiovascular diseases (CVDs), including heart attack and stroke (21.6%). A high disease burden is also caused by musculoskeletal disorders[1] (9.6%), chronic obstructive pulmonary disease (4.1%), Diabetes mellitus (3.6%), Alzheimer's disease (3.4%) and falls (3.1%). Emotional disorders (1.6%), chronic kidney disease (1.2%), Parkinson's disease (0.7%), stomach/peptic ulcer disease (0.3%), and cataract (0.3%) also belong among the most common age-related health conditions but with a lower disease burden (GBD, 2020).

Evidence on unmet need shows that OOP payments can limit access to not only essential but also non-essential health care (Thomson et al., 2019). Thus, we can assume that unmet need might be perceived as for fatal as well as for less severe health conditions and therefore, the identification of particular health conditions associated with unmet need due to costs is desirable when policy makers target improvements in access to needed health care.

Older people are not a homogenous group and inequalities in health among various age groups of older population have been documented (GBD, 2020). Measured by DALYs cancer causes the highest burden in the age category 60 to 69 (28.9%) with the lowest value for the 80+ population (14.7%). Conversely, CVDs burden increases linearly with age starting at 13.7% of DALYs in the age group 50 to 59 over 25.8% among 70 to 79 years old and reaching 33.7% in the age group 80+. A noticeable inequality can be observed for musculoskeletal disorders (rheumatoid arthritis and osteoarthritis); the highest disease burden can be found in the age category 50 to 59 (13.3% of DALYs) with a decreasing trend (4.5% of DALYs) among the 80+ population. Similarly, the disease burden for emotional disorders decreases with age (2.5% of DALYs for the age group 50 to 59 and 0.8% for the 80+ group). Even if the burden of Alzheimer's disease is relatively low in younger old age (0.3% of DALYs among 50 to 59) it increases sharply in the old age and reaches 12.4% of DALYs in the age group 80+ (GBD, 2020).

3 DATA AND METHODS

3.1 Data Source

For our analysis we use the sixth wave of the Survey of Health, Ageing and Retirement in Europe (SHARE), release 6.0.0 (Börsch-Supan, 2017). SHARE is a multidisciplinary panel database containing cross-national micro data with detailed information on the European population aged 50 years and older. These data cover the key areas of life; namely health and socio-economics as well as social networks and support (Börsch-Supan et al., 2013). With the fieldwork completed in 2015, the sixth wave includes 17 European countries plus Israel. We include all European countries participating in the survey, namely Austria, Germany, Swe-

[1] Musculoskeletal disorders are not usually termed "age-related" because younger people are also affected; however, their prevalence increases with age and therefore, they are often listed as health conditions associated with older age.

den, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, the Czech Republic, Poland, Luxembourg, Portugal, Slovenia, Estonia and Croatia. Technical details such as questionnaire innovations, methodological improvements, new procedures and further important changes valid for the sixth wave are documented elsewhere (Malter and Börsch-Supan, 2017).

3.2 Unmet Need for Doctors' Visits

When investigating unmet need, the dependent variable is derived from the question "Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?" Any type of doctor or qualified nurse, emergency room or outpatient clinic visit is considered (derived from the question HC114_UnmetNeedCost). The response categories 'yes' and 'no' specify a binary indicator for cost-induced unmet need for doctors' visits (yes = 1, no = 0). Further in the text we use the term 'unmet need' for our dependent variable. The sample sizes and shares of unmet need (% of individuals claiming unmet need) are displayed in Tab. 1.

Tab. 1: Presence of unmet need in the full sample and respective subsamples

Sample	Frequency	Percent	Share of unmet need (%)
Full	64,394	100.00	4.81
50–59	15,185	23.58	6.08
60–69	23,101	35.88	4.72
70–79	16,984	26.37	4.45
80+	9,124	14.17	3.58

Note: Kruskal-Wallis test showed a statistically significant difference in unmet need between the age groups, $\chi^2(3) = 12.178$, $p = 0.0068$.

3.3 Factors Affecting Unmet Need

Our analysis is based on the demand concepts for health care and the utilisation of health care services presented by Andersen and Newman (2005) as well as on empirical findings in the literature outlined above. The final set of included predictors respects results of multicollinearity and goodness-of-fit tests. As the focus is on the need factors, we involve two types of health related variables. The most important is the set of health conditions. Health condition dummies consider the fact of being diagnosed with a specific health problem or not. These conditions are derived from the question of whether the respondent has or has ever had a specific condition diagnosed by a doctor and is either currently being treated for or bothered by this condition (question PH006_DocCond). Tab. 2 presents a more detailed description of the health conditions. Other health variables are 'limitations in basic activities of daily living' (ADL) – dressing, eating, walking, using the toilet and hygiene – and 'instrumental activities of daily living' (IADL) – shopping, housekeeping, accounting, food preparation and taking medication. Both are used as continuous variables – a number of reported limitations.

Further, we control for the predisposing factors representing socio-demographic characteristics – gender and age. 'Age' is entered as a categorical variable with four groups (50 to 59, 60 to 69, 70 to 79 and 80 years or older).

The last class defines enabling factors. Income and education are observed. Further, variables reflecting health care systems settings capturing the financial burden due to OOP payments, expressed as a share of equivalised income, and supplementary health insurance are included. To account for differences in household size the variable 'income' is adjusted according to the square root equivalence scale (Organisation for Economic Cooperation and Development, 2013). For the analysis, equivalised income quartiles are constructed within each observed country in order to reflect the income distribution. 'Education' is measured according to the International Standard Classification of Education (ISCED-97) but recoded into three categories; having no or only primary education, secondary and tertiary education. The burden of OOP payments is expected to have the different magnitude of various OOP payment types. Therefore, four categories are distinguished: OOP burden for inpatient care, outpatient care, drugs and nursing care. We also include a dummy variable for supplementary health insurance which may lower OOP pay-

Tab. 2: Description of health condition variables

Health condition variable	Description
Heart attack	Heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure
High blood pressure	High blood pressure or hypertension
High blood cholesterol	High blood cholesterol
Stroke	Stroke or cerebral vascular disease
Diabetes	Diabetes or high blood sugar
Chronic lung disease	Chronic lung disease such as chronic bronchitis or emphysema
Cancer	Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers
Stomach ulcers	Stomach or duodenal ulcer, peptic ulcer
Parkinson	Parkinson's disease
Cataracts	Cataracts
Fractures	Hip fracture and other fractures
Alzheimer	Alzheimer's disease, dementia, organic brain syndrome, senility or any other serious memory impairment
Emotional disorders	Other affective or emotional disorders, including anxiety, nervous or psychiatric problems
Arthritis	Rheumatoid Arthritis, Osteoarthritis or other rheumatism
Kidney disease	Chronic kidney disease

Note: Descriptions are taken from the SHARE main questionnaire for the sixth wave, question PH006_DocCond.

ments and thus, improve access to health care services. Additionally, to control for various health care policy frameworks of the countries included, the OOP payment share of current national spending on health (Organisation for Economic Cooperation and Development, 2020) is used as a country-level proxy indicator for financial protection as suggested by Thomson et al. (2019). The characteristics of the sample are displayed in Tab. 3.

3.4 Analytical Framework

In this cross-sectional study, we apply binary logistic regression models to understand the determinants of unmet need. Developed in hierarchical stages the analysis starts with the need factors, is then extended by the predisposing factors and finally adding enabling factors (complete model). Running the analysis in the hierarchical stages also serves as a robustness check of our model (see supplementary file in the Annex). In the main analysis, we run the complete model for the full sample. As a next step, we perform age-specific regressions for four age categories with the complete model specification in order to check the model's applicability in different stages of the ageing process and to account for possible differences between these stages. The 'age' variable is included here as a continuous variable to control for age differences within a specific age group.

Model diagnostics, including checking for influential outliers and multicollinearity, link testing and goodness of fit testing indicate that the model is properly fitted. Regression results are displayed as average marginal effects (AMEs) as they allow comparison between the models. AMEs first calculate the marginal effect in every individual observation of the respective independent variable and then calculate the average. This is particularly useful as it produces a single quantity measure that reflects the full distribution of the respective variable.

Tab. 3: Sample characteristics (percentage shares)

Variable	Full sample	Subsamples 50–59	60–69	70–79	80+
Predisposing					
Gender					
– male	44.13	40.53	45.87	45.98	42.25
– female	55.87	59.47	54.13	54.02	57.75
Age	67.74 (9.924)	55.47 (2.547)	64.50 (2.861)	74.14 (2.831)	84.49 (3.860)
Age groups					
– 50–59	23.58				
– 60–69	35.87				
– 70–79	26.38				
– 80+	14.17				
Need					
Heart attack	11.31	4.38	8.52	15.42	22.26
High blood pressure	41.50	26.15	39.77	51.42	52.96
High blood cholesterol	24.48	16.91	25.23	29.25	26.30
Stroke	3.66	1.53	2.71	4.92	7.24
Diabetes	13.42	6.72	12.84	17.82	17.88
Lung disease	6.36	4.60	5.84	7.49	8.55
Cancer	4.61	3.04	4.25	6.06	5.46
Stomach ulcers	4.12	3.91	3.85	4.47	4.53
Parkinson	0.85	0.15	0.43	1.37	2.12
Cataracts	8.06	1.42	4.64	12.60	19.27
Fractures	5.78	4.60	4.72	6.29	9.49
Alzheimer	2.01	0.41	0.67	2.08	7.98
Emotional disorders	6.75	7.25	6.14	6.59	7.72
Arthritis	24.90	16.79	22.93	29.16	35.44
Kidney disease	1.96	1.20	1.53	2.44	3.39
ADL*	0.251 (0.874)	0.11 (0.527)	0.14 (0.619)	0.27 (0.891)	0.73 (1.479)
IADL*	0.51 (1.493)	0.16 (0.698)	0.24 (0.925)	0.54 (1.477)	1.74 (2.605)
Enabling					
Education					
– none/primary	40.89	28.02	36.23	47.03	62.71
– secondary	37.07	44.25	40.25	33.34	23.98
– tertiary	22.04	27.72	23.52	19.63	13.31
Income					
– 1st quartile	25.52	25.33	25.68	25.42	25.64
– 2nd quartile	25.20	25.16	24.82	26.04	24.67
– 3rd quartile	24.81	24.81	25.03	24.13	25.48
– 4th quartile	24.47	24.70	24.47	24.41	24.21
OOP burden*					
– inpatient	0.100 (1.204)	0.068 (1.109)	0.069 (0.808)	0.134 (1.423)	0.171 (1.656)
– outpatient	1.262 (3.701)	1.254 (3.828)	1.262 (3.556)	1.355 (3.887)	1.107 (3.478)
– drugs	1.272 (2.929)	0.888 (2.344)	1.121 (2.673)	1.538 (3.248)	1.801 (3.598)
– nursing	0.559 (5.584)	0.120 (1.685)	0.199 (2.450)	0.474 (3.843)	2.359 (12.992)
Supp. HI	36.68	42.54	37.94	32.98	30.60
Country OOP share of total health expenditure*	19.27 (7.271)	19.02 (7.473)	19.14 (7.292)	19.38 (7.082)	19.81 (7.199)

Note: * OOP burden, ADL, IADL and country OOP share of total health expenditure – continuous variables – mean and standard deviation (in parentheses).

Tab. 4: Logit regression results for unmet need (average marginal effects)

Variable	Complete model	Age-specific models 50–59	60–69	70–79	80+
Predisposing					
Gender[a]	−0.0125*** (0.0017)	−0.0214*** (0.0040)	−0.0140*** (0.0028)	−0.0109*** (0.0033)	−0.0019 (0.0040)
Age group[b]					
– 60–69	−0.0243*** (0.0027)				
– 70–79	−0.0371*** (0.0028)				
– 80+	−0.0520*** (0.0029)				
Age		−0.0038*** (0.0007)	−0.0026*** (0.0005)	−0.0012* (0.0005)	−0.0030*** (0.0006)
Need					
Heart attack	0.0146*** (0.0023)	0.0179* (0.0075)	0.0186*** (0.0040)	0.0126*** (0.0037)	0.0087* (0.0042)
High blood pressure	0.0066*** (0.0017)	0.0132** (0.0042)	0.0050 (0.0028)	0.0066* (0.0032)	0.0029 (0.0040)
High blood cholesterol	0.0073*** (0.0018)	0.0061 (0.0047)	0.0075** (0.0029)	0.0074* (0.0032)	0.0052 (0.0039)
Stroke	0.0097* (0.0038)	0.0004 (0.0132)	0.0057 (0.0069)	0.0104 (0.0060)	0.0068 (0.0065)
Diabetes	0.0021 (0.0022)	−0.0001 (0.0066)	0.0031 (0.0037)	0.0037 (0.0037)	−0.0028 (0.0045)
Lung disease	0.0133*** (0.0028)	0.0183** (0.0070)	0.0058 (0.0049)	0.0163*** (0.0047)	0.0081 (0.0056)
Cancer	0.0018 (0.0038)	−0.0117 (0.0107)	0.0045 (0.0063)	0.0027 (0.0064)	0.0017 (0.0082)
Stomach ulcers	0.0150*** (0.0030)	0.0188** (0.0071)	0.0118* (0.0052)	0.0084 (0.0055)	0.0179** (0.0061)
Parkinson	−0.0101 (0.0085)	0.0165 (0.0392)	−0.0347 (0.0232)	−0.0140 (0.0110)	−0.0147 (0.0125)
Cataracts	0.0039 (0.0028)	0.0068 (0.0127)	0.0016 (0.0055)	0.0088* (0.0041)	0.0031 (0.0044)
Fractures	0.0090** (0.0031)	0.0217** (0.0076)	0.0103* (0.0053)	0.0034 (0.0056)	0.0016 (0.0059)
Alzheimer	−0.0114* (0.0058)	−0.0313 (0.0255)	0.0050 (0.0121)	−0.0087 (0.0093)	−0.0070 (0.0076)
Emotional disorders	0.0212*** (0.0024)	0.0284*** (0.0055)	0.0167*** (0.0042)	0.0158*** (0.0046)	0.0156** (0.0054)
Arthritis	0.0208*** (0.0018)	0.0230*** (0.0045)	0.0229*** (0.0030)	0.0202*** (0.0032)	0.0133*** (0.0039)
Kidney disease	−0.0019 (0.0050)	−0.0013 (0.0133)	−0.0121 (0.0095)	−0.0063 (0.0092)	0.0137 (0.0078)
ADL	0.0018 (0.0011)	−0.0023 (0.0035)	0.0009 (0.0022)	−0.0005 (0.0019)	0.0053** (0.0017)
IADL	0.0021** (0.0007)	0.0086*** (0.0025)	0.0055*** (0.0014)	0.00440*** (0.0012)	−0.0019 (0.0011)
Enabling					
Education[c]					
– secondary	−0.0147*** (0.0019)	−0.0114** (0.0044)	−0.0180*** (0.0031)	−0.0177*** (0.0035)	−0.0117** (0.0045)
– tertiary	−0.0223*** (0.0022)	−0.0220*** (0.0050)	−0.0277*** (0.0035)	−0.0192*** (0.0044)	−0.0087 (0.0064)
Income[d]					
– 2nd quartile	−0.0178*** (0.0023)	−0.0322*** (0.0056)	−0.0181*** (0.0038)	−0.0095* (0.0044)	−0.0049 (0.0052)
– 3rd quartile	−0.0298*** (0.0023)	−0.0513*** (0.0055)	−0.0299*** (0.0038)	−0.0197*** (0.0044)	−0.0098 (0.0052)
– 4th quartile	−0.0295*** (0.0025)	−0.0520*** (0.0057)	−0.0245*** (0.0041)	−0.0274*** (0.0044)	−0.0066 (0.0058)
OOP burden					
– inpatient	−0.0011 (0.0007)	−0.0007 (0.0018)	−0.0024 (0.0018)	−0.0026 (0.0018)	0.0001 (0.0008)
– outpatient	0.0009*** (0.0001)	0.0014*** (0.0003)	0.0009*** (0.0002)	0.0005 (0.0003)	0.0007* (0.0003)
– drugs	0.0017*** (0.0002)	0.0027*** (0.0005)	0.0018*** (0.0003)	0.0011*** (0.0003)	0.0015*** (0.0003)
– nursing	−0.0004* (0.0002)	−0.0037 (0.0019)	−0.0002 (0.0004)	−0.0007 (0.0005)	−0.0000 (0.0002)
Supp. HI	−0.0133*** (0.0022)	−0.0174*** (0.0047)	−0.0151*** (0.0036)	−0.0093* (0.0043)	−0.0076 (0.0058)
OOP share of total health expenditure	0.0046*** (0.0001)	0.0050*** (0.0003)	0.0043*** (0.0002)	0.0047*** (0.0002)	0.0046*** (0.0003)

Note: Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Reference categories: [a]female, [b]50–59, [c]none/primary, [d]1st quartile.

4 RESULTS

Estimations for determinants of cost-induced unmet need to see a doctor are presented in Tab. 4. First, we interpret the results of the complete model for the 50+ population, then the results of the age-specific models. We focus on the interpretation of estimates related to health and health care factors especially.

4.1 Results of the Complete Model for the 50+ Population

Starting with the factors of main importance, the need factors, a significant association of unmet need with several health conditions is found among 50+ population. Emotional disorders (AME = 0.0212, $p < 0.001$) and arthritis (AME = 0.0208, $p < 0.001$) are strong correlates which most increase the probability of facing unmet need. Important correlates are stomach ulcers (AME = 0.0150, $p < 0.001$), heart attack (AME = 0.0146, $p < 0.001$) and chronic lung disease (AME = 0.0133, $p < 0.001$). A significant and positive association is also found for high blood pressure, high blood cholesterol, stroke, and fractures even if average marginal effects are rather small. Only Alzheimer's disease (AME = −0.0114, $p < 0.05$) shows a negative association with unmet need but at a lower significance level with no significant results for the age categories. While the number of limitations in IADL increases the probability of unmet need (but with a relatively low marginal effect), the number of limitations in ADL is not significant.

Regarding other health care variables, the OOP payments burden provides significant results for outpatient care (AME = 0.0009, $p < 0.001$) and drugs (AME = 0.0017, $p < 0.001$) even if average marginal effects are rather low. Nursing care showed a negative association; however, average marginal effects are negligible. The presence of supplementary health insurance is a strong and preventive correlate of unmet need (AME = 0.013, $p < 0.001$).

Age plays a significant role and is a strong correlate for unmet need. The results for age categories suggest that the likelihood of forgoing health care sharply decreases with age (AME = −0.052, $p < 0.001$, for 80+ age group). In other words, the younger older adults have a higher probability of experiencing an unmet need.

Briefly commenting on other control variables, women have a higher probability to face unmet need. Higher education leads to lower probability of unmet need, while the probability is lowest for those with tertiary education. Belonging to a higher income group, especially to the third and fourth income quartile, is associated with a lower probability of forgoing care. Thus, the greater the financial security the less likely is an unmet need for health care due to costs. The country-level indicator showed that an increasing share of OOP payments on national health spending is likely to increase the probability of unmet need.

4.2 Results of the Age-Specific Models

The results for the pre-retirement population (age category 50–59) showed that the probability of unmet need increases with an increasing number of limitations in IADL and average marginal effects are larger compared to the full sample. Seven health conditions are found to be associated with unmet need. The strongest effect relates to emotional disorders (AME = 0.0284, $p < 0.001$), arthritis (AME = 0.0230, $p < 0.001$) and fractures (AME = 0.0217, $p < 0.01$). A weaker but significant association is found for those who reported stomach ulcers, chronic lung disease, heart attack and high blood pressure (listed according to the magnitude). The OOP burden for outpatient care and especially for drugs is related to unmet need and is a much stronger correlate compared to the full sample. Supplementary health insurance is again identified as a preventive factor. Importantly, belonging to the lowest income quartile significantly increases the probability of facing unmet need.

Individuals close to retirement or shortly after retirement (age category 60–69) are likely

to forgo care due to arthritis (AME = 0.0229, $p < 0.001$), heart attack (AME = 0.0186, $p < 0.001$) and emotional disorders (AME = 0.0167, $p < 0.001$). Stomach ulcers, fractures and high blood cholesterol also show a positive association but with lower marginal effects. As the previous age group, limitations in IADL increase the probability of unmet need. The magnitude of OOP burden for drugs and outpatient care corresponds to the effects for the 50+ population. As with the previous age category, supplementary health insurance decreases the probability of unmet need significantly as well as belonging to the lowest income quartile continues to put individuals at a higher risk of forgoing care.

Individuals in the post-retirement phase (age category 70–79) with limitations in IADL experience a higher probability of unmet need. Unmet need is significantly and still with relatively high magnitude related to arthritis (AME = 0.0202, $p < 0.001$). Chronic lung disease (AME = 0.0163, $p < 0.001$), emotional disorders (AME = 0.0158, $p < 0.001$) and heart attack (AME = 0.0126, $p < 0.001$) are important correlates of unmet need. A low but significant probability of facing unmet is also found for cataracts, high blood pressure and high blood cholesterol. From the OOP payment burden point of view only payments for drugs are a significant but a weak correlate for unmet need. Supplementary health insurance is negatively correlated with unmet need with a low marginal effect. Higher income has a significantly preventive character as for the previous age groups

Among the oldest old (age category 80+) four health conditions were shown to increase the probability of facing an unmet need with the highest magnitude of stomach ulcers (AME = 0.0179, $p < 0.01$), emotional disorders (AME = 0.0156, $p < 0.01$), arthritis (AME = 0.0133, $p < 0.001$) and with the lowest marginal effect for heart attack (AME = 0.0087, $p < 0.05$). By contrast to the previous age groups the number of limitations in IADL is not significant but limitations in ADL show a positive even if a low association with unmet need. The OOP burden from drugs and to a lesser extent from outpatient care persists as the risk factor for unmet need. Income situation and supplementary health insurance are no longer significant.

5 DISCUSSION

It seems to be desirable to extend investigations of unmet need due to costs by addressing specific health conditions. We found a positive association between cost-induced unmet need and certain age-related health conditions. Additionally, we discovered differences in the effects of health conditions on unmet need for specific age groups.

Several health conditions were shown as a risk factor for unmet need among the population 50+ at large; however, across the age groups only arthritis, emotional disorders and to a lesser extent heart attack are associated with unmet need. Based on official statistics CVDs and musculoskeletal disorders are frequent health conditions in older age and highly contribute to the disease burden (GBD, 2020). Thus, greater health care needs can be associated with OOP payments for these health conditions leading to a strong association with unmet need due to costs. On the other hand, emotional disorders cause a low disease burden compared to CVDs and musculoskeletal disorders with a decreasing trend in age (GBD, 2020) but based on our findings they are one of the most important correlates for unmet need regardless of age group. An association of emotional disorders or depressive symptoms with unmet need among older adults has been shown in other studies (Bremer, 2014; Callander et al., 2017; Litwin and Sapir, 2009; Ronksley et al., 2012).

Discussing age differences, a more intensive perception of unmet need in relation to arthritis and emotional disorders for younger age groups corresponds to a higher disease burden for these groups. On the contrary, the disease burden for heart attack linearly increases with age and

is highest for the oldest old but as shown the probability of facing unmet need is the lowest for age group 80+. In addition, an interesting result is found for fractures. This disorder is strongly associated with unmet need for the age group 50–59 but it is not associated with age groups 70+ at all even if the prevalence of fractures increases with age. This might imply that physical limitations probably resulting in economic limitations play an important role.

Our findings suggest that the association of specific health conditions and unmet need does not have to be necessarily related to the prevalence of health conditions or their burden. Moreover, it is worth highlighting that several health conditions exhibited a strong associative power with unmet need for the pre-retirement population (50–59). These findings have important implications for health care policies because the majority of protective measures are usually targeted at the population in the retirement age (mostly 65+) and age is the only one criterion.

The effect of specific health conditions on unmet need might be further accelerated with a presence of limitations in IADL for younger age groups, especially for the age group 50–59. These limitations quite often go hand in hand with long-term care dependency and increased non-health care costs (Schokkaert et al., 2017) and therefore may put individuals at serious risk.

Discussing only the effect of age it is obvious that policy makers should pay more attention to older adults of a younger age. This conclusion is also supported by findings of other study about unmet need based on the first wave of SHARE (Litwin and Sapir, 2009). One might argue that studies focusing on OOP payments have shown that especially the oldest-old are the group most vulnerable to the OOP burden and thus, higher probability of unmet need would be expected; however, even if the younger older adults have a lower OOP burden they might feel themselves to be much more threatened by unmet need due to the fact that they are still obliged to support other family members financially or because of possible instability/insecurity of their earnings compared to people drawing regularly an old age pension. For that matter, it was found that a pension entitlement is associated with a decline in unmet need (Reeves et al., 2017). Moreover, as already suggested above the majority of protective features from high OOP payments are mostly targeted at the oldest generations, and therefore the younger older adults whose health capacity is in the phase of deterioration might urgently feel the need to have access to desirable care. From a different point of view, it might be explained by the theory of demand for health care. The consumption of health care services is taken not only as a consumer good but also an investment commodity (Grossman, 1972). Investing in a good health might produce time for other activities (market and nonmarket), thus the younger older adults might be more sensitive to cost induced unmet need than older people who are less motivated to invest in their mostly already very low health capacity. This could support our findings for the youngest age group. In any case, it seems that statements about the effect of age on unmet healthcare need to be made with more caution and an age-specific approach to investigating unmet need is thus justified.

Additional important findings have to be highlighted. Income is a powerful correlate of unmet need with the highest risk for the youngest old. This effect is supported by other studies concluding that OOP payment-induced unmet need is a problem among low-income individuals (Bremer, 2014; Herr et al., 2014; Kim et al., 2017; Mielck et al., 2009; Schokkaert et al., 2017). Thus, it seems to be highly relevant to improve access to health care for the 50+ population with low income. Furthermore, even if the associative power of OOP payments and unmet need is rather low and depends on the type of health care it is worth paying attention to OOP payments for drugs especially because they cause the highest burden of household budgets (Baeten et al., 2018). In relation to cost, or respectively the price of health care services, the importance of supplementary health insurance as a preventive factor can be highlighted. These findings suggest that cost plays an important role and additional coverage is desirable because

it prevents unmet need for the youngest-old especially.

Interpreting our findings, several aspects have to be taken into account. A pan-European approach is applied in our analysis bearing in mind that observed health care systems differ. On the other hand, we can find some commonalities in these health care systems which, to a particular extent, narrow differences among vulnerable groups. In essence, all health care systems apply some OOP payments (in particular for medication and outpatient care), claim to secure universal access to health care and protect the most vulnerable including some forms of protection from high OOP payments for chronically ill and older people (Baeten et al., 2018). Furthermore, cultural differences, values and beliefs of a society should be kept in mind as well. Thus, even if we control for cost sharing policy settings, one of the limitations of our study is a missing view on national health care policies which influence people's health care utilisation. Case studies of particular countries are a desirable step for future research. Another limitation is the cross-sectional design of our study. Extending it to a longitudinal analysis could allow tracing the effects of changes in correlates on changes in unmet need and might further increase the resonance of the findings.

Although SHARE is a unique data set to explore the older population and their behavioural patterns, several limitations emerge from the survey. Non-response and attrition may lead to sample selection bias, limitation of the data representativeness and the generalisation of the results. More on this issue can be found in Börsch-Supan et al. (2013). Basically, SHARE's limitations come from its strengths, the complexity and interdisciplinarity. In terms of that, a combination with more detailed and objectively recognised information about health conditions and treatment would be desirable for future research on unmet need related to specific health conditions. Finally, we acknowledge that unmet need due to financial reasons is only one of the aspects of forgoing health care considered in this paper.

6 CONCLUSION

Unmet need to see any type of doctor or qualified nurse, emergency room or outpatient clinic visit due to cost is a phenomenon which is present among older European adults. Our study contributes to the discussion on unmet need and extends it by highlighting the importance of a health condition and age-specific approach. If the objective of national health policies is to improve access to health care and to reduce perceived unmet need for the European 50+ population at large, the management of diseases such as emotional disorders, including anxiety, nervous and psychiatric problems as well as rheumatoid arthritis, osteoarthritis or other rheumatism should be a priority. The impact of cardiovascular diseases, chronic lung diseases and stomach ulcers nevertheless should be monitored as well. We conclude that policy makers should pay more attention to financial barriers within the health care sector taking into account also younger groups of the older population and to specific health conditions and their association with forgoing health care. Thus, complementing current general protective social policies with detailed health-related measures targeted at vulnerable groups could be a serious option. In the short run, implementing and/or extending safety nets and capping OOP payments with respect to income could improve access to health care. Another important alternative, although mainly in the long run, is implementing a comprehensive disease prevention strategy. Accompanied with promoting supplementary health insurance could also help to reduce the share of people with cost-related unmet need.

In order to make specific policy recommendations, results have to be interpreted against the background of national health care systems and regulations which is a step for future research. It would also be relevant to investigate unmet need across time to discover more about the

persistence of unmet need and the implications of changes in correlates and outcomes. Further, it might be important to look closer at certain population subgroups with a higher prevalence of unmet need (as from health condition perspective as well as from socio-demographic and economic perspective) to narrow down potential influences.

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8 REFERENCES

Allin, S., Grignon, M. and Le Grand, J. 2010. Subjective Unmet Need and Utilization of Health Care Services in Canada: What are the Equity Implications? *Social Science & Medicine*, 70 (3), 465–472. DOI: 10.1016/j.socscimed.2009.10.027.

Andersen, R. and Newman, J. F. 2005. Societal and Individual Determinants of Medical Care Utilisation in the United States. *The Milbank Quarterly: A Multidisciplinary Journal of Population Health and Health Policy*, 83 (4), 1–28. DOI: 10.1111/j.1468-0009.2005.00428.x.

Baeten, R., Spasova, S., Vanhercke, B. and Coster, S. 2018. *Inequalities in Access to Healthcare: A Study of National Policies*. European Commission, Brussels. DOI: 10.2767/371408.

Börsch-Supan, A. 2019. *Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 6*. Release version: 6.0.0. SHARE-ERIC. Data set. DOI: 10.6103/SHARE.w6.600.

Börsch-Supan, A., Brandt, M., Hunkler, C., Kneip, T., Korbmacher, J., Malter, F., Schaan, B., Stuck, S. and Zuber, S. 2013. Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *International Journal of Epidemiology*, 42 (4), 992–1001. DOI: 10.1093/ije/dyt088.

Bremer, P. 2014. Forgone Care and Financial Burden Due to Out-of-Pocket Payments within the German Health Care System. *Health Economics Review*, 4, 36. DOI: 10.1186/s13561-014-0036-0.

Callander, E. J., Corscadden, L. and Levesque, J.-F. 2017. Out-of-Pocket Healthcare Expenditure and Chronic Disease – Do Australians Forgo Care Because of the Cost? *Australian Journal of Primary Health*, 23 (1), 15–22. DOI: 10.1071/PY16005.

Chang, A. Y., Skirbekk, V. F., Tyrovolas, S., Kassebaum, N. J. and Dieleman, J. L. 2019. Measuring Population Ageing: An Analysis of the Global Burden of Disease Study 2017. *Lancet Public Health*, 4 (3), e159–e167. DOI: 10.1016/S2468-2667(19)30019-2.

Chaupain-Guillot, S. and Guillot, O. 2015. Health System Characteristics and Unmet Care Needs in Europe: An Analysis Based on EU-SILC Data. *European Journal of Health Economics*, 16 (7), 781–796. DOI: 10.1007/s10198-014-0629-x.

Connolly, S. and Wren, M.-A. 2017. Unmet Healthcare Needs in Ireland: Analysis Using the EU-SILC Survey. *Health Policy*, 121 (4), 434–441. DOI: 10.1016/j.healthpol.2017.02.009.

Cylus, J. and Papanicolas, I. 2015. An Analysis of Perceived Access to Health Care in Europe: How Universal is Universal Coverage? *Health Policy*, 119 (9), 1133–1144. DOI: 10.1016/j.healthpol.2015.07.004.

Fjær, E. L., Stornes, P., Borisova, L. V., McNamara, C. L., Eikemo, T. A. 2017. Subjective Perceptions of Unmet Need for Health Care in Europe among Social Groups: Findings from the European Social Survey (2014) Special Module on the Social Determinants of Health. *European Journal of Public Health*, 27 (suppl_1), 82–89. DOI: 10.1093/eurpub/ckw219.

GBD. 2020. *Data Resources* [online]. Institute for Health Metrics and Evaluation (IHME), Seattle. Available at: `http://ghdx.healthdata.org/gbd-results-tool?params=gbd-api-2017-permalink/553a7661ea994113d0132a2141914885`. [Accessed 2021, October 26].

Grossman, M. 1972. On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy*, 80 (2), 223–255. DOI: 10.1086/259880.

Guessous, I., Gaspoz, J. M., Theler, J. M. and Wolff, H. 2012. High Prevalence of Forgoing Healthcare for Economic Reasons in Switzerland: A Population-Based Study in a Region with Universal Health Insurance Coverage. *Preventive Medicine*, 55 (5), 521–527. DOI: 10.1016/j.ypmed.2012.08.005.

Herr, M., Arvieu, J.-J., Aegerter, P., Robine, J.-M. and Ankri, J. 2014. Unmet Health Care Needs of Older People: Prevalence and Predictors in a French Cross-Sectional Survey. *European Journal of Public Health*, 24 (5), 808–813. DOI: 10.1093/eurpub/ckt179.

Kim, T. J., Vonneilich, N., Lüdecke, D. and von dem Knesebeck, O. 2017. Income, Financial Barriers to Health Care and Public Health Expenditure: A Multilevel Analysis of 28 Countries. *Social Science & Medicine*, 176, 158–165. DOI: 10.1016/j.socscimed.2017.01.044.

Ko, H. 2016. Unmet Healthcare Needs and Health Status: Panel Evidence from Korea. *Health Policy*, 120 (6), 646–653. DOI: 10.1016/j.healthpol.2016.04.005.

Lindström, C., Rosvall, M. and Lindström, M. 2020. Unmet Health-Care Needs and Mortality: A Prospective Cohort Study from Southern Sweden. *Scandinavian Journal of Public Health*, 48 (3), 267–274. DOI: 10.1177/1403494819863530.

Litwin, H. and Sapir, E. V. 2009. Forgone Health Care Due to Cost among Older Adults in European Countries and in Israel. *European Journal of Ageing*, 6 (3), 167–176. DOI: 10.1007/s10433-009-0126-8.

Malter, F. and Börsch-Supan, A. 2017. *SHARE Wave 6: Panel Innovations and Collecting Dried Blood Spots*. Munich Center for the Economics of Aging (MEA), Munich.

Mielck, A., Kiess, R., von dem Knesebeck, O., Stirbu, I. and Kunst, A. E. 2009. Association between Forgone Care and Household Income among the Elderly in Five Western European Countries Analyses Based on Survey Data from the SHARE-Study. *BMC Health Services Research*, 9, 52. DOI: 10.1186/1472-6963-9-52.

Nielsen, C. R., Halling, A. and Andersen-Ranberg, K. 2017. Disparities in Multimorbidity Across Europe: Findings from the SHARE Survey. *European Geriatric Medicine*, 8 (1), 16–21. DOI: 10.1016/j.eurger.2016.11.010.

Organisation for Economic Cooperation and Development. 2013. *Framework for Statistics on the Distribution of Household Income, Consumption and Wealth*. OECD Publishing, Paris.

Organisation for Economic Cooperation and Development. 2020. *Health Spending Data (Out-of-Pocket Expenditure as a Percentage of Total Expenditure on Health in 2015)* [online]. Available at: `https://stats.oecd.org/viewhtml.aspx?datasetcode=SHA&lang=en#`. [Accessed 2020, November 16].

Palladino, R., Lee, J. T., Hone, T., Filippidis, F. T. and Millett, C. 2016. The Great Recession and Increased Cost Sharing in European Health Systems. *Health Affairs*, 35 (7), 1204–1213. DOI: 10.1377/hlthaff.2015.1170.

Prince, M. J., Wu, F., Guo, Y., Gutierrez Robledo, L. M., O'Donnell, M., Sullivan, R. and Yusuf, S. 2015. The Burden of Disease in Older People and Implications for Health Policy and Practice. *Lancet*, 385 (9967), 549–562. DOI: 10.1016/S0140-6736(14)61347-7.

Reeves, A., McKee, M., Mackenbach, J., Whitehead, M. and Stuckler, D. 2017. Public Pensions and Unmet Medical Need Among Older People: Cross-National Analysis of 16 European Countries, 2004–2010. *Journal of Epidemiology & Community Health*, 71 (2), 174–180. DOI: 10.1136/jech-2015-206257.

Ronksley, P. E., Sanmartin, C., Quan, H., Ravani, P., Tonelli, M., Manns, B., Hemmelgarn, B. R. 2012. Association between Chronic Conditions and Perceived Unmet Health Care Needs. *Open Medicine*, 6 (2), e48–e58.

Röttger, J., Blümel, M., Köppen, J., Busse, R. 2016. Forgone Care among Chronically Ill Patients in Germany – Results from a Cross-Sectional Survey with 15,565 Individuals. *Health Policy*, 120 (2), 170–178. DOI: 10.1016/j.healthpol.2016.01.004.

Schokkaert, E., Steel, J. and Van de Voorde, C. 2017. Out-of-Pocket Payments and Subjective Unmet Need of Healthcare. *Applied Health Economics and Health Policy*, 15 (5), 545–555. DOI: 10.1007/s40258-017-0331-0.

Thomson, S., Cylus, J. and Evetovits, T. 2019. *Can People Afford to Pay for Health Care? New Evidence on Financial Protection in Europe*. Regional report. World Health Organization Regional Office for Europe, Copenhagen.

9 ANNEX

Tab. 5: Logit regression results for unmet need (average marginal effects) – model developed in hierarchical stages.

Variable	Need	+Predisp	+Enabl	+OOP share
Need				
Heart attack	0.0094*** (0.0024)	0.0163*** (0.0024)	0.0115*** (0.0024)	0.0146*** (0.0023)
High blood pressure	0.0069*** (0.0018)	0.0105*** (0.0018)	0.0037* (0.0018)	0.0066*** (0.0017)
High blood cholesterol	0.0148*** (0.0019)	0.0146*** (0.0019)	0.0123*** (0.0019)	0.0073*** (0.0018)
Stroke	0.0037 (0.0039)	0.0060 (0.0039)	0.0053 (0.0039)	0.0097* (0.0038)
Diabetes	0.0049* (0.0023)	0.0070** (0.0023)	0.0001 (0.0023)	0.0021 (0.0022)
Lung disease	0.0137*** (0.0029)	0.0142*** (0.0029)	0.0097*** (0.0028)	0.0133*** (0.0028)
Cancer	−0.0056 (0.0040)	−0.0047 (0.0040)	−0.0032 (0.0039)	0.0018 (0.0038)
Stomach ulcers	0.0271*** (0.0031)	0.0253*** (0.0031)	0.0212*** (0.0031)	0.0150*** (0.0030)
Parkinson	−0.0087 (0.0088)	−0.0040 (0.0088)	−0.0051 (0.0086)	−0.0101 (0.0085)
Cataracts	−0.0032 (0.0029)	0.0037 (0.0030)	0.0035 (0.0029)	0.0039 (0.0028)
Fractures	0.0051 (0.0032)	0.0057 (0.0032)	0.0077* (0.0031)	0.0090** (0.0031)
Alzheimer	−0.0205*** (0.0061)	−0.0151* (0.0061)	−0.0123* (0.0060)	−0.0114* (0.0058)
Emotional disorders	0.0334*** (0.0025)	0.0273*** (0.0025)	0.0211*** (0.0025)	0.0212*** (0.0024)
Arthritis	0.0173*** (0.0018)	0.0167*** (0.0019)	0.0157*** (0.0018)	0.0208*** (0.0018)
Kidney disease	−0.0022 (0.0052)	−0.0031 (0.0052)	−0.0084 (0.0052)	−0.0019 (0.0050)
ADL	0.0011 (0.0012)	−0.0003 (0.0012)	−0.0002 (0.0011)	0.0018 (0.0011)
IADL	0.0023** (0.0007)	0.0045*** (0.0008)	0.0025*** (0.0008)	0.0021** (0.0007)
Predisposing				
Gender[a]		−0.0181*** (0.0018)	−0.0126*** (0.0018)	−0.0125*** (0.0017)
Age[b]				
– 60–69		−0.0212*** (0.0027)	−0.0259*** (0.0028)	−0.0243*** (0.0027)
– 70–79		−0.0312*** (0.0028)	−0.0394*** (0.0029)	−0.0371*** (0.0028)
– 80+		−0.0457*** (0.0030)	−0.0531*** (0.0030)	−0.0520*** (0.0029)
Enabling				
Education[c]				
– secondary			−0.0250*** (0.0019)	−0.0147*** (0.0019)
– tertiary			−0.0307*** (0.0022)	−0.0223*** (0.0022)
Income[d]				
– 2nd quartile			−0.0124*** (0.0023)	−0.0178*** (0.0023)
– 3rd quartile			−0.0223*** (0.0023)	−0.0298*** (0.0023)
– 4th quartile			−0.0204*** (0.0025)	−0.0295*** (0.0025)
OOP burden				
– inpatient			−0.0010 (0.0007)	−0.0011 (0.0007)
– outpatient			0.0014*** (0.0001)	0.0009*** (0.0001)
– drugs			0.0029*** (0.0002)	0.0017*** (0.0002)
– nursing			−0.0003 (0.0002)	−0.0004* (0.0002)
Supp. HI			−0.0432*** (0.0023)	−0.0133*** (0.0022)
OOP share of total health expenditure				0.0046*** (0.0001)

Note: Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Reference categories: [a]female, [b]50–59, [c]none/primary, [d]1st quartile.

AUTHOR'S ADDRESS

Veronika Kočiš Krůtilová, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: veronika.krutilova@mendelu.cz

Lewe Bahnsen, Scientific Institute of Private Health Insurance, Gustav-Heinemann-Ufer 74c, 50968 Cologne, Germany, e-mail: lewe.bahnsen@wip-pkv.de

WHAT AFFECTS INCOME IN SUB-SAHARAN AFRICA?

Raymond Kofi Adjei[1], Veronika Kajurová[1]

[1] *Mendel University in Brno, Czech Republic*

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ABSTRACT

This paper closely examines how selected macroeconomic variables affect income in Sub-Saharan Africa (SSA). The study employs a more recent dataset and uses fixed and random effects models to characterise the nature and direction of impact evidenced from the data. The analysis further incorporates a monetary policy element by introducing money market interest rate and examining its effects. In general, the paper reveals that income in SSA is significantly affected by trade. Additionally, money market interest rate is found to have no major impact on income as may be perceived, suggesting that this aspect of monetary policy has not played a major role in affecting income levels in SSA. The findings of this study can serve as a guide for policy makers within the region when considering policy actions in relation to income.

KEY WORDS

income, international trade, sub-Saharan Africa, money market interest rate

JEL CODES

B27, E01, E43, F14, F35

1 INTRODUCTION

Economic literature is replete with studies supporting and some opposing the various elements that characterize income generation and its determinants, but few (Ravallion, 2004; Afonso et al., 2010; Mehregan et al., 2012; Ata et al., 2019) examine the issues associated with it in the context of Sub-Saharan Africa (SSA). Admittedly, there is no one variable that can be identified as single-handedly being the only factor that affects income in any given economy. Historically, there are always a number of these factors with few country-specific variations. It is no wonder that the frequently cited paper of Roberto Perotti (1996) even considers demographic factors and includes democracy in his study of income distribution and growth. It

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is fair to say that he paved the way for a more insightful and a deeper approach towards the investigation of income and its distribution and effects in recent history.

When considering the macroeconomic factors that affect income in SSA, it is vital to observe that in some of the countries, international trade constitutes an important share of the gross domestic product (GDP) as it proves valuable in the prospects of profit growth and reduced dependence on already known local markets (Surugiu and Surugiu, 2015). Thus, it is essential to mention that the importance of international trade is at a higher level in the region now more than ever. The participation of SSA countries in international trade allows for the availability of many trade-related opportunities as they emerge into more globalized markets. In this regard, the significance of international trade and its links to income generation cannot be underestimated. Equally vital is the prominence of foreign aid, FDI, and inflation in the same vein.

Consequently, this paper aims to investigate the relationship between selected macroeconomic variables (which include trade, foreign aid, FDI, and inflation) and income in the context of SSA during the period of 2005 to 2018. Additionally, the study attempts to provide a better overview of direct monetary policy effects on income within the region by examining the effect of money market interest rate on income. This is something that is missing in available economic literature within the scope of SSA.

The study's contribution to current economic literature is characterised in two aspects. First and foremost, the paper uses a more recent dataset and a broader selection of countries to investigate the relationship between income and the selected determinants, thereby providing a more current and comprehensive contribution to the current state of knowledge in the subject area. Secondly, by including a broader range of macroeconomic variables such as foreign direct investment (FDI), foreign aid, inflation, and international trade, the paper is able to offer more ample recommendations for policy makers in SSA. Furthermore, the paper introduces an extended model to investigate the effects of monetary policy by incorporating money market interest rate, thereby offering meaningful insights for both academics and policy makers about the monetary policy effect on income within a region that often lacks such targeted research.

The remaining sections of the paper are organized in the following manner: First, a review of literature on factors affecting income is given in Section 2. Materials and Methods used in the study are presented in Section 3. The empirical result of the analysis and discussion then follows in Sections 4 and 5 respectively. Finally, the conclusion is presented.

2 REVIEW OF LITERATURE

2.1 Trade, FDI, and Income

International trade is estimated to have both direct and indirect effects on development by enhancing growth and promoting employment in various sectors of an economy. Nevertheless, the direct effects that trade exhibits on income has always been difficult to measure. In a recent study, Feyrer (2019) estimated that about 17 percent of the variations in income growth across countries between 1960 and 1995 can be accounted for by the differences in predicted growth of trade. Amjad (2015) also aimed at investigating the impact of trade on income distribution localised to Pakistan and found trade as having a negative impact on income distribution and likewise that income inequality was affected by remittances and GDP.

Erpek (2014) similarly investigated the effects of international trade on income in the context of Western Asia and found a positive relationship between international trade and income. Additionally, the study of Lee (2014) also revealed a statistically significant relationship between international trade, income inequality and poverty.

Meanwhile, Meschi and Vivarelli (2009) found that in developing countries, especially through importation and exportation, trade with high-income countries tend to worsen income distribution. By extension, differences in technology and the nature of those technologies themselves between developed and developing countries may be a significant factor influencing how trade affects income distribution. On the other hand, the studies of Irwin and Terviö (2002), Noguer and Siscart (2005), and Aradhyula et al. (2007) suggest that more trade increases income. However, Irwin and Terviö (2002) also highlighted that the estimates on the effects of trade on income using OLS were biased in almost all the years they sampled, akin to the findings of Frankel and Romer (1999) who successfully introduced country-specific geographic attributes in their study and subsequently concluded that trade has a positive and significant effect on income.

FDI inflows are often seen as a significant contributor to the overall gains of the host economy. Such inflows can help increase GDP and assure a multiplier effect which when positive, can result in an increase in national income. The question to consider is if this is always the case and if the response to income differs in the context of SSA. Studying the relationship between FDI and economic growth, Mahembe and Odhiambo (2014) revealed that FDI is a major contributor to economic growth. They argue that FDI affects economic growth by stimulating the transfer of knowledge both in skill acquisition and labour training. This seems to be a widely held position among academics. However, Herzer et al. (2008) challenged this position by arguing that FDI does not have a short- or long-term effect on growth for majority of the countries in their sample. They further argued that the correlation between FDI growth and its impact on income per capita in developing countries is rather not clear.

Wu and Hsu (2012) also concluded based on their study that FDI has a minimal effect on income inequality whereas international trade has a positive impact on income distribution. Meanwhile, Gao (2004) used a similar approach as Frankel and Romer (1999) and established that FDI inflows have a positive correlation with income. Considering that various authors report different findings about the impact of FDI on income and subsequently on economic growth, it seems likely that the more a host country is systematically and infrastructurally developed, the more it tends to gain from FDI inflows. Thus, when an economy has a well-developed and properly structured financial market, it stands to gain considerably more from the inflows of FDI (Alfaro et al., 2004).

2.2 Inflation, Interest Rate, Foreign Aid, and Income

While contemporary economic literature is awash with studies about the effect of inflation on income inequality, the direct effects of inflation on income levels itself is often not mentioned. An example is the study of Monnin (2014) which concludes that low inflation rates are associated with higher income inequality and as inflation increases, income inequality decreases. Relatedly, Li and Zou (2002) report that inflation decreases the rate of economic growth and has a negative impact on income distribution. Thus, a direct report on the actual impact of inflation on income levels seem to be missing especially in the SSA context.

Similarly, various authors have examined interest rate in an approach to characterise its effect on economic growth but again, a detailed examination of its direct effect on income levels seem to be missing. For instance, there are empirical studies that examine the relationship between interest rates and inflation towards economic growth resulting in the conclusion that interest rate has a significant impact on economic growth (Jelilov, 2016; Ramlan and Bin Suhaimi, 2017).

While examining the effects of foreign aid on income, it is common to come across evidence-based views that are yet divergent. Some authors report that development aid has a robust direct effect on donor exports and consequently, recipient countries experience an indirect effect on their income levels although these effects are heterogenous and differ from region to region (Martínez-Zarzoso, 2019). Additionally,

aid is seen to promote economic growth while it positively affects income (Gomanee et al., 2005; Karras, 2006) and some even provide evidence that foreign aid reduces poverty (Addison et al., 2005). Conversely, others conclude that foreign aid negatively impacts per capita income (Nowak-Lehmann et al., 2012). Evidently, there is no consensus about the effects of foreign aid on income. However, as the goal of most SSA countries is to boost economic growth, these findings are certainly useful.

2.3 Research Gaps

The main research gaps identified and addressed by this study is the lack of a wider cross-country examination of the observed variables that affect income within SSA. Most of the concluded research currently available deals with either (1) a single variable observed over a few countries, (2) multiple variables observed in a single country or (3) multiple variables observed in a few countries. At the same time, majority of the available studies do not focus on the countries of SSA. This study addresses that gap by offering a comprehensive examination of the variables affecting income on a regional level and with a focus on SSA. Furthermore, most of the available studies of recent times only focus on income inequality and distribution while ignoring income levels and how it is affected. More so, the studies that directly consider the dynamics of income in SSA predate the late 2000s, necessitating the importance of newer research. This study addresses such gaps by offering a holistic approach that employs more recent data about macroeconomic variables affecting income in a broader regional context.

3 MATERIALS AND METHODOLOGY

To achieve the objective of the study, two different initial models are developed in this paper. We selected a sample of twenty-five (25) countries over a period of 14 years (2005–2018) for the main model. For the second model, only ten (10) countries are selected for the same period due to constraints of data availability. The first model uses income, trade, foreign direct investment, foreign aid, and inflation data for the 25 selected SSA countries while the second model is extended to include money market interest rate.

The first model is an unbalanced panel with a total of 350 observations while the second constitutes a panel with a total of 140 observations. The countries are sampled purely based on the availability and consistency of data. The summary statistics and correlation analyses are provided in Tab. 4 and 5 in the Annex.

3.1 Data

GNI per capita measured on purchasing power parity (PPP) is used as a proxy for income, being the main dependent variable. We used this indicator primarily because it is a metric that takes into consideration all income inflows into the economy of a nation, regardless of whether it is earned within the country or not (World Bank, 2020a).

Balance of Trade as a percentage of GDP, referenced simply as Trade is used as a proxy for international trade. This variable is a major macroeconomic indicator of the comparative importance of international trade in and for the economy of a country and it is obtained primarily from UNCTAD (2021). We expect trade to have a positive sign based on the theoretical foundation presented by Frankel and Romer (1999) who estimated that trade raises income. Similar results were achieved by Erpek (2014) as well as Feyrer (2019) who predicted a significant effect on income with about one-half elasticity.

The remaining variables employed include inflation as measured by the consumer price index in annual %. This data is obtained from the World Bank (World Bank, 2020b). When inflation increases and there is a resultant adjustment based on the cost of living, then income is also expected to rise. The reverse is

also true when there is an increase in inflation with no adjustments. However, inflation can also have a negative effect for credit demand (Maiti et al., 2020) which then translates into a negative effect on income. We, therefore, expect inflation to have a negative sign.

Foreign direct investment (FDI) inflows is also used in this study and to ensure that the relationship to be observed between the other variables is non-spurious. This data is also derived from the World Bank's data bank (World Bank, 2020c) grounded on the sixth edition of the IMF's Balance of Payments Manual (BPM6). As far as FDI is concerned, its contribution to employment and subsequently the salary structure should necessarily improve income. Theoretically, this makes economic sense as also proven by the study of Cassette et al. (2012). Our initial assumption, therefore, proposes a positive sign.

Net official development assistance and official aid received is then used as a proxy for foreign aid (World Bank, 2020d). We refer to this variable simply as F_Aid. We expect foreign aid to have either a positive or a negative sign. The relationship is unclear until empirically proven, given that different kinds of foreign aid yield different results, especially considering the heterogeneity of the SSA region (Addison et al., 2005; Martínez-Zarzoso, 2019).

The last variable employed is money market interest rate (International Monetary Fund, 2021), referenced simply in this paper as interest rate (IR). A higher rate of interest often discourages credit demand while a lower rate of interest often translates into cheaper credit, thus boosting credit demand which can lead to an increase in income. Consequently, we expect money market interest rate to also exhibit a negative sign.

3.2 Unit Root Test

Because of the nature of the dataset, it was necessary to conduct a unit root test to establish the stationarity of the variables. We used the Im-Pesaran-Shin (IPS) unit root test to determine the order of integration. Based on the results of IPS unit root test of model 1 (Tab. 1), the null hypothesis is rejected for foreign aid, foreign direct investment, inflation, and trade. We then transformed income by differencing it once to achieve stationarity.

For model 2, FDI and inflation are stationary at their original values. Trade, foreign aid, and interest rate achieve stationary at the first differencing while income is stationary at the second differencing (Tab. 1).

Tab. 1: Unit Root Test

Variables	(1) Statistics	(2) Statistics
F_Aid	4.1774*** (0.000)	−1.1491 (0.125)
FDI	−2.8662*** (0.002)	−2.0845** (0.019)
Inflation	−4.4995*** (0.000)	−3.7984*** (0.000)
Trade	−2.1098** (0.017)	−1.6028 (0.054)
Income	6.6441 (1.000)	6.2069 (1.000)
D.Income	−3.2032*** (0.001)	−0.6209 (0.267)
Interest rate		−1.0725 (0.142)
D.F_Aid		−4.2953*** (0.000)
D.Trade		4.0598*** (0.000)
D.Interest rate		−2.8486*** (0.002)
D2.Income		−2.8308*** (0.002)

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.3 The Model

The conventional approach used in this study to investigate the effect of the selected variables on income is to regress the variables (trade, foreign aid, foreign direct investment, inflation, and interest rate) on income using panel data regression. We use fixed effects (FE) and random effects (RE) models to achieve our goal.

We fittingly group income strategically to the observed factors and model it with the selected variables accordingly. The presence of a statistically significant correlation between

the variables are also tested using the FE model. The panel regression equations for the FE models are given as:

$$Y_{it} = \alpha_0 + \alpha_1 \, \mathrm{F}_{\mathrm{aid}_{it}} + \alpha_2 \, \mathrm{FDI}_{it} + \\ + \alpha_3 \, \mathrm{Inf}_{it} + \alpha_4 \, \mathrm{Trade}_{it} + u_{it}, \tag{1}$$

$$Y_{it} = \alpha_0 + \alpha_1 \, \mathrm{d.F}_{\mathrm{aid}_{it}} + \alpha_2 \, \mathrm{FDI}_{it} + \\ + \alpha_3 \, \mathrm{Inf}_{it} + \alpha_4 \, \mathrm{d.Trade}_{it} + \\ + \alpha_5 \, \mathrm{d.IR}_{it} + u_{it}, \tag{2}$$

where Y_{it} for equation 1 is income after first differencing and Y_{it} for equation 2 is income after second differencing, all for country i in period t; α_0 is the constant and u_{it} is error term. Also, $\alpha_1, \ldots, \alpha_5$ are coefficients to be estimated, $F_{\mathrm{aid}_{it}}$, FDI_{it}, Inf_{it}, Trade_{it}, and IR_{it} are vectors of the independent variables.

We also use the variance components model, otherwise known as the random effects model, to aid in controlling for any unobserved time-constant heterogeneity (Maddala, 2001; Greene, 2003; Baltagi, 2008). The equations for the RE models are given as:

$$\alpha_i \sim \mathrm{iid}(0, \sigma_\alpha^2),$$

$$\mathrm{D.income}_{it} = \alpha + \Delta x_{it}^1 \beta + \alpha_i + u_{it}, \\ u_{it} \sim \mathrm{iid}(0, \sigma_u^2), \tag{3}$$

$$\mathrm{D2.income}_{it} = \alpha + \Delta x_{it}^1 \beta + \alpha_i + u_{it}, \\ u_{it} \sim \mathrm{iid}(0, \sigma_u^2), \tag{4}$$

where α_i is time-invariant and homoscedastic across individuals and it contributes to the correlation between the country, year and the variables. Also, βs are the coefficient values of the independent variables (trade, foreign aid, foreign direct investment, inflation and interest rate); iid indicates the independent and identically distributed variables, α is overall mean being captured in the variables and u_{it} is the error term or the random error.

3.3.1 Hausman Test

The Hausman test is used here as the robustness check between the FE models and the RE models. This test is a statistical hypothesis check to evaluate the consistency of the estimators employed in this paper to determine if our statistical model corresponds to the dataset used. Hausman test tests the null hypothesis H_0 such that x_{it} and u_{it} are uncorrelated. At different levels, the FE model and RE model would be considered.

H_0 is the random effects model:

$$\mathrm{D.income}_{it} = \alpha + \Delta x_{it}^1 \beta + \alpha_i + u_{it}, \tag{5}$$

$$\mathrm{D2.income}_{it} = \alpha + \Delta x_{it}^1 \beta + \alpha_i + u_{it}. \tag{6}$$

H_1 is the fixed effects model:

$$\mathrm{D.income}_{it} = \alpha + \Delta x_{it}^1 \beta + u_{it}, \tag{7}$$

$$\mathrm{D2.income}_{it} = \alpha + \Delta x_{it}^1 \beta + u_{it}. \tag{8}$$

$\hat{\beta}_{\mathrm{RE}}$ is consistent under the null hypothesis and $\hat{\beta}_{\mathrm{FE}}$ is consistent and appropriate under the alternative.

4 EMPIRICAL RESULTS

The results of the FE model from Tab. 2 point towards trade in its level having a statistical significance and a positive relationship with change in income whereas foreign aid, FDI, and inflation appear as not statistically significant. At the same time, the results from the RE model also show trade as being statistically significant and having a positive relationship with change in income. The model further shows a weak positive correlation with rho of 0.020. The other variables do not appear to prove any significant contribution to income (Tab. 2). The positive statistically significant relationship between trade and income evident in both models is similar to the findings of Feyrer (2019), with the simple economic implication being that trade increases income. The implication is that much like other economies of the world, trade has proven to have a significant effect on income also in SSA.

Although both the fixed and random effects variants of model 1 exhibit similar behaviour

and produced similar results, the output of the robustness Hausman test 1 (Tab. 6 in the Annex) indicates the FE model as more consistent and appropriate. Consequently, the output of the FE model is considered in the discussion.

Tab. 2: Model 1

Variable	FE	RE
Constant	647.378***	423.180***
	(120.964)	(84.691)
F_Aid	0.000	−0.000
	(0.000)	(0.000)
FDI	0.000	0.000
	(0.000)	(0.000)
Inflation	0.539	−5.786
	(10.188)	(7.422)
Trade	45.173***	12.428***
	(6.496)	(2.949)
σ_u	659.131	101.854
σ_e	708.376	708.376
ρ	0.464	0.020
Adj_R-squared	0.063	0.139

Notes: Dependent var. = D.Income; *** $p < 0.01$.

Tab. 3 presents the results of the extended model in which we included money market interest rate to identify its effect on income, if any. The output from the FE model 2 imply that FDI in its level has a statistically significant negative effect on change in income at the second difference. Although the opposite results would be generally expected, our findings seem to be in line with Herzer et al. (2008) who found that in majority of their sampled countries, there was no effect of FDI on growth and concluded that the relationship between FDI's growth impact and income is rather unclear in developing countries. At the same time, money market interest rate, inflation, and foreign aid do not exhibit any statistical significance in this extended model.

On the other hand, the RE model (Tab. 3) indicates that all the observed variables have no significant relationship with income. Nevertheless, money market interest rate has a negative coefficient in both the FE and RE models, which is in line with our initial expectations. The results of the robustness Hausman test 2 (Tab. 7 in the Annex) indicates the RE model 2 to be consistent and appropriate between the two models. The RE model is therefore considered as the basis for discussion.

Tab. 3: Model 2

Variable	FE	RE
Constant	27.041	14.964
	(38.898)	(25.988)
D.F_Aid	0.000	0.000
	(0.000)	(0.000)
FDI	−0.000**	−0.000
	(0.000)	(0.000)
Inflation	−1.262	−1.075
	(5.733)	(3.195)
D.Trade	−7.679*	−5.417
	(4.391)	(4.059)
D.Interest rate	−4.930	−7.579
	(8.970)	(8.386)
σ_u	49.069	0
σ_e	202.049	202.049
ρ	0.056	0
Adj_R-squared	0.060	0.096

Notes: Dependent variable = D2.Income;
** $p < 0.05$, * $p < 0.1$.

4.1 Robustness Check

As a measure of robustness, we performed a lag distribution test on both FE and RE models 1 and 2 using lag 1 and lag 2. Considering the fixed effects model 1, the results in Tab. 8 in the Annex indicate that trade in its level has a positive effect on change in income and remain significant at no lag, lag 1 and lag 2. Foreign aid, FDI, and inflation are not significant in this model. Therefore, a consistent result is shown for the factors affecting income in SSA countries in both model 1 and its lag equivalents. This further proves the Hausman test to be right in identifying the fixed effects model 1 as the appropriate first model.

There is, however, no consistency in the results of FE model 2 when compared with its lag equivalent. At no lag, trade and FDI are found to be significant. At lag 1, trade is not significant while FDI remains significant. Meanwhile at lag 2, none of the variables are significant. Nevertheless, this is no cause for alarm given that this model was not chosen and therefore, not considered in the discussion.

When comparing the variability of the dataset for the fixed effects model 1, there is an improvement of the variables from no lag to lag 2. At no lag, there is a variability of 14.60%. At lag 1, the variability is 15% and at lag 2, the variability is 16.30%. Similarly, an improvement is shown for fixed effects model 2. The result shows that 6.03% variability is explained by the explanatory variables for model 2 at no lag, 6.57% is explained by the explanatory variables at lag 1 and 7.63% is explained by the explanatory variables at lag 2 as shown in Tab. 8 in the Annex.

Tab. 9 in the Annex shows the results for lag distribution of the RE models. For model 1, trade shows a positive significant effect at no lag, lag 1, and lag 2. Foreign aid, FDI and inflation are found non-significant. For model 2, none of the variables show a significant effect with income at no lag, lag 1, and lag 2. This model proves a consistency in the results for both RE models.

5 DISCUSSION OF RESULTS

The study aimed to ascertain the effect of international trade, foreign aid, foreign direct investment, inflation, and interest rate on income, using panel data from the period 2005–2018 for selected SSA countries. Fixed effects and random effects models were used to establish the relationship between the variables at various significance levels.

We applied the Hausman test as a robustness measure to select the best of the two models. Consequently, the fixed effects model 1 is proven as appropriate for model 1 whereas the random effects model 2 is consistent and appropriate for model 2. We further applied the models at lags 1 and 2 for comparison and found that apart from model 2 of the fixed effects, the other models have consistent results with their lag equivalents, thereby further proving the robustness of the models.

5.1 Income and Trade

International trade has a substantial effect on the distribution of income across SSA countries. It is of the observation that trade has an impact on employment and wages in the occupational or sectoral level (UNCTAD, 2013b). Trade plays a crucial role in the job creation process and subsequently in the poverty alleviation process. It is also observed that international trade increases government revenue which helps the poor in financing their social expenditures. In evaluating the effect of international trade on income, several issues arise on the structure of trade policy and the general structure of trade itself in protecting the citizens of SSA to ensure maximum economic gains. Programs such as Aid for Trade and the multilateral agencies programs, among others, were launched by the World Trade Organisation to assist Least Developed Countries (LDC), some of which are in SSA. The programs aimed at overcoming some limitations and alleviating poverty and also to help achieve sustained growth of income in various African countries (DiCaprio and Trommer, 2010). In that regard, some studies (Nicita et al., 2014; Noguer and Siscart, 2005; Spilimbergo et al., 1999) have found trade to be significant with a positive impact on income. In line with those studies, our findings also showed that international trade has a positive significant impact on income. Bensidoun et al. (2011) also concluded in their study that a change in the factor content of trade has a significant impact on trade depending on the level of national income.

Our results ascertain a positive impact of trade on income in SSA, confirming the findings of Spilimbergo et al. (1999) and mainly also Noguer and Siscart (2005) who concluded based on their findings that the more a country trades, the higher the level of income they achieve. In the late 90s, Frankel and Romer (1999) asserted that trade has a significant and a positive effect on income and the effect is robust. Additionally, Feyrer (2019) also concluded on a similar result, finding trade to have a significant effect on income. Our result confirms that the trend is

no different for the countries of SSA and that trade is beneficial in boosting the income levels of SSA.

5.2 Income and Foreign Direct Investment

FDI is estimated to be a major driver of income growth in SSA. Africa has experienced a significant surge in domestic investment over the past two decades. That notwithstanding, most countries in the region of SSA still experience a wide gap between the requirements for investment and the availability of domestic resources. Naturally, FDI is expected to play a significant role in bridging this gap but that does not seem to be the case as the region accounts for a very low share of global FDI flows (UNCTAD, 2013a). Our general findings and that of UNCTAD (2013a) report no evidence suggesting that FDI has a major impact on the income level of SSA countries. This finding proves no relationship between FDI and income given that the result was not significant. This is possibly because FDI inflows are directed at only a few countries on the continent and even those are often focused on the extractive sector. As a result, whereas FDI might benefit a particular sector in a particular country, it does not necessarily translate to the entire SSA region. We further argue that in order for FDI to have a considerable impact on income, the economies of SSA should first and foremost have a well-developed financial market (Alfaro et al., 2004). This seems to be a necessary condition towards achieving real gains from FDI inflows. While the research of Tian et al. (2008), Jaumotte et al. (2008) and Cassette et al. (2012) seem to point toward FDI having some positive effect on income, our findings do not prove that when taken in the context of SSA. Like Herzer et al. (2008), we maintain that the effect that FDI has on income in SSA is rather unclear.

5.3 Income and Inflation

Through its effects on economic growth, inflation tends to have an effect on the distribution of income. In exploring this subject, it is necessary to note that the Tobin-Sidrauski model links inflation to the increase of capital accumulation while at the same time, a linking of inflation to a reduction in the accumulation of capital is put forth by other authors (Fischer, 1981). While there is no real consensus on the matter, the findings in three of our models reveal a negative sign, but the result is insignificant. Similarly, Li and Zou (2002) found that inflation has a negative but insignificant effect on the share of income for the poor and middle-class economic agents. In most SSA countries, income distribution faces many challenges arising from conflicts of inflation especially among policy objectives (Kasa, 2001; Gemayel et al., 2011). The findings of this study does not conclusively point to inflation having any real effect on income in SSA as no statistical significance is proven. However, given that inflation and its effects are often reviewed indirectly through growth, we point to the findings of Khan and Senhadji (2001) who estimated that at the threshold of 11–12%, inflation significantly slows growth in developing countries.

5.4 Income and Foreign Aid

In exploring the nature of the relationship between foreign aid and income in SSA, our findings reveal no significant impact. Nowak-Lehmann et al. (2012) likewise reveal on a general note that aid has insignificant impact on income per capita. They also argue that where there is a significant impact, it is rather negative and comparatively minute. Addison et al. (2005) maintain that different kinds of aid have different impacts, and this is rightly so. The scope of foreign aid itself and the channels through which they are distributed can largely influence how they impact income in SSA and subsequently growth. However, it is now rather unclear if foreign aid does significant good and if so, whether or not the benefits outweigh the potential disadvantages within the context of SSA.

5.5 Income and Interest Rate

In our extended model, we sought to determine if monetary policy has any significant impact on income levels in SSA through money market interest rate. As the main regulator overseeing banks and banking in the economy (Boldeanu and Tache, 2016; Cipovová and Dlasková, 2016), the central bank controls total money supply in the economy with the aid of monetary policy instruments. The results of our study does not find money market interest rate as having a statistically significant impact on income in SSA. Although the focus of this paper is not on economic growth, it is important to note that while we do not prove any impact of interest rate on income, studies have revealed a significant impact of interest rate on economic growth (Jelilov, 2016; Ramlan and Bin Suhaimi, 2007). We mention this in acknowledgment that growth is ultimately the desired goal for the economies of SSA. Additionally, monetary policy itself is seen to have a distributional effect through different mechanisms of transmission (Davtyan, 2017). Nevertheless, our results suggest that whilst monetary policy might be significant for economic growth as a whole, it may not necessarily be as significant of a factor in determining the direct income levels within the countries of SSA.

6 CONCLUSION

This paper sought to determine if international trade, foreign direct investment, foreign aid, inflation, and monetary policy through money market interest rate have any influence on income in SSA by analysing available panel data for 25 SSA countries and 10 SSA countries over a period of 14 years. Two sets of models were developed. The first model set used a dataset from 25 SSA countries and the second model used a dataset from 10 SSA countries, all for the period 2005–2018. The empirical analysis of the panel data comprised of fixed effects and random effects models to investigate the relationship between the observed variables and income.

The result of the fixed effects model showed trade to be significant and with a positive effect on income for model 1. Additionally, foreign aid, FDI, and inflation were not significant. The results of the random effects model 2 did not prove any of the variables as statistically significant even with the introduction of money market interest rate. Consequently, the only variable with a proven effect on income in this study is trade. Supporting the theories of Noguer and Siscart (2005), and Spilimbergo et al. (1999), our main empirical finding points to trade having a significant impact on income in SSA.

The implications of our findings rest toward international trade as having a major role to play in the income levels of SSA countries. An improvement in the strategic trade partnerships within the region can therefore go a long way to boost the sector, resulting in the improvement of income level. Money market interest rate, being insignificant in this study suggests that this aspect of monetary policy may not necessarily be influencing income generation as expected. This is an eye-opener for policy makers when considering what aspects of monetary policy has had real effects on income within the SSA region. FDI, foreign aid, and inflation also proved to have no significant effect on income when taken in the context of SSA. However, there is a possibility that when these variables are studied for each country independently, different results may be reached. This would be in recognition of the heterogeneous nature of the countries in SSA, thereby taking into account possible unique factors that may otherwise be omitted in a study for the entire region combined.

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8 REFERENCES

Addison, T., Mavrotas, G. and McGillivray, M. 2005. Aid to Africa: An Unfinished Agenda. *Journal of International Development*, 17 (8), 989–1001. DOI: 10.1002/jid.1255.

Afonso, A., Schuknecht, L. and Tanzi, V. 2010. Income Distribution Determinants and Public Spending Efficiency. *The Journal of Economic Inequality*, 8 (3), 367–389. DOI: 10.1007/s10888-010-9138-z.

Alfaro, L., Chanda, A., Kalemli-Ozcan, S. and Sayek, S. 2004. FDI and Economic Growth: The Role of Local Financial Markets. *Journal of International Economics*, 64 (1), 89–112. DOI: 10.1016/S0022-1996(03)00081-3.

Amjad, Z. 2015. Trade and Income Distribution in Pakistan. *Global Journal of Management and Business Research*, 15 (8), 18–25.

Aradhyula, S. V., Rahman, T. and Seenivasan, K. 2007. Impact of International Trade on Income and Income Inequality. In *2007 Annual Meeting*. American Agricultural Economics Association. DOI: 10.22004/ag.econ.9999.

Ata, F. N., Alam, S. and Saeed, N. 2019. The Determinants of Income Distribution, an Empirical Analysis of Developing Countries. *Public Finance Quarterly*, 64 (4), 494–510. DOI: 10.35551/pfq_2019_4_3.

Baltagi, B. H. 2008. *Econometric Analysis of Panel Data*. 4th ed. Chichester: John Wiley & Sons.

Bensidoun, I., Jean, S. and Sztulman, A. 2011. International Trade and Income Distribution: Reconsidering the Evidence. *Review of World Economics*, 147 (4), 593. DOI: 10.1007/s10290-011-0107-9.

Boldeanu, F. T. and Tache, I. 2016. The Financial System of the EU and the Capital Markets Union. *European Research Studies Journal*, 19 (1), 59–70. DOI: 10.35808/ersj/506.

Cassette, A., Fleury, N. and Petit, S. 2012. Income Inequalities and International Trade in Goods and Services: Short- and Long-Run Evidence. *The International Trade Journal*, 26 (3), 223–254. DOI: 10.1080/08853908.2012.682023.

Cipovová, E. and Dlasková, G. 2016. Comparison of Different Methods of Credit Risk Management of the Commercial Bank to Accelerate Lending Activities for SME Segment. *European Research Studies Journal*, 19 (4), 17–26. DOI: 10.35808/ersj/577.

Davtyan, K. 2017. The Distributive Effect of Monetary Policy: The Top One Percent Makes the Difference. *Economic Modelling*, 65 (C), 106–118. DOI: 10.1016/j.econmod.2017.05.011.

DiCaprio, A. and Trommer, S. 2010. Bilateral Graduation: The Impact of EPAs on LDC Trade Space. *Journal of Development Studies*, 46 (9), 1607–1627. DOI: 10.1080/00220381003706502.

Erpek, H. 2014. *The Effect of International Trade on Income* [online]. Clemson University. Available at: `https://tigerprints.clemson.edu/all_theses`.

Fischer, S. 1981. Towards an Understanding of the Costs of Inflation: II. *Carnegie-Rochester Conference Series on Public Policy*, 15, 5–41. DOI: 10.1016/0167-2231(81)90016-6.

Frankel, J. A. and Romer, D. H. 1999. Does Trade Cause Growth? *American Economic Review*, 89 (3), 379–399. DOI: 10.1257/aer.89.3.379.

Feyrer, J. 2019. Trade and Income–Exploiting Time Series in Geography. *American Economic Journal: Applied Economics*, 11 (4), 1–35. DOI: 10.1257/app.20170616.

Gao, T. 2004. FDI, Openness and Income. *The Journal of International Trade & Economic Development*, 13 (3), 305–323. DOI: 10.1080/0963819042000240048.

Gemayel, E. R., Jahan, S. and Peter, A. 2011. *What Can Low-Income Countries Expect from Adopting Inflation Targeting?* IMF Working Paper No. 11/276. International Monetary Fund.

Gomanee, K., Girma, S. and Morrissey, O. 2005. Aid and Growth in Sub-Saharan Africa: Accounting for Transmission Mechanisms. *Journal of International Development*, 17 (8), 1055–1075. DOI: 10.1002/jid.1259.

Greene, W. H. 2003. *Econometric Analysis*. 5th ed. Pearson Education.

Herzer, D., Klasen, S. and Nowak-Lehmann Danzinger, F. 2008. In Search of FDI-Led Growth in Developing Countries: The Way Forward. *Economic Modelling*, 25 (5), 793–810. DOI: 10.1016/j.econmod.2007.11.005.

International Monetary Fund. 2021. *International Monetary Fund Statistics* [online]. Available at: `https://data.imf.org/regular.aspx?key=61545867`. [Accessed 2021, January 12].

Irwin, D. A., Terviö, M. 2002. Does Trade Raise Income? Evidence from Twentieth Century. *Journal of International Economics*, 58 (1), 1–18.

Jaumotte, F., Lall, S. and Papageorgiou, C. 2008. *Rising Income Inequality: Technology, or Trade and Financial Globalization*. IMF Working Paper No. 08/185. International Monetary Fund.

Jelilov, G. 2016. The Impact of Interest Rate on Economic Growth Example of Nigeria. *African Journal of Social Sciences*, 6 (2), 51–64.

Karras, G. 2006. Foreign Aid and Long-Run Economic Growth: Empirical Evidence for a Panel of Developing Countries. *Journal of International Development*, 18 (1), 15–28. DOI: 10.1002/jid.1187.

Kasa, K. 2001. *Will Inflation Targeting Work in Developing Countries?* FRBSF Economic Letter. Federal Reserve Bank of San Francisco.

Khan, M. S. and Senhadji, A. S. 2001. *Threshold Effects in the Relationship Between Inflation and Growth*. IMF Working Paper. International Monetary Fund.

Lee, K.-K. 2014. Globalization, Income Inequality and Poverty: Theory and Empirics. *Social System Studies*, 28, 109–134.

Li, H. and Zou, H.-F. 2002. Inflation, Growth, and Income Distribution: A Cross-Country Study. *Annals of Economics and Finance*, 3 (1), 85–101.

Maddala, G. S. 2001. *Introduction to Econometrics*. 3rd ed. New York: John Wiley & Sons.

Mahembe, E. and Odhiambo, N. M. 2014. Foreign Direct Investment and Economic Growth: A Theoretical Framework. *Journal of Governance and Regulation*, 3 (2), 63–70. DOI: 10.22495/jgr_v3_i2_p6.

Maiti, M., Esson, I. A. and Vuković, D. 2020. The Impact of Interest Rate on the Demand for Credit in Ghana. *Journal of Public Affairs*, 20 (3), e2098. DOI: 10.1002/pa.2098.

Martínez-Zarzoso, I. 2019. Effects of Foreign Aid on Income through International Trade. *Politics and Governance*, 7 (2), 29–52. DOI: 10.17645/pag.v7i2.1830.

Mehregan, N., Imandoust, S. and Mohseni, E. 2012. Estimating of Inflation and Income Distribution Threshold Level in Iran. *International Journal of Science and Advanced Technology*, 2 (1), 102–107.

Meschi, E. and Vivarelli, M. 2009. Trade and Income Inequality in Developing Countries. *World Development*, 37 (2), 287–302. DOI: 10.1016/j.worlddev.2008.06.002.

Monnin, P. 2014. *Inflation and Income Inequality in Developed Economies*. CEP Working Paper No. 2014/1. Council on Economic Policies.

Nicita, A., Olarreaga, M. and Porto, G. 2014. Pro-Poor Trade Policy in Sub-Saharan Africa. *Journal of International Economics*, 92 (2), 252–265. DOI: 10.1016/j.jinteco.2014.01.001.

Noguer, M. and Siscart, M. 2005. Trade Raises Income: A Precise and Robust Result. *Journal of International Economics*, 65 (2), 447–460. DOI: 10.1016/j.jinteco.2003.11.006.

Nowak-Lehmann, F., Dreher, A., Herzer, D., Klasen, S. and Martínez-Zarzoso, I. 2012. Does Foreign Aid Really Raise Per Capita Income? A Time Series Perspective. *Canadian Journal of Economics*, 45 (1), 288–313. DOI: 10.1111/j.1540-5982.2011.01696.x.

Perotti, R. 1996. Growth, Income Distribution, and Democracy: What the Data Say. *Journal of Economic Growth*, 1 (2), 149–187.

Ramlan, H. and Bin Suhaimi, M. S. I. 2017. The Relationship between Interest Rates and Inflation Toward the Economic Growth in Malaysia. *Journal of Humanities, Language, Culture and Business*, 1 (1), 55–63.

Ravallion, M. 2004. *Looking Beyond Averages in the Trade and Poverty Debate*. Policy Research Working Paper Series 3461, The World Bank. DOI: 10.1596/1813-9450-3461.

Spilimbergo, A., Londoño, J. L. and Székely, M. 1999. Income Distribution, Factor Endowments, and Trade Openness. *Journal of Development Economics*, 59 (1), 77–101. DOI: 10.1016/S0304-3878(99)00006-1.

Surugiu, M.-R. and Surugiu, C. 2015. International Trade, Globalization and Economic Interdependence between European Countries: Implications for Businesses and Marketing Framework. *Procedia Economics and Finance*, 32, 131–138. DOI: 10.1016/S2212-5671(15)01374-X.

Tian, X., Wang, B. and Dayanandan, A. 2008. The Impact of Economic Globalization on Income Distribution: Empirical Evidence in China. *Economics Bulletin*, 4 (35), 1–8.

UNCTAD. 2013a. *Strengthening Linkages Between Domestic and Foreign Direct Investment in Africa.* Trade and development board. United Nations Publication. TD/B/EX(57)/3.

UNCTAD. 2013b. *The Impact of Trade on Employment and Poverty Reduction.* United Nations Publication. TD/B/C.I/29.

UNCTAD. 2021. *UNCTAD Statistics* [online]. Available at: `https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_referer=&sCS_ChosenLang=en`. [Accessed 2021, January 13].

World Bank. 2020a. *World Development Indicators. GNI Per Capita, PPP (Current International Dollars)* [online]. Available at: `https://databank.worldbank.org/reports.aspx?source=2&series=NY.GNP.PCAP.PP.CD&country=SSF#`. [Accessed 2021, January 13].

World Bank. 2020b. *Inflation, Consumer Prices (Annual %)* [online]. Available at: `https://databank.worldbank.org/reports.aspx?source=2&series=FP.CPI.TOTL.ZG&country=SSF`. [Accessed 2021, January 13].

World Bank. 2020c. *Foreign Direct Investment, Net Inflows (BoP, Current USD)* [online]. Available at: `https://databank.worldbank.org/reports.aspx?source=2&series=BX.KLT.DINV.CD.WD&country=SSF#`. [Accessed 2021, January 13].

World Bank. 2020d. *Net Official Development Assistance and Official Aid Received* [online]. Available at: `https://databank.worldbank.org/reports.aspx?source=2&series=DT.ODA.ALLD.CD&country=SSF#`. [Accessed 2021, January 13].

Wu, J.-Y. and Hsu, C.-C. 2012. Foreign Direct Investment and Income Inequality: Does the Relationship Vary with Absorptive Capacity? *Economic Modelling*, 29 (6), 2183–2189. DOI: 10.1016/j.econmod.2012.06.013.

9 ANNEX

Tab. 4: Summary Statistics and Correlation Analysis of Model 1

	Income	F_Aid	FDI	Inflation	Trade
Mean	5,040.8860	817,000,000	780,000,000	6.4031	−9.9408
Std.Dev	5,755.7010	906,000,000	1,840,000,000	6.1889	16.1516
Min	610	520,000	−7,400,000,000	−2.8147	−66.3460
Max	28,750	11,000,000,000	10,000,000,000	34.6953	57.1514
Obs	350	350	350	344	346
			Correlation analysis		
F_Aid	−0.2621				
FDI	0.1331	0.3378			
Inflation	−0.0864	0.1121	0.0472		
Trade	0.4372	0.0812	0.1448	0.0844	

Note: F_Aid is foreign aid.

Tab. 5: Summary Statistics and Correlation Analysis of Model 2

	Income	F_Aid	FDI	Inflation	Trade	Interest rate
Mean	5,088.3570	822,000,000	896,000,000	5.2722	−6.8436	6.8235
Std.Dev	5,512.4650	487,000,000	2,290,000,000	6.0271	10.8408	5.1220
Min	680	11,700,000	−7,400,000,000	−2.2480	−28.5173	0.9448
Max	26,080	2,910,000,000	10,000,000,000	32.3777	30.0079	25.4350
Obs	140	140	140	139	140	134
Correlation analysis						
F_Aid	−0.3881					
FDI	0.2122	0.3107				
Inflation	0.1037	−0.1194	−0.0501			
Trade	0.1222	−0.1578	−0.0826	0.4219		
Interest rate	−0.0937	0.1765	0.1005	0.7812	0.3034	

Note: F_Aid is foreign aid.

Tab. 6: Hausman Test 1

D.Income	(b) **Fixed**	(B) **Random**	$(b-B)$ **Difference**	$\sqrt{\text{diag}\,(V_b - V_B)}$ **S.E.**
F_Aid	0.0000	−0.0000	0.0000	0.0000
FDI	0.0000	−0.0000	0.0000	0.0000
Inflation	0.5388	−5.7861	6.3249	6.9802
Trade	45.1729	12.4282	32.7446	5.7885
$\chi^2(2)$	32.0300		Prob $> \chi^2$	0.0000

Tab. 7: Hausman Test 2

D2.Income	(b) **Fixed**	(B) **Random**	$(b-B)$ **Difference**	$\sqrt{\text{diag}\,(V_b - V_B)}$ **S.E.**
D.F_Aid	0.0000	0.0000	0.0000	0.0000
FDI	−0.0000	−0.0000	−0.00002	0.0000
Inflation	−1.2618	−1.0752	−0.1866	4.7602
D.Trade	−7.6793	−5.4172	−2.2622	1.6751
D.Interest rate	−4.9303	−7.5794	2.6491	3.1818
$\chi^2(2)$	2.07		Prob $> \chi^2$	0.5571

Tab. 8: Fixed Effect Lag Distribution Test of Models 1 and 2

Model 1				**Model 2**			
Variable	**No lag**	**Lag 1**	**Lag 2**	**Variable**	**No lag**	**Lag 1**	**Lag 2**
Constant	647.3775***	667.4863***	711.9948***	Constant	27.0414	−59.5153	17.6835
Trade	45.1729***	46.4627***	50.2924***	D.Trade	−7.6793*	2.5544	−5.5312
F_Aid	0.0000	0.0000	0.0000	D.F_Aid	0.0000	0.0000	0.0000
FDI	0.0000	−0.0000	0.0000	FDI	−0.0000**	−0.0000*	−0.0000
Inflation	0.5387555	0.4416	−0.4430	Inflation	−1.2618	5.4628	−3.0762
				D.Interest rate	−4.9303	−6.2561	−8.5136
R-squared	0.1460	0.1501	0.1630	R-squared	0.0603	0.0657	0.0763
P-value	0.0000	0.0000	0.0000	P-value	0.1609	0.2558	0.2313

Notes: Dependent variable = D.Income; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Tab. 9: Random Effects Lag Distribution Test of Models 1 and 2

Model 1				Model 2			
Variable	**No lag**	**Lag 1**	**Lag 2**	**Variable**	**No lag**	**Lag 1**	**Lag 2**
Constant	423.1803***	408.0997***	400.8819***	Constant	14.9644	−59.5153	17.6835
Trade	12.4282***	11.7589***	11.80431***	D.Trade	−5.4171	2.5544	−5.5312
F_Aid	−0.0000	−0.0000	−0.0000	D.F_Aid	0.0000	0.0000	0.0000
FDI	−0.0000	−0.0000	−0.0000	FDI	−0.0000	−0.0000	−0.0000
Inflation	−5.7861	−4.2251	−2.9269	Inflation	−1.0752	5.4628	−3.0762
				D.Interest rate	−7.5794	−6.2561	−8.5136
R-squared	0.1387	0.1124	0.1253	*R*-squared	0.0961	0.0787	0.0761
P-value	0.0006	0.0010	0.0021	*P*-value	0.2423	0.2558	0.2313

Notes: Dependent variable = D2.Income; *** $p < 0.01$.

AUTHOR'S ADDRESS

Raymond Kofi Adjei, Department of Regional and Business Economics, Faculty of Regional Development and International Studies, Mendel University in Brno, třída Generála Píky 7, 613 00 Brno, Czech Republic; Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: xadjei1@mendelu.cz

Veronika Kajurová, Department of Economics, Faculty of Business and Economics, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic, e-mail: veronika.kajurova@mendelu.cz

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