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Indian and Chinese Metal Futures Markets: A Linkage Analysis

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Abstract. This paper aims to test the long-run and short-run relationships between the Indian and Chinese metal futures markets using the weekly closing prices of three nonferrous metals, that is, copper, aluminium, and zinc, for the period of 2009–2020. The empirical results show no cointegration for any of the three metals. The Granger causality test suggests a unidirectional relationship from India to China for copper futures and bidirectional causality for aluminium and zinc futures markets. This paper contributes to the literature by studying the relationship between the mentioned two emerging markets, which are top producers and consumers in commodities and have growing futures markets. The results have important implications for investors, portfolio makers, and policymakers of emerging economies.

Keywords: short-run relationship, long-run relationship, Granger causality, cointegration, futures market

JEL Classification: C22, G13, G15

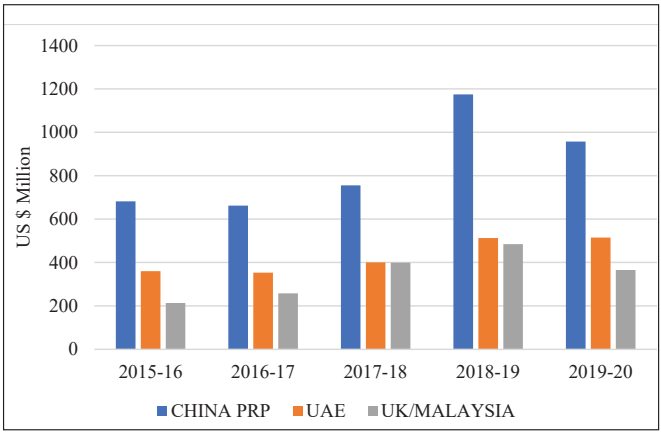
1. Introduction

Trading in commodities has a much longer history than today's frequently traded asset classes such as shares, mutual funds, and even real estate. It dates back to the era when people had no common currency, and the barter system prevailed. Trading in commodities is still taking place in modern times, rather with more complex contracts such as futures and options, with more dedicated nationalized institutions, regulators, and other vital stakeholders. The commodity futures market in countries such as India and China have been multiplying. In the initial decades of established commodity markets, authors emphasized studying the relationship between the spot and the growing futures market commodities. The objectives of such relationships are to know the efficiency of the futures market. The long-run

and short-run relationships are found using the cointegration and Granger causality tests. Modelling the market's volatility is important and exciting in studying the risk involved in trading. The integration of world markets and liberalizing trade barriers across nations allowed futures market study a broader scope. This was also fuelled by the development of futures markets in different countries. The salient features of this market attracted not only producers but also hedgers and investors. With the development of the market and the growing number of stakeholders, the authors' interest shifted to studying linkages of different commodity futures markets of the world in the liberalized trade environment. The first study of cross-border linkages of the Chinese commodity futures market is claimed (Hua and Chen, 2007).

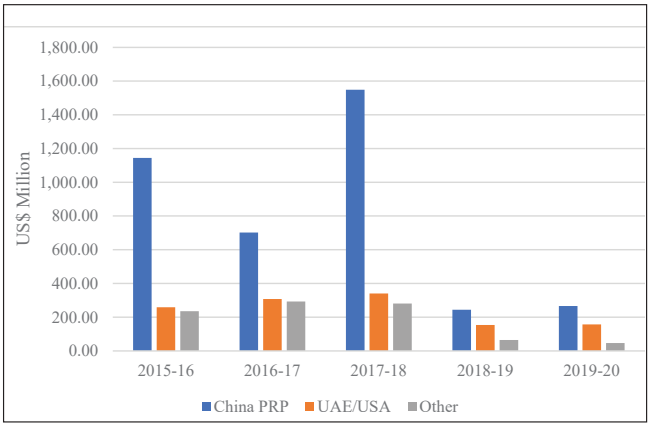
The commodity futures markets in countries such as India and China have been growing rapidly, but the scholarly literature available on the linkages of the futures market is unmatched. However, since 2007, various researchers have contributed to the study of cross-country linkages of commodity futures markets (Hua and Chen, 2007; Fung, Tse, Yau, and Zhao, 2013; X. Li and Zhang, 2008, 2009, 2013). Literature provides that the stock and commodity derivatives of a developing nation have often been studied, considering financially dominant economies such as the USA, the UK, and Brazil. As far as financial derivatives are concerned, the angle of comparison with developed nations may suffice. But when trading the commodities, and their derivatives are considered, the largest producer and consumer economies deserve to be studied, as they affect a major portion of the world market. Aroul and Swanson (2018) mention that India and China lead in the supply of manufactured goods and services among the emerging economies. They share a similar development history and have adjusted their political rigidity to keep themselves abreast with global capitalism (Aroul and Swanson, 2018). China is one of the largest importers of copper, which is mostly used in electrical conductivity. China has also been one of the largest producers and exporters of aluminium, having wide application in construction, transportation, and packaging. Demand and supply of commodities in the emerging markets have a major role in the price fluctuation of nonferrous metals (Hu et al., 2017). Wang and Wang (2019) showed how China dominates the global base metal consumption and how the industrial growth in China has a significant impact on the overall price of base metals.

Figure 1 shows that the aluminium import in India is largely from China itself. Similarly, *figures 2–3* show that China has been one of India's largest importers of copper and zinc. With the selected commodities (copper, aluminium, and zinc), this paper intends to study the relationship between Indian and Chinese metal futures markets.



Source: Ministry of Commerce, GoI (Government of India)

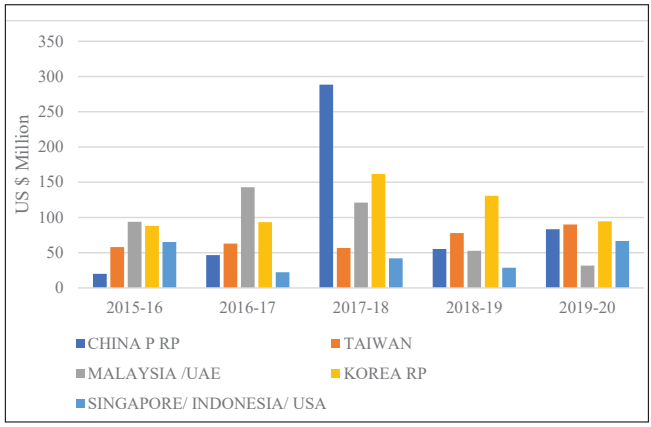
Figure 1. *Top aluminium importing sources for India*



Source: Ministry of Commerce, GoI

Note: for the years 2015–16, the grey bar is for the UK and for all other years is for Malaysia.

Figure 2. *Top copper export destinations for India*



Source: Ministry of Commerce, GoI

Note: Grey bar denotes Malaysia for 2015–16 and 2017–18, Singapore for 2016–17, Qatar for 2018–19, and UAE for 2019–20.

Figure 3. *Top zinc export destinations for India*

So, although the linkages between the commodity markets have been studied, the literature is mostly limited to the developing economies. The commodity futures markets of emerging economies with a large scale of production, consumption, and international trade need to be explored further. The article bridges the gap by finding the linkages of the Indian metal futures market with the Chinese one. The paper's findings are helpful for the metal industries of emerging countries, investors, portfolio managers, and regulators. Section 2 of the paper includes a brief literature review of price discovery and cross-country linkages of commodity derivatives. Section 3 discusses the data and methodology of the study. Results are discussed in section 4. Last, section 5 concludes the paper with the conclusion and limitations of this research.

2. Literature Review

Chinese and Indian Metal Futures Markets

The empirical results from the literature suggest that China's metal futures market has changed its adjective from inefficient to efficient in price discovery. This is evident from the results of Chowdhury (1991) and Xin, Chen, and Firth (2006), as the market was found to be inefficient for copper, lead, tin, and zinc in 1991, but again in 2006 copper and aluminium futures traded on Shanghai futures exchanges had a major role in the price discovery process using data from the years 1999 to

2004. The test used in the study was the Johansen cointegration test. An important metal, copper, has a big market in China. Indriawan, Liu, and Tse (2019) describe copper futures and steel rebar futures in China as the most active metal contracts and as informationally more efficient than other metal futures such as iron ore and aluminium. In the long run, copper stock prices have a significant asymmetric impact from demand shocks and supply shocks; however, in the short run, demand shocks have such an impact on stock prices (Hu et al., 2017). Copper futures prices in China, the US, and the UK are found to be cointegrated with the least contribution from the Chinese market in the process of price discovery (Hua, Lu, and Chen, 2010). Klein and Todorova (2021) examined the effect of the introduction of the night session on the volatility of the metal futures market at Chinese exchanges. It has been found that, unlike the day session, the copper futures traded at night session has an impact from the volatility at the London Metal Exchange (LME). On the contrary, the aluminium futures at Shanghai Futures Exchange (SHFE) show no impact from the LME. The authors suggest one more important finding – namely that there is no increase in the volume of trade in the metal futures after the introduction of the night trading session at the Chinese exchange.

Linkages between Commodity Futures Markets

It is noteworthy that Hua and Chen (2007) claim to be the first to study the cross-country linkages of China's metal and agricultural commodity futures markets with the rest of the world markets. The authors studied the linkages by finding the cointegration among the commodity futures markets. Fung et al. (2013) studied the linkages of Chinese futures markets with the US, the UK, Japanese, and Malaysian markets using the lead–lag relationship between the Chinese market and world markets. Hua and Chen (2007) used cointegration tools to find the long-term relationship, while Fung et al. (2013) found a short-run relationship by employing a causality test. X. Li and Zhang (2008) and X. Li and Zhang (2009, 2013) also traced linkages in the price for copper futures of the Chinese market and world markets. X. Li and Zhang (2008) studied the time-varying correlation between the futures markets of China and the UK by employing the rolling sample method. Not only dynamic correlation but cointegration and Granger causality tests also confirmed the result of strong connections among copper futures markets. X. Li and Zhang (2013) included India and Chicago with the UK and Chinese markets. The short-run, or causal, relationship and the long-run relationship could be studied using the structural vector autoregression model to trace inter-market linkages.

The Chinese commodity futures market has been increasing its interaction with the US commodity futures market, and the relationship between the markets have strengthened over the years from 2000 to 2010 (Tu, Song, and Zhang, 2013). Like the effect of the US market on Chinese futures, the UK market also has a

dominating role. X. Li and Zhang (2009) and Sinha and Mathur (2013) studied the effect of UK markets on the metal futures of China and India using the Johansen cointegration test. The copper futures market in Shanghai has a strong connection with London, and the Shanghai market has a more prominent role in the price discovery process. Bidirectional information flow and long-run relationship has been found between the US and Chinese copper futures markets (Guo, 2017). Similarly, a significant correlation and long-run relationship are found among the copper futures markets of Shanghai, London, and New York. Further, the copper futures markets of Shanghai and London are most significantly integrated among the three markets (Rutledge, Karim, and Wang, 2013). The Indian metal market (copper, aluminium, and zinc futures) has been found to have a unidirectional impact from world markets; moreover, commodities of all categories are found to be cointegrated with the world markets (Kumar and Pandey, 2011). Pradhan, Hall, and Toit (2021) reveal for the period of 2009–2020 with regard to Indian exchanges that there has been a long-run unidirectional causality (from spot to futures) and a short-run bidirectional causality for metal futures, including copper and aluminium.

Various other researchers have contributed to the study of relationships, or linkages, among futures markets worldwide using cointegration test and causality test to study the long-run and short-run relationship (Booth, Brockman, and Tse, 1998; X. Li and Zhang, 2009; Aroul and Swanson, 2018; Aruga and Managi, 2011). For the copper futures in London and the UK, both markets influence each other for being informationally linked. However, if quantified, the London metal exchange has a greater influence on the Shanghai futures exchange (X. Li and Zhang, 2009). Tsiaras (2020) investigated the volatility transmission among the precious and industrial metal futures and found evidence of strong volatility spillover from gold to metals, including copper, aluminium, and zinc. The author also finds the zinc futures market to have less impact than the copper and aluminium futures markets.

3. Data and Methodology

For this analytical study, data on the Indian and Chinese metal futures markets have been collected from secondary sources. The official websites of Multi-Commodity Exchange (MCX) in India and of Shanghai Futures Exchange (SHFE) in China have been used to collect data. Weekly closing prices have been collected for each commodity for 12 years from 1 January 2009 to 31 December 2020, with 626 observations. Three commodities, including copper, aluminium, and zinc, have been identified for the study. A few other metal commodities are also common in both of the exchanges but could not be considered in the study due to non-

availability of synchronized data for a common time frame, as some products traded in both countries have either been launched late or are currently inactive in either of the countries. For preparing the continuous data of futures contracts, the front (spot) month method has been used for MCX. For tabulating the data for SHFE, a different approach has been taken for a true representation of prices derived by demand and supply mechanisms in the Chinese markets. This has been done giving due importance to the turnover of contracts of each commodity. The basis of this methodology for tabulation is inspired by Hua and Chen (2007). For all the three metals, on any date, SHFE has 12 contracts, each expiring in the period of January–December for a particular year. For any date in a particular month (X), the closing price of a contract, expiring or deliverable in a month X+2, is considered. For example, for any date in January, the closing price for a contract expiring in March is considered; for dates in February, contracts deliverable in April are considered. For convenience, continuous price series of copper, aluminium, and zinc from MCX (India) have been denoted as ICOPPER, IALUMINIUM, and IZINC respectively. Similarly, the price series from SHFE (China) have been named CCOPPER, CALUMINIUM, and CZINC. For the non-trading Friday in India, Thursday prices have been considered. For the non-trading weeks in China, the average closing price of the previous and next value have been imputed. The Chinese exchanges quote their price of copper, aluminium, and zinc futures in Yuan per ton; on the contrary, MCX has quoted prices in Rs per kg. For convenient comparison of descriptive measure of data, quotations from SHFE have been converted into per kg, and prices from both the exchanges have been converted into dollars using daily exchange rates. In this way, all the variables happen to be in US dollars per kg.

For the analysis, the level of integration has been checked for all the series. The Augmented Dickey–Fuller (ADF) test has been used to test the presence of unit root in the series. This test is an improvement over the Dickey–Fuller test. The null hypothesis tested by the ADF test is the presence of a unit root in the series. Since the ADF test is said to have low power in rejecting the null hypothesis of the presence of unit root, we also employ a stationary test named KPSS (Kwiatkowski–Phillips–Schmidt–Shin) test. The null hypothesis of this test is different from that of the ADF test. In the KPSS test, the null hypothesis is taken as stationarity in the series. The optimal lag length for this study has been taken following the Schwarz information criterion (SIC).

For the long-run relationship, the Johansen cointegration test has been used. Authors identify this test as superior to other tests for its robustness (Sendhil and Ramasundaram, 2014). For applying this test, the precondition is that all the variables under consideration should be integrated at the same level (all the variables should be either I(1) or I(2)). The Johansen method for the cointegration test uses two different statistics. These are Trace statistics and Eigen-value statistics.

Most of the time, both methods yield similar results. To confirm the findings, we also used Autoregressive Distributed Lag (ARDL) bound test to know the cointegration between the markets. This test can be applied irrespective of the level of integration of the two series; however, none of the series should be integrated or order 2. This test uses the F test to decide whether to reject the null hypothesis or not. The null hypothesis of this test happens to be no cointegration between the variables.

The short-run relationship is estimated using the Toda–Yamamoto Granger causality test (Toda and Yamamoto, 1995). The Toda–Yamamoto method is an alternative and improvement over the Granger causality test. This test uses an augmented structured vector autoregressive (SVAR) at level $k+d_{max}$, where k is the optimal lag length, and d_{max} is the maximum order of integration. It generates asymptotic VAR (vector autoregressive) static in the form of a Chi-square distribution. If we have two series Y_t (Indian commodity market price series) and X_t (Chinese commodity market price series), then Y_t is said to Granger cause X_t if the values of the future of X_t can be better predicted using the past values of both Y_t and X_t than it can be by using the past values of X_t only. The equation for Granger causality can be estimated by following the VAR model.

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + ... + \alpha_p Y_{t-p} + \theta_1 X_{t-1} + ... + \theta_p X_{t-p} + e_t \quad (1)$$

$$X_t = \beta_0 + \beta_1 X_{t-1} + ... + \beta_p X_{t-p} + \gamma_1 Y_{t-1} + ... + \gamma_p Y_{t-p} + V_t \quad (2)$$

Null hypothesis of equation (1), $(H0)$: $\Theta_1 = \Theta_2 = ... \Theta p = 0$, which implies that X_t does not Granger cause Y_t. Similarly, for equation (2), the null hypothesis is: $\gamma_1 = \gamma 2 = ... = \gamma_p = 0$, which implies that Y_t does not Granger cause X_t.

4. Results and Discussion

This section presents the results. First, descriptive statistics are presented in *Table 1*. Next, in *Figure 4*, the graphical representation of data illustrates the nature of the data collected. The preliminary statistics suggest that India's prices have always been on the higher side for all the three metals under consideration. The Jarque–Bera test indicates that only the copper series from both of the exchanges are normally distributed.

Table 1. *Descriptive statistics*

	ICOPPER	CCOPPER	IALUMINIUM	CALUMINIUM	IZINC	CZINC
Mean	6.66	7.66	1.95	2.19	2.26	2.68
Median	6.69	7.59	1.93	2.17	2.19	2.59
Maximum	10.16	11.43	2.78	2.85	3.59	4.29
Minimum	3.16	3.49	1.28	1.54	1.07	1.48
Std. Dev.	1.31	1.46	0.27	0.26	0.47	0.5
Skewness	0.15	0.13	0.26	-0.09	0.4	0.78
Kurtosis	3.1	2.96	3.17	2.26	2.99	3.92
Jarque–Bera	2.72	1.72	7.98	14.98	16.31	85.01
Probability	0.26	0.42	0.02	0	0	0
Sum	4170.23	4792.59	1217.59	1367.66	1416.88	1677.31
Sum Sq. Dev.	1068.93	1329.6	44.91	43.67	137.9	158.13
Observations	626	626	626	626	626	626

Source: own edition based on authors' calculations

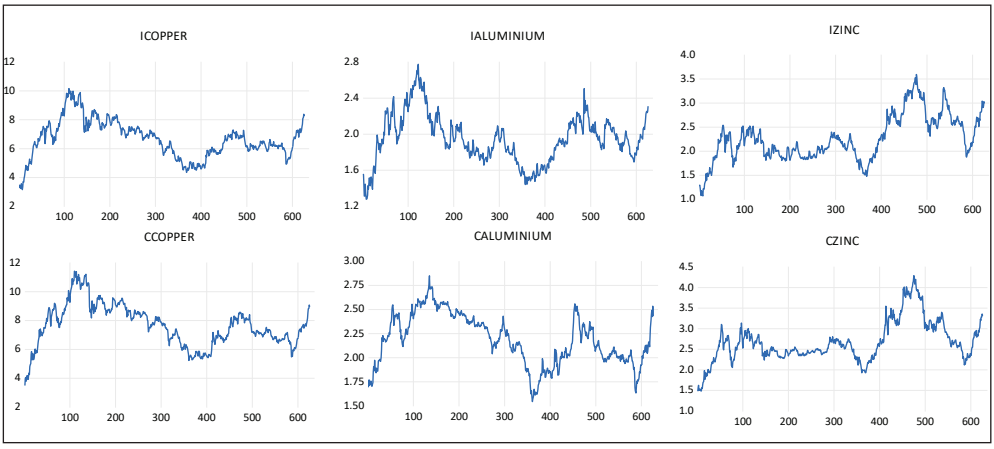


Figure 4. *Graphical representation of data*

The ADF test result for the presence of unit root is also different for copper futures presented in *Table 2*. The CCOPPER series at 5% level of significance is found to be stationary at level. All the other series at 5% significance level are non-stationary at level. At first difference, all the series are found to be stationary. However, the KPSS test suggests all the series to be integrated of order 1. Since the CCOPPER series seems to be fractionally cointegrated of orders 0 and 1, we conducted only the ARDL bound test for the copper series. For the other two

metal series, we conducted both tests, i.e. the ARDL bound test and the Johansen cointegration test.

Table 2. *Results for the unit root test*

	ADF				KPSS	
Variables	At level		At first difference		At level	At first difference
	t-statistic	P-value	t-statistic	P-value	t- statistic	t-statistic
ICOPPER	-2.675	0.079	-25.750	0	0.658	0.228
CCOPPER	-2.891	0.047	-26.468	0	0.722	0.287
IALUMINIUM	-2.645	0.085	-24.793	0	0.279	0.079
CALUMINIUM	-2.268	0.183	-24.910	0	0.915	0.150
IZINC	-2.334	0.162	-25.271	0	1.380	0.051
CZINC	-2.592	0.095	-27.383	0	0.971	0.086

Source: own edition based on authors' calculations

Note*: At 5% significance level, the critical value of the t-statistic is 0.463 for the KPSS test.*

We have found the optimal lag length following the Akaike information criteria (AIC) for the three pairs of time series. These results are presented in *Table 3*.

Table 3. *Optimal lag length*

Pairs of variables	optimal lag length
ICOPPER – CCOPPER	7
IALUMINIUM – CALUMINIUM	3
IZINC – CZINC	4

Source: own edition based on authors' calculations

Note*: The optimal lag length has been taken following the Akaike information criteria (AIC).*

Results for the long-run relationship have been reported in *Table 4* (Johansen cointegration test results) and *Table 5* (ARDL bound test results). The Johansen cointegration test reports no cointegration between Chinese and Indian metal futures (aluminium and zinc). The result is supported by the ARDL bound test findings, which indicate no long-run relationship for the copper, aluminium, and zinc futures of MCX and SHFE. This result indicates that metal futures prices in the Indian and Chinese markets do not move together in the long run. These findings are contrary to the findings of Kumar and Pandey (2011) and Sinha and Mathur (2013), where authors found linkages between metal futures markets traded on MCX (India) and London Metal Exchange (UK). The results of copper markets should also be studied bearing in mind the conclusions of X. Li and Zhang (2008) and Hua et al. (2010), where authors found a long-run relationship between copper futures markets of SHFE (China) and LME (UK).

Table 4. *Johansen cointegration test results*

		Trace statistic		Eigenvalue statistics	
Variables	Hypothesis	Trace statistic	P-value	Eigen-stat	P-value
ICOPPER – CCOPPER	r = 0	---	---	---	---
	r< = 1	---	---	---	---
IALUMINIUM – CALUMINIUM	r = 0	14.402	0.073	8.507	0.330
	r< = 1	5.895	0.015	5.895	0.015
IZINC – CZINC	r = 0	14.334	0.074	8.121	0.367
	r< = 1	6.213	0.013	6.213	0.013

Source: own edition based on authors' calculations

Table 5. *ARDL bound test results*

Variables	F-statistic	Lower bound	Upper bound
ICOPPER – CCOPPER	2.84	3.62	4.16
IALUMINIUM – CALUMINIUM	2.97	3.62	4.16
IZINC – CZINC	2.85	3.62	4.16

Source: own edition based on authors' calculations

Note*: The lower and upper bound are at 5 % level of significance.*

Table 6. *Toda–Yamamoto Granger causality test results*

Dependent variable	Independent variable	Chi-square	Degree of freedom	P-value
ICOPPER	CCOPPER	4.192	7	0.757
CCOPPER	ICOPPER	133.75	7	0
IALUMINIUM	CALUMINIUM	8.761	3	0.033
CALUMINIUM	IALUMINIUM	60.724	3	0
IZINC	CZINC	8.670	4	0.07
CZINC	IZINC	179.728	4	0

Source: own edition based on authors' calculations

Finally, *Table 6* reports the Toda–Yamamoto Granger causality test results. The findings suggest bidirectional causality for aluminium (at 5 per cent significance

level) and zinc (at 10 per cent significance level) markets. For copper futures markets, the causality is unidirectional: from the Indian to the Chinese market. This suggests that both metal markets affect each other significantly in the short run. Our findings from the short-run causality test are partially similar to the findings of Kumar and Pandey (2011).

5. Conclusions

India and China are the two emerging economies that provide the largest markets in the world. The economies often easily achieve to be considered among the top producer and consumer economies and as the leading exporting and importing economies. This study examines the short- and long-term relationship between Indian and Chinese metal futures markets. Copper, aluminium, and zinc futures are taken as the proxy for the metal futures market in both countries. The Johansen cointegration test and the ARDL bound test collectively suggest no cointegration between the markets. The Toda–Yamamoto approach of Granger causality suggests bidirectional Granger causality for aluminium and zinc and unidirectional causality for the copper futures market. The empirical results conclude that India's and China's metal futures markets have no long-run relationship but a remarkable short-run causal relationship. Futures prices seem to have an effect on each other in the short run only. These findings have important implications for investors and portfolio managers. Government policies on import-export and trade barriers may also draw significant conclusions from the results. This study has obvious limitations concerning restrictions on the analysis of time series data. The study leaves enormous scope for further research on cross-border linkages between emerging economies with different tools to explore the hidden possibilities in commodity futures.

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Differences in Capital Market Network Structures under COVID-19

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Abstract. This paper analyses the structural changes of the underlying stock and currency markets as well as the industrial productions by using a minimum spanning tree graph on a Central and East European sample. The aim is to point out the similarities and differences of the COVID-19 pandemic compared to previous recessions, namely the Dot-com crisis in the early 2000s and the Subprime crisis around 2008. Focusing on the incidence, closeness, and betweenness properties of the graph, we are looking for the emergence of a shock-propagating hub. We identify such a hub during the Subprime crisis but not during the COVID-19 pandemic, which points to the higher efficiency of the economic policy to absorb the worst effects of the crisis.

Keywords: COVID-19, network, minimum spanning tree graph, CEE

JEL Classification: C31, C33, D53, E58

1. Introduction

Countries had to face a series of widespread lockdowns during the COVID-19 pandemic, generating a technical recession globally. Meanwhile, the Eurozone was already in a state of slow growth one year before this crisis, creating a chance for a "perfect storm". This paper focuses on the differences of the COVID-19 crisis observed by comparing its impacts on the stock markets, currencies, and industrial production on a Central and East European sample – in the light of the previous

crisis periods (namely the Dot-com bubble in the early 2000s and the Subprime crisis of 2008). This special attention was motivated by the nature of the crisis: unlike the previous recessions, it was not triggered by a financial crisis, and both the unconventional monetary and fiscal policies seemed to be more prepared to absorb its effects. The composition of the group of countries was motivated by the strong economic connections of Czechia, Croatia, Hungary, Poland, and Romania with the European Union (and especially with the Eurozone) both from funding and foreign trade perspectives (Balla, 2014). Therefore, they seemed to be an ideal test group to see how the shocks propagated amongst them.

Our research is looking for the signs of contagion, assuming that in this case we can identify one country (or the Eurozone) that finds itself in the middle of a cross-country network. Therefore, we will employ a minimum spanning tree graph on the entire timeframe and on the different recession subsets as well to look for such an emergent behaviour. In case of the appearance of such a hub, we can assume that the market is in a hyper-synchronized state and shock propagation is present. Otherwise, the market is dominated much more by the country-specific issues and not by the abruptly changing market sentiment.

This study is structured as follows: Section 2 summarizes the foundations of the network theory concept, and then the stock and currency market implications are underlined in the theoretical background section to point out the importance of the usage of minimum spanning tree graphs during crisis analysis. This is followed by the data and methods in Section 3, where the analysed datasets are determined and the Student-t copula framework is introduced, which is a crucial ingredient for the graph analysis. The development of the datasets and the influence of recession periods are presented in Section 4. Section 5 summarizes the different graph metrics to determine the market topology under the different datasets and time periods.

2. Theoretical Background

2.1 Contagions and Networks

Contagion has a broad and narrow definition.[1] The general one is that it is the cross-border transmission of shocks or general cross-border spillovers that need not be associated with shocks, while the restrictive definition means that the correlations between countries in "crisis times" compared to "tranquil times" have relatively increased.[2] This indicates the spread of shocks from one (or a group of) market(s) or country/ies to other(s) (Pritsker, 2001). Contagion spreads between countries through three basic links: financial, real, and political. Financial links are

1 See: http://go.worldbank.org/JIBDRK3YC0.

2 Interdependence exists when there is no significant difference between the correlations in extreme and normal conditions, but these can still be high.

the links of the international financial system such as joint financial institutions, interconnected lenders, non-bank financial market participants, etc. The actual connections relate to international trade or the cross-border division of labour driven by FDI. Political ties are based on mutual exchange rate agreements, as well as other ongoing remittances based on international cooperation.

Transmission-related extreme events emerge from the dynamics of the underlying system, as Jentsch et al. (2006) stated, meaning that the initial shock and the market topology also determine the development of domino effects on the capital market due to the sudden increase of partner risk (Benedek et al., 2007). Partner risk became a significant systemic factor in the post-Breton Woods era due to the unavoidable role of financial innovations in risk management, or even in the essential maturity transformation in the banking sector (Barrel et al., 2010). It is important to understand the systemic background of the market because the allowance of free capital movement in the last three decades has increased the cross-market correlations since the 1980s (Obstfeld and Taylor, 2002). Heathcote and Perry (2004) underlined that capital markets integrated faster than the real economies in the recent 30 years – despite that macro fundamentals tended to move together, showing a "real regionalization" between 1972 and 1986, while "financial regionalization" emerged later with higher geographic diversification, cross-border consumption, and the increasing volatility of external trade. Goetzman et al. (2005) pointed out the following paradox: diversification strategies were efficient only before the liberalization of capital flows because convertibility allows the spreading of risks. Cross-market correlation was high also in the past when world economy was integrated: both between 1875 and 1914 and since 1972 – which is parallel to the results of Chen and Zhang (1997) and Obstfeld and Taylor (2002).

To model the market network (*n*), it is necessary to define the interactions (*c*) between the nodes or actors (*a*) on the market, which determines the shape (*sh*) of the entire network. If extreme events emerge from the underlying system, then the following formula has to collect the most important factors behind these dynamics:

$$n(a, c, sh)$$

Before the comparison of the efficient market and complex market models, it is necessary to define the basic characteristics necessary for describing a network. Market participants as nodes (actors) differ from each other only in the number of connections in the basic network theory. Therefore, the *sh* shape of the network can be described with five structural properties: average path length (*pa*), clustering coefficient (*cl*), degree distribution (*dd*), small-world effect (*sw*), *and* connectivity (*cy*) (Barabási and Albert, 1999; Wang and Chen, 2003; Watts and Strogatz, 1998; Alderson, 2008).

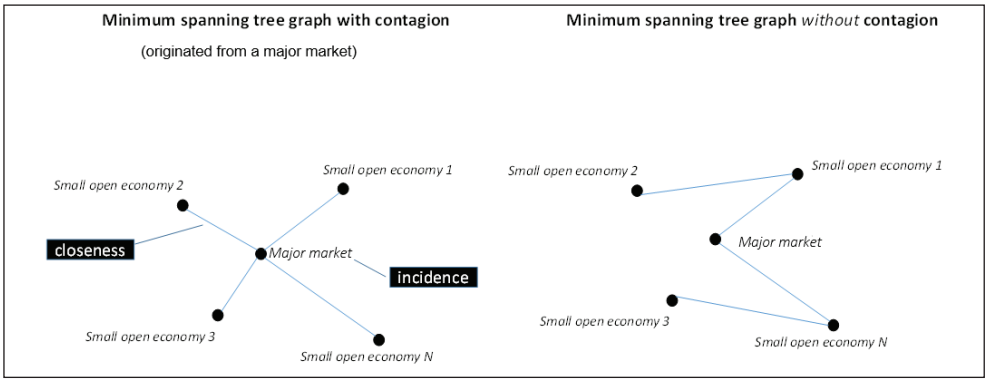
$$sh(pa, cl, dd, sw, dy)$$

The *distribution of degrees* describes the heterogeneity and the hierarchy between the nodes. The total number of links among *i* nodes is called *degree* k_i, which represents its importance in the network. The average degree of the network is *k*, the average of k_i over all *i*-s. The node degree distribution function *P(k)* is the probability that a randomly selected node has exactly *k* edges. *Average path length* is calculated by taking the average distance pa_{ij} between the i^{th} and j^{th} nodes of the network. The *clustering coefficient* is the average proportion of a node's neighbour pairs that are also neighbours to each other: *cl* as the average of cl_i over all *i*-s. The *small-world effect* can occur due to the interaction between the clustering coefficient and the grade distribution. Shortcuts reduce the distance between nodes if there are nodes (hubs) in the network with degrees above average; they allow the *small-world effect* to be present. *Hubs* are usually responsible for synchronizing the network. *Connectivity* represents the durability of the connections between nodes: its high level indicates a rapid recombination of the nodes, while the low level indicates stability. These properties can be developed with more variables, for example with different kind of connections, as Csermely (2008) contends: the so-called "weak" connections represent the informal while the "strong" connections the contractual relations between the nodes. Also, we can distinguish between the actors (nodes) on the capital markets not only by the number of their connections – representing this partner's importance on systemic level –, but we can check the fragile nature of their parameters too (see Benedek et al., 2007).

This paper focuses on the emergence of the topological changes among the economic actors under market stress. Therefore, we will assume that network topology will become much more hub-based (or centralized) under stress – not just for the actors *within* but also for those *between* the markets. It means that we would like to identify the emerging clustering behaviour on the macro-level, focusing only on the stock and currency market and the industrial production, hoping that cross-border investments, borrowing, and production will be visible on the shape of minimum spanning tree graphs (*Figure 1*).

A system is complex if the outcomes are highly irregular and seemingly unpredictable despite the potential simplicity of the equation of its motion (Kantz et al., 2006: 71). Capital market complexity causes collective effects under extreme trading days, as Bonanno et al. (2001) suggest, resulting in contagion, divergence, and interdependence as well. The assumed price equilibrium represents the fundamental value of an asset – a significant change in the cross-market correlation points to the possibility of exogenous divergence between fundamental and market value on extreme trading days. Market bubbles can emerge on a market with rational actors, but the upper "coincidence" is crucial because trade activity is affected both by trading patterns and cognitive factors (Komáromi, 2006: 76). Therefore, the description of capital markets as complex networks requires the assumption of the bounded rationality of the actor as well (Herrmann and Pillath, 2000). The complex or even

the scale-free network can describe the oligopolistic nature of the market, where key market actors are symbolized with the hubs as well as their importance with attached preferences. Statistic phenomena as fat tailness, heteroscedasticity, autocorrelation, or even collective effects are the results of this market structure. Scale-free complex networks are based on the preferential attachments, causing a hub-based structure, as postulated by Barabási and Albert (1999). This structure is between the two extreme statuses, i.e. regular (lattice) and random networks (Watts and Strogatz, 1998).



Source: author's edition

Figure 1. *Minimum spanning tree graph with and without contagions*

The *incidence* of the graph describes the number of connections from one node (in our case country) to another, as *betweenness* represents the degree to which nodes stand between each other, while *closeness* describes the strength of this relation. In a minimum spanning tree design, we can assume that only the most significant edges (node-to-node connections) are represented, so an emerging hub structure can prove the highly synchronized state of contagions. Under a fully stressed global contagion scenario, we can expect for the emergence of a single hub market, which synchronizes the rest of the network due to crisis propagation. This hub will have a high incidence and betweenness value due to its relative importance in the network, while it will have a strong connection to the rest of the nodes. However, in the case of country-specific stress, the network remains in an atomized (or non-centralized) state, so we will be unable to identify such a node with asymmetric properties.

2.2 Pricing Anomalies

Funding and market liquidity conditions are determined by the secondary market's depth for the assets, as well as the market sentiment (Varga, 2016; BIS, 2011).

Stock market pricing reacts both to the monetary policy instruments and to the expectations of the private sector regarding the future development of the most important macroeconomic indicators as a forward-looking reference (Kurov, 2010; Sági, 2018). Therefore, asset price bubbles can be interpreted as a structural uncertainty in the valuation process, namely about the cash-flow-generating ability or the discount rate (Robinson and Stone, 2004). A tighter monetary policy can help to disinflate such bubbles by setting the discount rate, but it can increase the volatility of asset prices if it "leans against the wind" (Galí, 2013). Monetary policy can have, therefore, an endogenous influence on asset valuation.

Currencies, however, are special assets since they represent both the external and the internal balances of two economies, wherefore they can be considered as more appropriate indicators for cross-country shock propagation. Their values are affected by the change in the demand for individual currencies, which can be biased by the "fear of floating" phenomenon, as Calvo and Reinhart (2002) showed. It means that central banks are following a flexible regime that pursues undeclared exchange rate target (*de jure* floating) – but neither the adversary effects of devaluation-driven inflation or debt revaluation nor the appreciation-driven pressure on productivity is preferred to be minimized. In case a powerful shock affects the economy, a long period of exchange rate fluctuations can follow, which can be harmful for the tradable sector. However, crisis periods can trigger the investments and capital flow towards safe assets and "safe-haven" currencies with a dramatic price effect (Ranaldo and Söderlind, 2009). This can lead to deflationary waves in an open economy like Switzerland or Czechia, where temporary currency ceilings had to be implemented in the mid-2010s (Madaras and Györfy, 2016).

3. Data and Methods

In this research, we used monthly dataset from February 2000 to September 2020 to capture contagions among a set of Central-East European (Czech, Croatian, Hungarian, Polish, and Romanian) stock markets, currencies, and industrial output against their counterparts in the Eurozone. To represent the financial links, stock and currency markets were analysed. For the stock markets, this paper used Euro-Stoxx (Eurozone), PX (Czechia), CROBEX (Croatia), BUX (Hungary), WIG (Poland), and BET (Romania), while currencies were denominated in US dollars (USD) in the same order: EUR/USD, CZK/USD, HRK/USD, HUF/USD, PLN/USD, RON/USD. All these data were acquired from the *Refinitiv Eikon* database. Meanwhile, real links were captured through the industrial output from the Euro area 19, Czechia, Croatia, Hungary, Poland, and Romania, downloaded from the Eurostat database.

To compare the different recession periods, we used the Business Cycle Clock of the European Commission, which can be implemented as an official conjuncture

dating database. Therefore, the following recession periods were compared: the Dot-com (Oct. 2000–Sept. 2003), the Subprime (Jan. 2008–Sept. 2009), and the COVID-19 (Oct. 2017–Sept. 2020).

We applied minimum spanning tree graphs, which were based on Student-t copulas. To describe Student-t copulas following Bouyé et al. (2000), let us take N number of $X_1,\ldots, X_N$ random variables, whose dependency can be written by the C common or F multivariate distribution:

$$F(x_1, \ldots, x_N) = P[F_1(X_1) \leq F_1(x_1), \ldots, F_N(X_N) \leq F(x_N)] = C(F_1(x_1), \ldots F_N(x_N)).$$

With $\rho = \begin{bmatrix} \rho_{11} & \rho_{12} \\ \rho_{21} & \rho_{22} \end{bmatrix}$ linear correlation matrix and ν degree of freedom, a $T_{\rho,\nu}$ Student's t distribution can be parameterized as:

$$C(x_1, \ldots, x_n, \ldots, x_N; \rho) = |\rho|^{-\frac{1}{2}} \frac{\Gamma\left(\frac{\nu+N}{2}\right)\left[\Gamma\left(\frac{\nu}{2}\right)\right]^N}{\left[\Gamma\left(\frac{\nu+1}{2}\right)\right]^N \Gamma\left(\frac{\nu}{2}\right)} \frac{\left(1+\frac{1}{\nu}\varsigma^T\rho^{-1}\varsigma\right)^{-\frac{\nu+N}{2}}}{\prod_{n=1}^{N}\left(1+\frac{\varsigma_n^2}{\nu}\right)^{-\frac{\nu+1}{2}}}$$

(where $\varsigma_n = t_\nu^{-1}$, $\Gamma(\mathrm{n}) = (\mathrm{n}-1)!$).

Minimum spanning tree graphs were calculated, following the work of Deeley (2020) in Matlab, by imputing the cross-country correlations from the Student-t copula and determining the incidence and closeness variables by this algorithm.

4. Results and Discussion

Currencies in the sample have a long tendency of strong common movements (see Stavárek, 2009), while stock markets have a mild correlation that intensifies under stressed periods (see Kiss, 2017). Meanwhile, the industrial production should be interlinked due to the intense foreign trade among the countries and the high importance of FDI-driven export. Recessions in the Eurozone had a widespread effect on the sample (*Appendix 1*), causing decline in stock market indices and industrial production as well as depreciating currencies. This result means that the recession periods were well calibrated since they were able to capture stressed periods well.

4.1 Stock Markets

Central and East European stock markets (*Table 1*) were characterized by the dominance of the Eurozone during the entire time set, where the Euro-Stoxx index was literally

sitting in the middle of the network and dominating corporate valuation. However, we were able to find Euro-Stoxx in a similar central role under the Subprime crisis only when higher closeness ratios were present in the network. The Czech PX and the Hungarian BUX indices had secondary importance at this time, which is interesting since they had a central role during the Dot-com crisis (but with lower overall closeness levels) and the Czech PX had a central role during the COVID-19 period. This result underlines that the COVID-19 recession has had no global impact on public companies' valuation yet and has remained to be a country-specific phenomenon.

Table 1. *Stock market minimum spanning tree graph characteristics*

Entire dataset			
	Incidence	**Closeness**	**Betweenness**
Eurozone	5	0.2454	10
Czechia	1	0.1422	0
Hungary	1	0.1410	0
Poland	1	0.1469	0
Romania	1	0.1281	0
Croatia	1	0.1259	0
Dot-com			
	Incidence	**Closeness**	**Betweenness**
Eurozone	1	0.1190	0
Czechia	2	0.1609	6
Hungary	3	0.1609	7
Poland	1	0.1095	0
Romania	1	0.0789	0
Croatia	2	0.1278	4
Subprime			
	Incidence	**Closeness**	**Betweenness**
Eurozone	3	0.3113	7
Czechia	2	0.3113	6
Hungary	2	0.2505	4
Poland	1	0.2182	0
Romania	1	0.2128	0
Croatia	1	0.1636	0
COVID-19			
	Incidence	**Closeness**	**Betweenness**
Eurozone	2	0.1786	4
Czechia	3	0.2236	8
Hungary	1	0.1215	0
Poland	1	0.1559	0
Romania	1	0.1107	0
Croatia	2	0.1699	4

Source: authors' calculations in Matlab following Deeley (2020)

4.2 Currencies

Currencies were less centralized (*Table 2*), which is a surprising result if we consider their strong correlations. Both the Czech koruna and the euro had a central role in the network with the Hungarian forint in the third position on the entire timeframe. However, we can identify strange differences between the COVID-19 and the previous recession periods: closeness levels increased dramatically, suggesting that the previous slowdown and the following pandemic had an icy grip on all the regional currencies. Meanwhile, we were unable to identify clear hubs, nor the primary role of the euro.

Table 2. *Currency minimum spanning tree graph characteristics*

	Entire dataset		
	Incidence	**Closeness**	**Betweenness**
Eurozone	2	0.2569	6
Czechia	3	0.2569	7
Hungary	2	0.2000	4
Poland	1	0.1386	0
Romania	1	0.1603	0
Croatia	1	0.1899	0
Dot-com			
	Incidence	**Closeness**	**Betweenness**
Eurozone	2	0.2202	6
Czechia	3	0.2202	7
Hungary	2	0.1794	4
Poland	1	0.1106	0
Romania	1	0.1232	0
Croatia	1	0.1523	0
Subprime			
	Incidence	**Closeness**	**Betweenness**
Eurozone	2	0.2051	4
Czechia	2	0.2560	6
Hungary	1	0.1540	0
Poland	1	0.1363	0
Romania	2	0.2560	6
Croatia	2	0.2230	4
COVID-19			
	Incidence	**Closeness**	**Betweenness**
Eurozone	2	0.4067	6
Czechia	1	0.2945	0
Hungary	1	0.2227	0
Poland	2	0.3239	4
Romania	3	0.4067	7
Croatia	1	0.2774	0

Source: authors' calculations in Matlab following Deeley (2020)

4.3 Industrial production

Industrial production (*Table 3*) presented the lowest closeness numbers, which is strange because of the dominance of FDI-driven trade in the region. The central role of Polish industrial production seems to be counter-intuitive as well since most of the countries' foreign trade is conducted with other EU Member States. However, we were able to identify the hub-like behaviour of the Eurozone (probably as a main domain of shocks) during the Subprime crisis, which was a clear example for a systemic crisis both in the financial sector and in the real economy. Fortunately, neither the Dot-com nor the COVID-19 recessions had similar characteristics since they remained to be country-specific phenomena.

Table 3. *Industrial production minimum spanning tree graph characteristics*

	Entire dataset		
	Incidence	**Closeness**	**Betweenness**
Eurozone	1	0.0801	0
Czechia	2	0.1214	4
Hungary	1	0.0972	0
Poland	4	0.1598	9
Romania	1	0.0932	0
Croatia	1	0.0941	0
Dot-com			
	Incidence	**Closeness**	**Betweenness**
Eurozone	2	0.1100	6
Czechia	2	0.0903	4
Hungary	2	0.0913	4
Poland	2	0.1100	6
Romania	1	0.0610	0
Croatia	1	0.0650	0
Subprime			
	Incidence	**Closeness**	**Betweenness**
Eurozone	3	0.1603	7
Czechia	3	0.1603	7
Hungary	1	0.1005	0
Poland	1	0.1079	0
Romania	1	0.0987	0
Croatia	1	0.0908	0
COVID-19			
	Incidence	**Closeness**	**Betweenness**
Eurozone	1	0.0955	0
Czechia	3	0.1576	7
Hungary	2	0.1576	6

	Entire dataset		
	Incidence	**Closeness**	**Betweenness**
Poland	2	0.1300	4
Romania	1	0.1011	0
Croatia	1	0.0874	0

Source: authors' calculations in Matlab following Deeley (2020)

5. Conclusions

Despite the disruptive effects of the COVID-19 pandemic on the global value production chains, financial markets remained relatively insulated from its effects, and the situation did not turn into another global financial crisis like the Subprime crisis of 2008. It was mostly averted by the various fiscal and unconventional monetary stimulus packages developed during the 2010s to mitigate the effect of the last global recession and to reinforce the single currency.

This paper pointed out that the financial (stock or currency markets) and the real economy (industrial production) suffered from a global crisis, but the global crisis was not propagated through a hub-like structure this time. However, Central and East European currencies had a dramatically stronger interlinkage, pointing to the systemic nature of the drastic depreciations in 2020. The capital market impact of these periods of economic downturn has been examined in several recent studies (Onofrei et al., 2019; Cărăuşu et al., 2018; Armeanu et al., 2016), whose results are almost consistent with our findings that market contagions are common in this region due to the close interconnectedness of the sample countries. The novelty of this study is based on our methodological approach, because we cannot find any other paper in this topic using Student-t copulas and minimum spanning tree methods.

However, the pandemic is not over yet since most of the European countries are still under some sort of lockdown, production chains are suffering from various bottlenecks due to unstable supply, and the intra-continental passenger transport is frozen. But at least the sovereign risks were not present on the markets, or currencies were able to maintain their automatic stabilizer functions.

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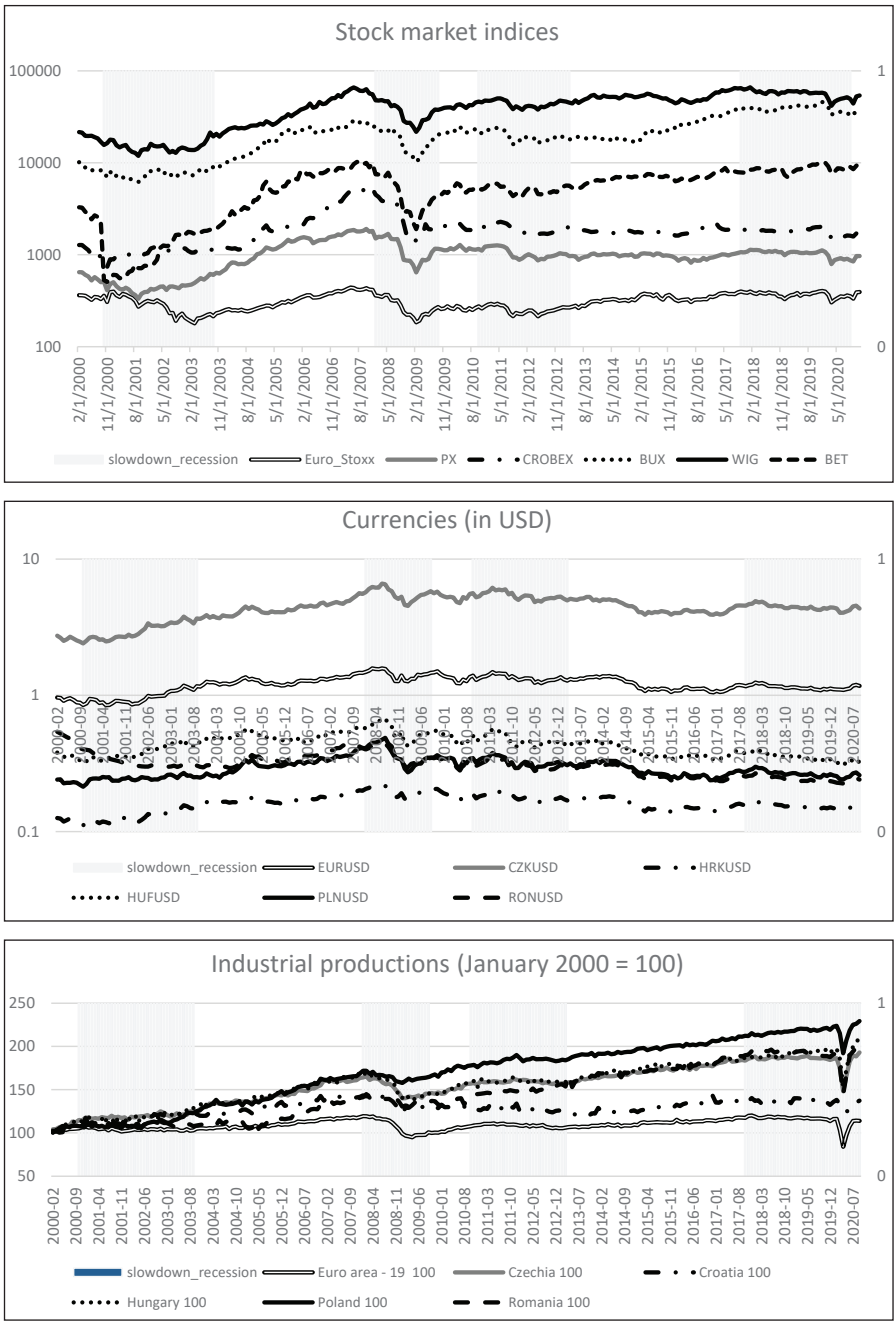
Appendix 1. *Historical values of stock market indices, exchange rates, and industrial productions*



Source: Refinitiv Eikon, Eurostat, European Commission

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The Impact of Oil Price on Economic Growth in Middle-Income Oil-Importing Countries: A Non-Linear Panel ARDL Approach

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Abstract. In this study, the impact of the crude oil price on economic growth is investigated in seven middle-income oil-importing countries in sub-Saharan Africa (SSA), namely Botswana, Kenya, Mauritania, Mauritius, Namibia, South Africa, and Zambia. The estimation is based on both linear and non-linear panel autoregressive distributive lag (panel ARDL) models. The real oil price is decomposed into negative oil price shock and positive oil price shock in order to examine the non-linear impact of oil price on economic growth. Using an annual dataset from 1990 to 2018, it was found that in the symmetric model the oil price has a positive and significant impact on economic growth in the long run. The short-run estimates, however, show that the oil price has no significant impact on economic growth. The overall results from the asymmetric model also show that there is a non-linear relationship between oil price and economic growth in the studied countries.

Keywords: oil price, economic growth, middle-income countries, sub-Saharan Africa, panel asymmetric effects

JEL Classification: Q43, O55, N17, C33

1. Introduction

The debate on the impact and causal relationship of oil price and economic growth remains a subject of great interest by policymakers and researchers, especially after the drastic reduction in oil commodity prices from $105 per barrel to $47 per barrel in the second half of 2014. This connects to the fact that oil has become a major and important source of energy to the economy. Moreover, oil is an essential

production input and cuts across all economic activities. It dominates the global source of energy consumption. Therefore, oil price fluctuates heavily and has both micro- and macro-economic effects on an economy. Global oil prices remained low in 2015 and increased only marginally towards the end of 2016 and at the beginning of 2017 (Canuto, 2014; Energy Information Administration, 2017).

While studies on the subject have been explored in the literature, this paper is novel in examining whether the income level of countries plays a significant role in determining the link between oil price and economic growth for oil-importing countries. Secondly, in some of the previous studies, only the causality between oil price and economic growth has been examined. The panel Autoregressive Distributive Lag (panel-ARDL) model employed in this study augments previous studies on the subject by including both the long-run and the short-run impacts (Asongu et al., 2016). Thirdly, previous studies have argued that the effect of oil price on economic growth could be non-linear. Studies that assert that oil price analysis should be nonlinear to capture the asymmetry effects include Mork (1989), Lee et al. (1995), Hooker (1996a), Jiménez-Rodríguez and Sánchez (2005), Salisu et al. (2017), and Raheem (2017). Lee et al. (1995) specifically argued that oil price volatility induces a nonlinear effect on economic activities. Hooker (1999) also affirms that the impact of oil price on growth is less accented when the data span is beyond 1973. Therefore, this study adopts the panel nonlinear Autoregressive Distributive Lag (panel-NARDL) to examine the asymmetry impact of oil price on growth. Therefore, oil price is decomposed into oil price positive and oil price negative shocks.

Lastly, many studies on this subject have mainly focused on single countries (Gbatu et al., 2017a; Benedictow et al., 2013; Aliyu, 2011; Du and Wei, 2010; Hanabusa, 2009; Mory, 1993; Hamilton, 1983; Hooker, 1996a, 1996b). Recent studies include Su et al. (2021), who examined the effect of oil price on economic uncertainty in BRICS. Jiang et al. (2021) examined the asymmetric relationship between oil price and economic uncertainty in China. The closest paper to the current study is based on work done by Akinsola and Odhiambo (2020). While Akinsola and Odhiambo (2020) focused on low-income countries, such as Mali, Mozambique, Ethiopia, Senegal, Tanzania, the Gambia, and Uganda, in the current study, the focus is on middle-importing countries such as Botswana, Kenya, Mauritius, Mauritania, Namibia, South Africa, and Zambia. As reported by some previous authors, lumping countries that are at different stages of development may lead to potential bias, which could result in inconsistent estimates (see Ghirmay, 2004; Casselli et al., 1996). Consequently, this study is aimed at only focusing on middle-income countries, as they are at the same level of economic development.

The remainder of this paper is organized as follows. Section 2 provides a global review of the literature, while Section 3 deals with the methodology, empirical model specification, and data sources. In Section 4, the empirical results are analysed and discussed, while Section 5 concludes the study and proffers policy recommendations.

2. Literature Summary

This literature review is based on the debate regarding the symmetric and asymmetric effects of oil price on economic growth. While there are huge existing studies on the subject, only a few of them have considered the nonlinear impact of oil price on economic growth using dynamic panel techniques. Hamilton (1983, 1996) was one of the pioneers of the literature on the link between oil price and economic growth. The author found that oil price exerts a negative impact on economic growth. The European Central Bank (2016) also examined the relationship between oil prices and the world GDP using simulation models from the National Institute Global Econometric Model (NiGEM), the six-mod version of IMF's flexible System of Global Models, and a structural VAR model. They reported that the growth in the aggregate demand of oil-importing countries had been limited despite the gains from lower oil prices. Therefore, a 10% decrease in oil prices driven by supply fluctuations caused an increase of between 0.1% and 0.2% in the world GDP, while a 10% decline driven by demand fluctuations caused a decrease of more than 0.2% in the world GDP. However, if the oil price declines due to more supply shocks than demand shocks, the models suggest that the combined effect of the two shocks on the world GDP would be close to zero or even slightly negative. Bacon (2005) used a large dataset in a panel study of 131 countries. Higher crude oil prices are argued to affect oil-importing countries and could be more detrimental to poorer oil-importing countries. Similarly, Rasmussen and Roitman (2011) used a global dataset in their analysis and concluded that a 25% rise in oil prices would only cause a 0.5% or lower decrease in GDP.

Time series analyses of the symmetry effect of oil price include Abeysinghe (2001), who examined the direct and indirect impact of oil price for oil-importing and oil-exporting countries. The dataset includes the US, ten Asian countries, and the OECD. The author found that higher oil prices affect both oil-importing and oil-exporting economies through direct and indirect effects. The indirect effects are from interactions with trading partners. The study concluded that even though the effect of oil price may not be significant for large economies such as the US, it nonetheless plays a critical role in small open economies. Moreover, even net oil exporters such as Indonesia and Malaysia experienced the negative impact of oil prices through a trade matrix. Another study by Kumar (2009) estimated the impact of oil price on the growth of industrial output in India using a multivariate VAR. Employing quarterly data from 1975 to 2004, Kumar (2009) found that oil price negatively impacts output growth in India. Another study on an emerging Asian country was conducted by Benedictow et al. (2013). The authors employed the general to specific OLS method to analyse the effects of oil price fluctuations on fiscal policies in Russia. They found that a higher oil price stimulates economic growth but also causes a rupture in the economy.

There is still a dearth of research on the impact of oil price on economic growth for developing countries, especially for middle-income countries in SSA. This may be because the demand for energy and oil in developing countries has been growing only in recent times. Some studies based on SSA, such as Fofana et al. (2009) and Ziramba (2010), examined the relationship between oil prices and the South African economy. Using the Computable General Equilibrium (CGE) Model and the Macro-Meso-Micro modelling approach, the study found that oil price negatively impacts the macro-economy of South Africa, especially its GDP and current account. Other studies on South Africa include those conducted by McDonald and van Schoor (2005) and Essama-Nssah et al. (2007), who also used the CGE Model. McDonald and van Schoor (2005), for example, found that a 20% increase in oil prices results in a 1% decrease in GDP. Major impacts were in the petroleum industry, but the effect on a "liquid-fuel"-dependent sector, such as transport, is not as large as expected. The depreciating currency was found to offset the negative impact of higher petroleum prices, especially in exporting areas of the sector. In the long run, there is a high mobility of capital and skilled labour, which may not be advantageous to the whole economy.

Essama-Nssah et al. (2007) examined the economy-wide and distributional impact of oil price shocks on South Africa. The authors employed a CGE macro to the micro-framework. Their CGE Model had 43 production activities categorized into agriculture, industry, and services. The study found that a surge in the crude oil price results in a reduction in the quantity of imported crude oil by approximately 1%. The micro results showed the welfare impact of the oil price shock on the level of skills of households.

Some studies have examined the asymmetric effect of oil prices on macro-economy. Gbatu et al. (2017a) found the presence of asymmetries using asymptotic and bootstrap distribution techniques for an oil-importing country, namely Liberia. Positive oil price shocks are found to have a positive impact on the Liberian economy. Balcilar et al. (2017) also found the presence of a nonlinear relationship between oil price and economic growth. The authors employed growth regime analysis in a Markov switching VAR and found that oil price is predictive of real output growth, especially in low-growth regimes. They found that the high-growth regime is longer on average than the period of the low-growth regime.

Other studies that have examined the asymmetric effect of oil price using an ARDL methodology include those conducted by Nusair (2016), Salisu et al. (2017), and Raheem (2017). Salisu et al. (2017) employed panel linear and nonlinear ARDL techniques and investigated the impact of oil price on inflation in a panel of oil-importing and oil-exporting countries. They found that the effect of asymmetries in the oil price seems to be higher in the panel of oil-exporting countries. Raheem (2017) also found an asymmetric effect of oil price on trade components for six countries in a time series analysis. The countries are categorized into oil-importing, oil-exporting, and high-trading countries.

3. Empirical Model Specification, Methodology, and Data Sources

3.1. Empirical Model Specification and Methodology

A modified version of Gbatu et al's (2017b) model is used in this study to examine the linear and nonlinear impact of oil price on economic growth in seven middle-income SSA countries. The model is extended by including oil consumption, labour force, investment, and domestic credit as a percentage of GDP.

The model can be expressed as follows:

$$y = f(ROP, OC, LF, INV, RER, DC) \tag{1}$$

Real GDP per capita is represented as y and presented as a function of the real oil price, oil consumption labour force participation rate, investment, real exchange rate, and domestic credit as a percentage of GDP. All variables are expressed in logarithmic form.

A dynamic model based on Pesaran et al. (1999) is presented as a panel ARDL (p,q) to estimate the long-run and the short-run relationship among the variables. Therefore, the panel ARDL model is specified as follows:

$$\begin{aligned}\Delta y_{it} = \lambda_i + \sum_{j=1}^{p} \lambda_{1ij}\, \Delta y_{i,t-j} + \sum_{j=0}^{q} \lambda_{2ij}\, \Delta ROP_{i,t-j} + \sum_{j=0}^{q} \lambda_{3ij}\, \Delta OC_{i,t-j} + \sum_{j=0}^{q} \lambda_{4ij}\, \Delta LF_{i,t-j} \\ + \sum_{j=0}^{q} \lambda_{5ij}\, \Delta INV_{i,t-j} \sum_{j=0}^{q} \lambda_{6ij}\, \Delta REER_{i,t-j} + \sum_{j=0}^{q} \lambda_{7ij}\, \Delta DC_{i,t-j} + \delta_{1ij} \Delta y_{i,t-1} \\ + \delta_{2ij} \Delta ROP_{i,t-1} + \delta_{3ij} \Delta OC_{i,t-1} + \delta_{4ij} \Delta LF_{i,t-1} + \delta_{5ij} \Delta INV_{i,t-1} \\ + \delta_{6ij} \Delta REER_{i,t-1} + \delta_{7ij} \Delta DC_{i,t-1} + \varepsilon_{it},\end{aligned} \tag{2}$$

where y_{it} is the dependent variable for group i. The groups are denoted as i = 1,2,… N countries, and t = 1,2… T periods. λ_i represents the fixed effects. The first part of the model with coefficients λ_1 *to* λ_7 depicts the short-run dynamics of the model, and the second part with coefficients δ_1 *to* δ_7 depicts the long-run relationship and the error term.

After establishing a long-run relationship, the panel error correction model (ECM) is presented as follows:

$$\Delta y_{it} = \lambda_i + \sum_{j=1}^{p} \lambda_{1ij}\, \Delta y_{i,t-j} + \sum_{j=0}^{q} \lambda_{2ij}\, \Delta ROP_{i,t-j} + \sum_{j=0}^{q} \lambda_{3ij}\, \Delta OC_{i,t-j} + \sum_{j=0}^{q} \lambda_{4ij}\, \Delta LF_{i,t-j}$$

$$+\sum_{j=0}^{q}\lambda_{5ij}\,\Delta INV_{i,t-j}+\sum_{j=0}^{q}\lambda_{6ij}\,\Delta REER_{i,t-j}+\sum_{j=0}^{q}\lambda_{7ij}\,\Delta DC_{i,t-j}+\lambda_{8ij}ECT+\varepsilon_{it} \tag{3}$$

The asymmetric effect of oil price on growth is also examined in a panel nonlinear ARDL (panel NARDL) model. The panel NARDL model used in capturing the asymmetric impact follows Shin et al. (2014) and is specified as follows (see Raheem, 2017; Salisu et al., 2017):

$$\Delta y_{it}=\emptyset_i\left(y_{i,t-1}+ROP^{+}_{i,t-1}+ROP^{-}_{i,t-1}+\gamma_i' X_{i,t}\right)+\sum_{j=1}^{p-1}\lambda^{*}{}_{ij}\,y_{i,t-j}+\sum_{j=1}^{q-1}\lambda^{*}{}_{ij}\,ROP^{+}_{i,t-j}+\sum_{j=1}^{p-1}\lambda^{*}{}_{ij}\,ROP^{-}_{i,t-j}+\sum_{j=0}^{q-1}\sigma^{*}{}_{ij}\,X_{i,t-j}+\mu_i+\varepsilon_{it}, \tag{4}$$

where ROP^{+} and ROP^{-} depict decomposed oil price into oil price positive and negative changes respectively. The oil price can be theoretically decomposed as (see Raheem, 2017):

$$ROP^{+}_{i,t}=\sum_{j=1}^{t}\Delta\,ROP^{+}_{i,j}=\sum_{j=1}\max\left(\Delta\,ROP^{+}_{i,j},0\right) \tag{5}$$

$$ROP^{-}_{i,t}=\sum_{j=1}^{t}\Delta\,ROP^{-}_{i,j}=\sum_{j=1}\min\left(\Delta\,ROP^{-}_{i,j},0\right) \tag{6}$$

Equation (6) can be re-parameterized to include the ECM as follows (see Salisu et al., 2017):

$$\Delta y_{it}=\tau_i\,\xi_{i,t-1}+\sum_{j=1}^{N1}\lambda_{ij}\,\Delta y_{i,t-j}+\sum_{j=0}^{N2}\left(\gamma^{+}_{ij}\,\Delta ROP^{+}_{t-j}+\gamma^{-}_{ij}\,\Delta ROP^{-}_{t-j}\right)+\mu_i+\varepsilon_{it} \tag{7}$$

The error correction term ($\xi_{i,t-1}$) captures the long-run equilibrium in the panel-NARDL, while τ_i represents the speed of adjustment that measures the time frame it takes the system to converge to its long-run equilibrium during a shock.

3.2 Data Sources

The countries included in this study are Botswana, Kenya, Mauritius, Mauritania, Namibia, South Africa, and Zambia. Brent crude oil price has been chosen as it has been found to be a major measure of crude oil price in the world. The data on real GDP per capita, investment, labour force participation rate, and domestic credit were obtained from the World Development Indicators, while data on the oil price was obtained from the BP Statistical Review of World Energy. Data on oil consumption were sourced from Energy Information Administration, while the real exchange rate was obtained from the Bruegel Statistical database.

4. Empirical Analysis

4.1 Panel Unit Root Tests

The panel unit root test is conducted using the homogenous unit root process (Levin, Lin, and Chu – hereafter as LLC and the Breitung tests) and the heterogeneous unit root process (Im, Perasan, and Shin Chu – hereafter as IPS, ADF-Fisher, and PP-Fisher Chi-square tests). The homogenous unit root process assumes that a common unit root process exists in the panel. This assumption that the unit root processes are homogenous across cross-sections might be restrictive since the literature shows that the economic structure and oil consumption of the sampled countries are heterogeneous. Therefore, they respond differently to oil price changes. This heterogeneity was also acknowledged by Behmiri and Manso (2013) and Salisu and Isah (2017).

The heterogeneous panel unit root tests, however, allow heterogeneity across cross-sections and relax the assumption that all panels share the same autoregressive parameter. The null hypothesis for these tests is that there is a unit root for all cross-sections, and the alternative hypothesis is that some cross-sections are stationary (Barbieri, 2006). *Table 1* presents the results from the panel unit root tests.

The results from *Table 1* show that some of the variables are stationary at level, while others are stationary at first difference. The results of the panel unit root tests confirm the suitability of the panel ARDL model, which allows for the combination of I(0) and I(1) order of integration (Salisu and Isah, 2017).

Table 1. *Panel unit root tests*

Variable	Tests	At level		At first difference		Order of integration
		Intercept	Trend	Intercept	Trend	
y	LLC	0.04(0.518)	-0.91(0.180)	-6.02***(0.000)	-5.77***(0.000)	
	Breitung	-	1.27(0.898)	-	-2.88***(0.002)	
	IPS	3.63(1.000)	-1.50*(0.067)	-6.70***(0.000)	-5.61***(0.000)	I(1)
	ADF-Fisher	1.95(1.000)	21.87*(0.081)	70.95***(0.000)	57.51***(0.000)	
	PP-Fisher	1.19(1.000)	21.04(0.101)	105.25***(0.000)	332.48***(0.000)	
ROP	LLC	-5.13***(0.000)	2.18**(0.015)	-	-	
	Breitung	-	-0.33(0.373)	-	-4.18***(0.000)	
	IPS	-3.89***(0.000)	-2.00**(0.023)	-	-	I(0)
	ADF-Fisher	42.19***(0.000)	24.09**(0.045)	-	-	
	PP-Fisher	42.75***(0.000)	21.88**(0.047)	-	-	
OC	LLC	-0.84(0.200)	-3.73***(0.000)	-6.93***(0.000)	-	
	Breitung	-	-1.44*(0.075)	-	-	
	IPS	1.31(0.904)	-4.26***(0.000)	-9.78***(0.000)	-	I(1)
	ADF-Fisher	8.68(0.851)	46.58***(0.000)	106.12***(0.000)	-	
	PP-Fisher	17.81(0.216)	45.63***(0.000)	163.20***(0.000)	-	
RER	LLC	-1.16(0.123)	-1.07(0.142)	-7.10***(0.000)	-5.97***(0.000)	
	Breitung	-	-1.64**(0.051)	-	-6.46***(0.000)	
	IPS	-0.05(0.479)	-0.65(0.257)	-7.61***(0.000)	-6.58***(0.000)	I(1)
	ADF-Fisher	14.92(0.384)	17.28(0.242)	80.42***(0.000)	65.41***(0.000)	
	PP-Fisher	10.06(0.758)	13.37(0.498)	124.12***(0.000)	338.24***(0.000)	
INV	LLC	-1.98**(0.024)	-1.80**(0.036)	-	-	
	Breitung	-	-3.19***(0.000)	-	-	
	IPS	-1.93**(0.027)	-2.69***(0.004)	-	-	I(0)
	ADF-Fisher	23.12**(0.058)	29.31***(0.009)	-	-	
	PP-Fisher	22.36*(0.071)	23.76**(0.049)	-	-	

Variable	Tests	At level		At first difference		Order of integration
		Intercept	Trend	Intercept	Trend	
LF	LLC	1.27(0.899)	0.08(0.530)	-3.43***(0.000)	-2.83***(0.002)	I(1)
	Breitung	-	-1.35*(0.089)	-	-3.51***(0.000)	
	IPS	3.56(1.000)	-2.27**(0.012)	-4.62***(0.000)	-3.30***(0.000)	
	ADF-Fisher	4.14(0.995)	26.22**(0.024)	52.46***(0.000)	39.54***(0.000)	
	PP-Fisher	9.03(0.829)	9.37(0.807)	52.18***(0.000)	39.19***(0.000)	
DC	LLC	-5.31***(0.000)	0.07(0.528)	-	-9.05***(0.000)	I(0)
	Breitung	-	-1.62**(0.053)	-	-	
	IPS	-4.84***(0.000)	-3.23***(0.001)	-	-	
	ADF-Fisher	55.81***(0.000)	34.39***(0.002)	-	-	
	PP-Fisher	46.12***(0.000)	34.62***(0.002)	-	-	

*Notes: Probability values in parentheses. ***, **, and * imply statistical significance at 1%, 5%, and 10% levels respectively. LLC stands for Levin, Lin, and Chu test, IPS is the Im, Pesaran, and Shin test, ADF is the augmented Dickey–Fuller test, and PP is the Phillips–Perron test.*

4.2 Panel Cointegration Tests

This study employs the Pedroni (2004) and Kao (1999) panel cointegration tests to examine the cointegration relationship between oil price and its regressors. The results of these tests are reported in *tables 2–3*.

Table 2. *Pedroni cointegration test*

	Statistic	P-value	Weighted statistic	P-value
Within-dimension				
Panel v-Statistic	4.781***	0.000	2.388***	0.009
Panel rho-Statistic	3.063	0.999	3.037	0.999
Panel PP-Statistic	0.400	0.656	0.567	0.715
Panel ADF-Statistic	-1.296*	0.098	-1.284	0.100
Between-dimension				
Group rho-Statistic	3.567		1.000	
Group PP-Statistic	-3.415***		0.000	
Group ADF-Statistic	-3.088***		0.001	

*Notes: *** and * indicate statistical significance at 1% and 10% levels respectively.*

The results reported in *Table 2* show that four out of seven tests reject the null hypothesis of no cointegration in the Pedroni test. These four statistics are panel v, panel ADF, group PP, and group ADF statistics. The panel v, group PP, and group ADF statistics are significant at the 1% level, while the panel ADF statistics are significant at the 10% level. Therefore, the results of the Pedroni test confirm the presence of a cointegrating relationship among the variables. Similarly, the cointegration test was conducted using the Kao panel cointegration test. The result with a -2.262 statistic and 0.012 probability value rejects the null hypothesis of no cointegration at the 5% level of significance. Hence, both panel cointegration tests confirm the existence of a long-run relationship among the variables used in this study.

4.3 Symmetry Effect of Oil Price

The results of the panel unit root tests and panel cointegration tests show that we can now proceed with the panel ARDL estimation. The results of the linear impact of oil price on economic growth based on panel ARDL are reported in *Table 3*.

The Hausman test values of 3.16 and its probability of 0.789 suggest that it is not significant. Therefore, the null hypotheses that the difference in coefficients is not systematic are rejected and confirm that the difference is systematic, thereby confirming that the PMG is more appropriate than the MG at 5%. The results for the long-run estimates reported in *Table 4* show that the real oil price exerts a positive and

significant impact on growth. Although contrary to the expectations of this study, this finding is in line with studies conducted by Behmiri and Manso (2013) and Suleiman (2013), amongst others. Behmiri and Manso (2013), for example, found a positive impact of oil price on economic growth for some of the countries in the panel of oil-importing countries. Suleiman (2013) also reported that oil price positively impacts economic growth. The study included South Africa – one of the countries which are also included in the current sample. The variables are, however, not significant in the short-run country estimates. The error correction term conforms to a priori expectation; it is negative and significant, which signifies that the speed of adjustment is high.

Table 3. *Symmetric PMG estimates*

Dependent variable: y				
Panel PMG long-run estimates				
Regressors	Coefficient	Std. error	t-statistic	P-value
ROP	0.076***	0.010	7.948	0.000
OC	0.014	0.030	0.477	0.634
LF	-0.009	0.205	-0.045	0.964
INV	0.087***	0.031	2.805	0.006
DC	0.015	0.029	0.511	0.610
RER	-0.052	0.037	-1.410	0.161
Panel PMG short-run estimates				
Constant	2.532***	0.643	3.937	0.000
D(ROP)	0.003	0.008	0.427	0.670
D(OC)	0.030	0.025	1.196	0.234
D(LF)	-0.897	0.934	-0.961	0.338
D(INV)	-0.010	0.018	-0.522	0.602
D(DC)	0.000	0.019	0.025	0.980
D(RER)	0.005	0.020	0.258	0.797
ECT	-0.343***	0.081	-4.225	0.000
Hausman test	3.16(0.789)			
Akaike info criterion	-4.546			
Schwarz criterion	-3.420			
S. E. of regression	0.023			

*Notes: *** indicates statistical significance at 1% level.*

Moreover, innovation in the use of oil enhances productivity, and, therefore, oil consumption efficiently employed with modern innovation may have a positive impact on economic growth (Berk and Yetkiner, 2014). The result is also in line with the mainstream theory of economic growth (see: Estrada and Hernandez de Cos, 2012; Berk and Yetkiner 2014), which deliberates on the capacity of energy in the production process, especially for oil-importing countries. The results of the short-run country estimates are reported in *Table 4*.

Table 4. *Short-run country estimates for the symmetric effect of oil price*

	Botswana	Kenya	Mauritania	Mauritius	Namibia	South Africa	Zambia
Constant	2.850	0.169	3.150**	0.687**	3.909*	5.277**	2.399**
	(0.195)	(0.195)	(0.017)	(0.026)	(0.059)	(0.031)	(0.035)
D(ROP)	0.037***	0.011***	0.017***	-0.011***	-0.008***	0.0004*	-0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.099)	(0.000)
D(OC)	0.037**	0.018***	0.018***	0.130***	-0.061***	0.101***	-0.029***
	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
D(LF)	0.062	0.244*	0.665	-0.668***	-0.062	-0.097	-6.425
	(0.485)	(0.083)	(0.735)	(0.003)	(0.712)	(0.173)	(0.134)
D(INV)	-0.060***	0.044***	-0.069***	-0.008***	-0.023***	0.061***	-0.010***
	(0.002)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.002)
D(DC)	-0.005***	-0.026***	-0.064***	0.043***	0.076***	0.019***	-0.041***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)
D(RER)	-0.092	0.013**	0.011	0.076***	-0.032**	0.023***	0.037***
	(0.119)	(0.009)	(0.203)	(0.000)	(0.008)	(0.000)	(0.001)
ECT	-0.357***	-0.028***	-0.458***	-0.081***	-0.484***	-0.618***	-0.379***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

*Notes: Probability values in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels respectively.*

The results show that there is a negative and significant effect of the real oil price on economic growth in Mauritius, Namibia, and Zambia. This has been confirmed by the coefficients of the real oil price, which are negative and statistically significant in these countries. Unlike in the case of these three countries, the results show that there is a positive impact of real oil price on economic growth in Botswana, Kenya, Mauritania, and South Africa. This finding has been confirmed by the coefficients of the real oil price in these countries, which are positive and statistically significant. A possible explanation for this positive relationship between oil price and economic growth may be associated with the inclusion of South Africa, which imports crude oil and exports refined oil to other African countries, despite their high level of oil consumption. Other countries, such as Kenya, are also currently developing their crude oil production (Kibunyi et al., 2018). Moreover, Hooker (1996) argues that the impact of oil price on economic growth is not serious for data following 1980.

Furthermore, the coefficients of error correction terms (ECTs) for all countries are significant and negative except for South Africa, which implies a quick correction to the steady state for all countries. The coefficients of the ECTs show that the speed of adjustment to the equilibrium is high and is corrected in the next period.

4.4 Asymmetry Effect of Oil Price

The asymmetry effect of oil price on economic growth is presented in *tables 5–6*. *Table 5* presents the long-run and short-run estimates of the nonlinear (asymmetry) effect of oil price changes, while *Table 6* provides an overview of the short-run country estimates.

Table 5. *Asymmetric PMG estimates*

Dependent variable: y				
Panel PMG long-run estimates				
Regressors	Coefficient	Std. error	t-statistic	P-value
ROP^{--}	0.162***	0.030	5.358	0.000
ROP^{+}	-0.166***	0.047	-3.535	0.001
OC	0.002	0.038	0.046	0.963
LF	0.499**	0.212	2.351	0.021
INV	0.086***	0.028	3.072	0.003
DC	0.011	0.018	0.617	0.539
RER	0.224***	0.065	3.463	0.001
Panel PMG short-run estimates				
Constant	1.381**	0.532	2.595	0.011
D(y(-1))	-0.042	0.079	-0.536	0.593
D(y(-2))	-0.063	0.145	-0.432	0.666
$D(ROP^{--})$	-0.002	0.017	-0.136	0.892
$D(ROP^{+})$	0.040***	0.013	3.066	0.003
D(OC)	0.045**	0.020	2.240	0.027
D(LF)	-0.953	0.691	-1.380	0.170
D(INV)	-0.022	0.016	-1.346	0.181
D(DC)	-0.023	0.030	-0.773	0.441
D(RER)	-0.011	0.039	-0.271	0.787
ECT	-0.324***	0.113	-2.858	0.005
Hausman test	6.85(0.125)			
Akaike info criterion	-4.354			
Schwarz criterion	-2.869			
S. E. of regression	0.019			

*Notes: *** and ** indicate statistical significance at 1% and 5% levels respectively.*

The real oil price is decomposed into positive real oil price shocks and negative real oil price shocks to capture the asymmetry effect of the real oil price. The Hausman test values of 6.85 and its probability of 0.125 confirms that the PMG is more appropriate than the MG at 5%. Findings from the long-run estimates show that a negative oil price shock has a positive impact on economic growth, while a positive oil price shock has a negative impact on economic growth. The results are

in line with the expected results for oil-importing countries. However, in the short run, a positive change in the real oil price has a positive impact on economic growth, while a negative shock in the real oil price does not significantly impact growth. The short-run country estimates for the asymmetric model are reported in *Table 6*.

Table 6. *Short-run country estimates for asymmetry effect of oil price*

	Botswana	Kenya	Mauritania	Mauritius	Namibia	South Africa	Zambia
Constant	0.034***	-0.040	-0.089***	0.046**	-0.042	-0.014***	-0.395***
	(0.000)	(0.379)	(0.004)	(0.013)	(0.794)	(0.000)	(0.001)
D(y(-1))	-0.204**	-0.275***	0.132*	-0.307***	0.271***	0.340**	-0.435***
	(0.013)	(0.000)	(0.083)	(0.000)	(0.000)	(0.016)	(0.000)
D(y(-2))	0.235**	-1.115***	-0.341***	-0.496***	0.173***	0.249***	-0.125***
	(0.007)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)
D(ROP^{-})	0.158***	0.007***	0.044***	-0.034***	0.015***	0.044***	-0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
D(ROP^{-} (-1))	-0.037***	0.044***	0.005***	0.013***	-0.052***	-0.024***	0.039***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
D(ROP^{+})	-0.064***	0.036***	0.026***	-0.021***	0.027***	0.040***	0.007**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.021)
D(ROP^{+} (-1))	-0.094***	-0.017***	-0.144***	0.044***	0.026**	0.007***	-0.125***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.008)	(0.000)	(0.000)
D(OC)	0.092***	0.001	-0.008***	0.104***	-0.051***	-0.014***	0.056***
	(0.000)	(0.245)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
D(OC(-1))	-0.069***	0.046***	0.022***	-0.075**	0.005	-0.155***	0.070***
	(0.000)	(0.000)	(0.000)	(0.020)	(0.275)	(0.000)	(0.000)
D(LF)	0.771***	0.814**	-5.785	-0.209***	-0.296***	0.593***	-3.911*
	(0.003)	(0.025)	(0.628)	(0.004)	(0.000)	(0.000)	(0.058)
D(LF(-1))	0.071	0.023	6.489	-0.473***	0.195	0.055	-6.720
	(0.965)	(0.357)	(0.519)	(0.000)	(0.310)	(0.342)	(0.706)
D(INV)	-0.008*	-0.012***	-0.026***	0.019***	0.054***	0.038***	0.006***
	(0.070)	((0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
D(INV(-1))	0.009*	-0.009***	0.024***	0.028***	0.046***	-0.008***	0.002
	(0.089)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.119)
D(DC)	-0.002***	-0.111***	-0.176***	0.014***	-0.296***	0.002***	-0.116***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
D(DC(-1))	0.004***	0.022***	-0.045***	-0.014***	0.009***	-0.029***	-0.045***
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
D(RER)	-0.053	0.225***	0.453***	0.190***	0.127***	0.003***	-0.046***
	(0.268)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
D(RER(-1))	-0.513***	0.120***	0.254**	-0.073***	0.228***	0.020***	-0.084***
	(0.004)	(0.000)	(0.012)	(0.001)	(0.000)	(0.001)	(0.000)
ECT	0.066**	0.002***	-0.118***	-0.095***	-0.586***	0.075***	-0.197***
	(0.015)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

*Notes: Probability values in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels respectively.*

The ECTs are negative and significant in four of the seven countries. The decomposed oil price changes have mixed effects in the countries. The result showed that the real oil price positive shock exerts a negative impact on growth in two countries, while the real oil price negative shock positively impacts growth in five countries. Therefore, the positive effect of a negative shock in the real oil price is more evident in the panel of countries. This implies that most of the countries have the potential for growth in real GDP due to savings from negative price shocks. Oil price shocks can affect monetary, fiscal, and structural policies depending on whether a country is an oil importer or exporter. Therefore, when the oil price is very low, the selected SSA oil importers can encourage loose monetary policies and forward-looking policies that will accentuate stable macroeconomic policies. Lower oil prices can generate significant savings that will help improve most oil-importing countries' structural and fiscal position and enhance economic growth in the short and long run. This finding is different from Jiang et al. (2021), who examined the asymmetric and volatility relationship of global oil prices and economic uncertainty in China. They found that the effect of oil price is greater during monetary policy uncertainty than during fiscal policy uncertainty. Negative oil price shocks have a negative effect on monetary policy uncertainty in the short to medium term. It, however, changes to positive impact in the medium to long term. However, Su et al. (2021) also found that negative oil price shock has an impact on economic policy uncertainty in Russia and South Africa.

4.5 Diagnostic Tests

Findings from the cross-sectional dependence (CD) tests are presented in *Table 7*. The CD tests are important for panel data analysis. Panel data analysis tends to exhibit cross-sectional dependence due to unexplained components in the residual terms and the presence of common shocks (Eregha and Mesagan, 2020). The cross-sectional dependence tests presented here include the Breusch–Pagan Lagrange Multiplier (LM) test, the Pesaran Lagrange Multiplier (LM) normality test, the Pesaran Cross-Sectional Dependence (CD) test, the Friedman Chi-square test, and the Frees normality test.

Evidence in *Table 7* suggests that the null hypothesis of cross-sectional dependence can be rejected, as most of the tests are not significant in both the symmetry and asymmetry models. This implies that there is no major cross-sectional reliance among the selected oil-importing middle-income countries. Only the Pesaran LM test is significant at the 5% level in the asymmetry model. However, because of the role that regional cooperation plays in international trade among its members, the Pesaran LM test conclusion implies that a certain level of dependency may exist. However, such a relationship is not strong enough to imply a strong cross-sectional dependence. The results of cross-dependence tests,

therefore, validate the use of the first-generation unit root tests as appropriate for the panel of MICs in this study.

Table 7. *Panel cross-sectional dependence test*

	Symmetry			Asymmetry		
Test	Statistic	P-value		Statistic	P-value	
Breusch–Pagan LM	28.400	0.129		13.116	0.905	
Pesaran LM	0.062	0.951		-2.297**	0.022	
Pesaran CD	-0.749	0.454		0.491	0.624	
Friedman	23.392	0.713		27.800	0.475	
Frees Q	0.021	1%	0.166	-0.079	1%	0.166
		5%	0.116		5%	0.116
		10%	0.089*		10%	0.089*

*Notes: ** and * indicate statistical significance at 5% and 10% levels respectively.*

5. Conclusions

In this paper, the impact of oil price on economic growth is examined using data from seven SSA middle-income countries. The study adopted linear and nonlinear panel ARDL techniques to examine the oil price growth dynamics. The study is based on oil-importing countries, which include Botswana, Kenya, Mauritania, Mauritius, Namibia, South Africa, and Zambia. The results of the linear panel ARDL show that real oil price has a positive impact on economic growth. However, the positive effect of the oil price on economic growth in the model might be due to the influence of large economies such as South Africa, which imports crude oil and exports refined oil products. Moreover, middle-income countries are characterized by more efficient use of energy unlike low-income countries that put pressure on the economic stance of low-income countries. However, oil price does not significantly impact economic growth for the PMG estimates in the short run. The short-run country estimates show that oil price negatively impacts economic growth in three of the seven countries.

The results of the asymmetric panel ARDL show that both forms of oil price shocks have a significant effect on growth in the long run. Real oil price positive shock has a negative impact on economic growth, while real oil price negative shock has a positive impact on economic growth, which is consistent with the a priori expectations. In the short run, contrary to the expected results, a positive oil price shock has a positive effect on economic growth, while a negative oil price shock does not have a significant impact on economic growth. Oil consumption also has a positive and significant impact on growth in the short run. Findings from the short-run country estimates are in line with the expected result in some

of the countries. The negative oil price shock has a positive impact on economic growth in five countries, while the positive oil price shock has a negative impact on economic growth in two of the seven countries.

Overall, the results show that the impact of oil price on economic growth in middle-income oil-importing countries depends on whether the model is linear or nonlinear. It is, therefore, imperative for MICs' policymakers to adopt technological advancement to explore growth from oil, especially during periods of lower oil prices since negative oil price shocks have a positive impact on economic growth in five of the seven countries, and oil consumption positively impacts growth in the short run. The negative impact of oil price positive shock in only two countries might be because countries in the panel of MIC utilize other sources of energy such as coal and renewable energy. Moreover, the studied countries could also adopt market-friendly energy price controls and diversification of energy sources in order to reduce the risks resulting from oil price fluctuations.

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Second-Hand Clothing Shoppers' Motivations. An Exploratory Study among Ethnic Hungarians from the Szeklerland Region of Romania

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Abstract. We conducted a non-representative online questionnaire survey among inhabitants of the Szeklerland region in Romania with a view to looking into their second-hand shopping habits. Based on an adapted version of an international scale, the present analysis aims to explore the motivational background of these shopping activities. The exploratory factor analysis indicated five motivational dimensions: economic/austerity, critical/environmental, originality, social interaction, nostalgic and self-expression. The three latter motivational dimensions resemble the hedonic motivational dimensions indicated by the literature. The motivational dimensions can be explained by a series of independent variables; however, the explanatory power of regression models is marginal. As a second step, we adopted a cluster analysis in order to model second-hand shoppers' typical consumer segments. We found three clusters: austerity social interactionist, originality seekers, and nostalgic critics.

Keywords: second-hand shops, thrift, motivations, sustainability, Szeklerland

JEL Classification: Z13, Q56, P46, I31

1. Introduction

Second-hand retail refers to the acquisition of items previously owned and/or used "by at least one person prior to the present owner" (Borusiak et al., 2020). The movement of products takes place in diverse contexts and does not always presume a monetary transaction. One can obtain used products also in the form

of donations, exchanges, sharing, or swapping – this informal context is first of all characteristic of families and groups of friends (Clarke, 2000). In formal contexts, second-hand products appear in charity shops, garage sales, or shops largely resembling first-hand retail settings, and the products can be acquired through purchase, i.e. through monetary transaction (Laitala and Klepp, 2018).

There is an extremely broad palette of products on sale on second-hand markets. Gregson and Crewe (2003) take the view that, except for foods, any sort of product can make it to the stands of second-hand markets. In the case of certain products (e.g. antique books, works of art), we can speak about exclusive second-hand markets, where specific professional activities precede the marketing of goods (Balsa-Budai and Kiss, 2019). The second-hand market of everyday consumer goods reveals a lower price range for second-hand products as compared to new ones, wherefore the consumption of the former category can be defined as frugal, modest consumption (Gregson and Crewe, 2003). Borusiak et al. (2020: 875) also stress that the consumption of second-hand products can be qualified as modest not only due to the low price of the products but also because the consumption of used products offers a second chance for products intended to be disposed of, which may eventually lead to consumers buying less new products. This is exactly what sustainability narratives revolving around second-hand products emphasize: by placing used products back on the market, we can extend product life cycle and reduce waste (Gregson and Crewe, 2003).

One of the most popular categories encountered on the market of second-hand products is represented by used clothing items (Balsa-Budai and Kiss, 2019; Laitala and Klepp, 2018). The market of used products has typical exporting and importing countries. Borusiak et al. (2020) contend that developed nations, such as the USA, Germany, and the UK, are the biggest exporters of second-hand clothes, while the highest amounts of such clothes are imported by developing regions (e.g. Sub-Saharan Africa) and East-Central Europe. For instance, in Romania, the value of the second-hand clothing import was USD 34.8 million in 2011 (Cuc and Tripa, 2013), while in 2013 Poland imported second-hand clothes worth 100 million euros (Mailat, 2014).

Therefore, the market share of used clothing is surprisingly high. Despite that fast-fashion brands' increasingly lower prices make these products available to an ever-wider range of consumers, a rising popularity of second-hand clothes can be observed in western countries as well (Laitala and Klepp, 2018). Data of the *2016 European Quality of Life Survey* (Eurofound, 2016) show that 42% of the Romanian citizens cannot afford to buy new clothes, and so they rather opt for buying from second-hand shops. Therefore, it appears that in countries in a weaker economic position it still pays off more to buy used products instead of new ones.

Consequently, researchers suspect a complex set of motivations underlying the growing popularity of second-hand shops. Besides economic considerations,

a combination of pursuing sustainability, conscious consumption, and consumer experiences related to thrift stores (unique, vintage products, treasure hunt) may determine customers' choice to buy clothing articles in second-hand shops (e.g. Guiot and Roux, 2010; Laitala and Klepp, 2018). Some authors quite boldly state that the popularity of thrift stores amounts to a cultural turn (e.g. Murphy, 2017) and can be explained on the basis of two macro-societal changes: the 2008 economic crisis in whose context second-hand shops offered consumers a form of value shopping (Marzella, 2015; Ferraro et al., 2016; Murphy, 2017) and the rising of ethical consumption megatrend (Törőcsik, 2016; Murphy, 2017).

The ambition of our research was to map the shopping habits related to second-hand clothes among the consumers living in Covasna, Harghita, and Mureş counties in Romania. The investigation based on online questionnaire survey covered several aspects of thrifting, but the present study will include only the results on the motivations behind shopping. These three counties correspond to the context of the historical Szeklerland in the broader sense, whose present-day feature is that it forms an economically less developed region in the territory of Romania. The region shows levels of unemployment below the national average in each economic segment (Kapitány, 2019), foreign investors are sporadic (Csíki, 2019), and the entrepreneurial activity and trade – due to the lack of major cities – are limited compared to the national average (Csata and Csata, 2019). Shops selling second-hand clothes are extremely widespread in the towns of the region; they are essential elements of city centres, wherefore the common slang refers to these areas as "thrift towns" (Bíró, 2008; Antal, 2018). Thrifting appears in these narratives with a negative connotation, as a sign of poverty, and indicates that, on the one hand, cities are unable to attract investors (e.g. malls) that could offer a broad spectrum of new wearing apparel, while, on the other, the earning potential of the local population does not allow for the purchasing of new products. Consequently, we expected our research to reveal that thrift shopping constitutes a popular activity among the respondents and that it can be accounted for primarily by motivations associated with financial constraints. At the same time, in connection with the literature, we were also curious if some other motivations emerged besides the scarcity of financial resources and wished to see what variables each motivation involves. For this purpose, we carried out multivariate analyses (factor analysis, regression, cluster analysis).

The paper develops as follows: in Section 2, we elaborate on the viewpoints expounded in the literature regarding the motivations of second-hand shopping, and here we present the *Second-Hand Shoppers' Motivation Scale* created by Guiot and Roux (2010). In Section 3, we outline the methodology of our research, while in Section 4 we present and discuss the results. Lastly, we formulate the major conclusions of the study.

2. Literature Review

The history of second-hand retail practices shows that they emerged in the 18th/19th centuries, but due to the proliferation of mass production in the mid-20th century they became marginal, unpopular, and stigmatized sites of shopping (e.g. Balsa-Budai and Kiss, 2019). Later, in the context of growing incomes and the large-scale availability of new products, purchasing used items instead of new ones was considered a sign of social failure and poverty (Guiot and Roux, 2010). However, second-hand shops started to proliferate since the 2000s, not only in the developing world but also among the wealthy nations (Williams and Paddock, 2003).

As summarized elsewhere (Nistor, 2021), scholars interpret the growing popularity of second-hand shops on the basis of two macro-societal changes. 1) The 2008 economic crisis: in this austere context, second-hand shops offered consumers a form of value shopping (Marzella, 2015; Ferraro et al., 2016; Murphy, 2017). 2) The rising of ethical consumption mega-trend (Törőcsik, 2016) is assumed to also contribute to the popularity of second-hand settings (Murphy, 2017). According to this trend, nowadays' reflexive consumers not only wish to satisfy their material needs but also want to contribute to the wellbeing of others (i.e. the living planet). In this respect, second-hand products allow them to practise reuse and recycling and to help extend the lifecycle of products. From this point of view, second-hand practices are, in fact, an example of circular economy (Tranberg Hansen and Le Zotte, 2019) and ethical consumption (Franklin, 2011). By reducing the acquisition of new products and reusing some previously owned products (i.e. recycling), consumers contribute to the advancement of sustainability (Borusiak et al., 2020).

The growing popularity of second-hand shops has resulted in valuable empirical research, much of the analyses being concerned with the motivations of second-hand shopping, i.e. with "the psychological and material motives which orient consumers toward second-hand products and/or channels" (Guiot and Roux, 2010: 385). Thus, most recent research has started to shift away from the initial scarcity-centred explanations and increasingly points to the complex motivational background behind thrift shopping, which for the most part cannot be reduced to economic motivations. Williams and Paddock (2003) divide motivations behind thrifting into two large categories: 1) economistic reading, under which financial constraints account for this sort of shopping; 2) agency-oriented reading, under which such shopping activities are attributable to individual preferences such as uniqueness, recyclability, thrifting-related experiences, etc. Classifying thrift shoppers into two large categories based on their motivations, Thompson and Haytko (1997) and Waight (2013) suggest a similar division: shopping in thrift stores out of necessity and due to individual preferences. Of course, motivations behind thrift shopping can be further divided within these two large groups.

Pursuant to economic motivations (e.g. thriftiness), thrift shopping is explained by the scarcity of financial means (Bardhi and Arnould, 2005), which is why it comes as no surprise that this kind of motivation was generally used to describe customers who prefer these shops because of their lower price range. Williams and Windebank (2002: 501) make use of the "excluded consumers" concept to describe customers who cannot afford to buy new products owing to their more modest financial situation, wherefore second-hand stores become the main scenes of shopping for them by default. In their Leicester-based study, Williams and Paddock (2003) showed that economic motivations are primordial in the case of economically less wealthy households; the authors revealed that in such households 94% of the second-hand products are bought based on economic motivation (i.e. "It is their first option but second choice." – Williams and Paddock, 2003: 326). The authors thus consider that in the case of economically disadvantaged consumers shopping from second-hand settings becomes a "symbol of social exclusion" and shapes the identity of such consumers by further accentuating their economic limits and inability to shop according to their preferences (i.e. new goods from traditional shops).

Economic motivations behind thrift shopping lose much of their explanatory power if we consider that new clothing items are becoming increasingly cheaper nowadays: the case of fast-fashion brands or the clothing collections of hypermarkets often reveals price ranges not (much) higher than that of the products on sale in second-hand shops. Hence, as Laitala and Klepp (2018) also postulate, there are reasonable grounds for suspecting that present-day thrift shopping has much more diversified motivations than the single rationale of the past decades, represented by financial scarcity. The economic, scarcity factor as the underlying reason is a hardly tenable explanation also because better-off customers, too, were found to be in the habit of thrifting: members of the middle class pay frequent visits to second-hand shops with a view to acquiring products at a favourable price:quality ratio and to make some good bargains (Guiot and Roux, 2010; William and Paddock, 2003; Waight, 2013). Gregson and Crewe (2003) found that thrift stores provide a fertile ground also for middle-class consumers to purchase branded products at a relatively low price. Based on previous research, Laitala and Klepp (2018) also note that the scarcity motivation is much more present in research carried out among the general population. Among the various consumer subcultures (e.g. conscious or vintage consumers), sustainability and experiences linked to thrift shopping constitute a stronger motivation than the price of the products on sale in such stores.

Based on a complex, mixed-mode research performed in France, Guiot and Roux (2010) created the Second-Hand Shoppers' Motivation Scale. Since we have also made use of this scale as a starting-point in the exploration of the motivations included in our questionnaire, we must note that the authors distinguished between

four motivational dimensions on the scale, which were eventually classified into three second-order dimensions. In addition to economic motivation, critical/conscious consumption, experience consumption, and nostalgia appeared as motivations for thrifting. Consequently, it must be observed that in keeping with thrifting-related individual preferences we can find motivations that 1) reflect customers' critical, conscious consumer status and 2) are connected with pleasant experiences provided by thrift shopping.

According to the logic behind the consumption-critical, ethical, and environmental motivations, consumers opt for thrifting out of moral, ethical conviction (Bardhi and Arnould, 2005; Franklin, 2011; Waight, 2013). On the other hand, customers driven by even more radical motivations might opt for used products also as a way of expressing their critical attitudes about "the market system, consumption, and the characteristics and offerings of conventional channels" (Guiot and Roux, 2010: 385). Thus, consuming from second-hand shops can also stand as a possibility of boycotting conventional retail practices to avoid consumerist ostentation and contribute to the broader idea of sustainability (Guiot and Roux, 2010). Williams and Paddock (2003) note that these motivations associated with conscious consumption are correlated with ostentatious, spectacular consumption as well: thrift shopping conveys the message that consumers are making the right choice, as they are well aware of the issues around sustainability and environmentalism. In this context, Gregson and Crewe (2003) found that consumers who prefer second-hand shops form a peculiar subculture given that "second-hand spaces provide key resources for particular discursive communities to enact both distinction and skill" (id.: 86). Thus, in line with the environmental motivations surrounding second-hand shopping, there is also the possibility for the consumers to "elevate cultural over economic capital" (Gregson and Crewe, 2003: 100).

Experiences provided by thrifting are referred to as hedonic motivations in literature: those consumers will be driven by such motivations who visit second-hand stores because they find shopping there interesting, exciting, and adventurous. Bardhi and Arnould (2005) distinguish between two types of hedonic motivations: on the one hand, there is the realization of consumer fantasies, which means that due to the lower price of the products, consumers can satisfy their preferences for luxury, and they can accumulate a larger amount of products which may seem satisfying to them (i.e. self-gratification). At this point, it also becomes clear that the materialization of experiences provided by thrifting is eventually linked with the lower price range of the goods on sale in second-hand shops. On the other hand, thrift shopping allows the pursuit of the unexpected, and it can mean a "shopping for surprise and luck" (id.: 230). Thus, "the pursuit or practice of thrift itself provides hedonic benefits", it is "a way of indulging" (Bardhi and Arnould, 2005: 225).

A whole set of motivations can be associated with thrift shopping: searching for special, unique goods (Mitchell and Montgomery, 2010; Guiot and Roux, 2010) or

having nostalgia about old times and products (Roux, 2006) – these elements jointly account for consumer demand for vintage fashion products (e.g. Thompson and Haytko, 1997; Gregson and Crewe, 2003; Palmer and Clark, 2005). On the basis of the supply of unique, special products and environmental awareness associated with thrift shopping, it can be contended that second-hand clothing "has become a desirable fashion" (Ferraro et al., 2016: 264), which means that fashionability itself is an important motivation that can be quoted under the set of hedonic values.

Some consumers tend to see a connection between the thrifting experience and social interaction: shopping in second-hand settings often takes place in groups, visiting such stores in the company of friends and family members, chatting, conversing with each other while shopping around, which makes the shopping activity easy to be connected with the pleasant experience that recreational activities can provide, with the ludic context of thrifting (Williams and Paddock, 2003; Guiot and Roux, 2010; Laitala and Klepp, 2018). Gregson and Crewe (2003) also remark that social interaction associated with thrifting is not only realized during shopping itself but also before and after this activity, when consumers share their experiences about second-hand shops in the form of a quasi-word-of-mouth marketing (e.g. where and what products are worth looking for).

Finally, it is important to mention that the various motivations are not mutually exclusive, and in most cases they become altogether important in shaping the shopping behaviours in second-hand settings (Bardhi and Arnould, 2005; Laitala and Klepp, 2018). However, it should also be borne in mind that staying away from second-hand shops has at least a similarly wide range of motivations (Laitala and Klepp, 2018), starting from fears associated with hygiene all the way to social stigmatization. The present research has been conducted among consumers who, although with varying frequency, are in the habit of thrifting, wherefore we did not look into the motivations associated with avoidance related to thrift shopping. Consequently, these motivations will not be covered in this paper.

3. Methodology and Research Questions

The online questionnaire survey was conducted among the population of Harghita, Covasna, and Mureş counties in the period of 4–19 June 2020. Although the timing of the research occurred after the first wave of the COVID-19 pandemic and the associated lockdown, our aim was not to investigate the influence of the pandemic and its economic outcomes on second-hand clothes shopping. In our questionnaire, we have included solely one question related to this context, i.e. whether the respondent has become unemployed due to the pandemic, so that in this way we succeeded to control the influence of recent financial scarcity on second-hand clothes shopping. The results showed that this situation was not

widespread among the respondents, but obviously we are aware that this specific context could have resulted in some sort of bias, and thus we quote the timing of our research as one of the limitations of the study. Our questionnaire included 27 questions altogether and addressed participants' habits of shopping for second-hand clothes, particular focus being placed on the motivations behind buying used clothing items (Guiot and Roux, 2010). Hence, the target group of the research was made up of individuals living in the Szeklerland area and shopping for second-hand clothing articles. The questionnaire was published in Hungarian language, thus targeting ethnic Hungarian customers.

The exploratory and explanatory analysis belonged to the type of open research, during which convenience sampling was adopted by applying the self-selection method. The questionnaire could be accessed via links placed on social media websites and was filled in by a total of 381 valid respondents. The greatest handicap of this type of research is the lack of researcher control, as sample size and composition could not be regulated: this latter problem is also reflected by the normal distributions (*Table 1*).

Table 1. *The demographic composition of the sample*

Variable	Category	Frequency	Percent (%)
Gender	Male	13	3.4
	Female	368	96.6
	Total	381	100.0
Age	17–30	136	35.7
	30–45	188	49.3
	46–70	57	15.0
	Total	381	100.0
Education	Medium level	123	32.3
	Upper level	258	67.7
	Total	381	100.0
Marital status	Married/in partnership	282	74.0
	Single	82	21.5
	Divorced	14	3.7
	Widowed	3	0.8
	Total	381	100.0
Type of settlement	Urban	256	67.2
	Rural	125	32.8
	Total	381	100.0

Similarly to most online questionnaire surveys, the following could be observed as compared to population distributions: greater proportion of female respondents (also justified by the topic under analysis); lower average age of

the participants (by 6.6 years than the average age in Romania on 1 January 2020);[1] higher educational attainment (14.4% of the Romanian population over 10 years of age had a post-secondary education degree in 2011);[2] higher share of intellectual professions, married individuals/living in a consensual union, and urban residents.

Obviously, literature on non-representative online questionnaires admits that these investigations fall short of the ones based on representative data collections, but at the same time researchers make it clear that online questionnaires offer a relatively cheap, fast, and widely used possibility for exploratory research (Sue and Ritter, 2006; Kholos and Wysocki, 2008; Leiner, 2016). Given that the topic under study as well as the context are new (as to our knowledge, there has not yet been any similar research either in Romania or, more specifically, in the analysed region), we consider the selected method suitable to create a prior image of our research questions and, based on our results, to establish some starting points for future research. The questionnaire survey was preceded by a qualitative research as well (Nistor, 2021), which assisted in formulating the questions, thus meeting research expectations with regard to non-representative online surveys, i.e. to complete them with other data collection methods. International surveys using non-representative online questionnaire methods in their analysis of shopping for used clothing items also served as a reference point to our research method (e.g. Guiot and Roux, 2010; Balsa-Budai and Kiss, 2019).

The topic of the present research is mapping the motivations behind shopping for second-hand clothes. For this purpose, we relied on Guiot and Roux's 2010 work. Based on a complex, mixed-method research performed in France, the authors designed the Second-Hand Shoppers' Motivation Scale. The original scale was composed of 24 statements, which corresponded to eight first-order and three second-order factors (critical, economic, and recreational motivations). Due to space limitations deriving from the nature of online questionnaires, our research adopted only 19 Likert-type items from the original Second-Hand Shoppers' Motivation Scale (response options with five gradations: 1 – strongly disagree, 2 – disagree, 3 – neither disagree nor agree, 4 – agree, 5 – strongly agree), in accordance with the three dimensions (see *Table 1* in the *Appendix*). Since the questionnaire was compiled in Hungarian, the statements included in the originally English-language scale were translated into Hungarian, thus inevitably causing subtle differences compared to the original items. When creating the items, consideration was taken of qualitative research results as well, the original scale thus suffering further modifications (some of the statements were omitted or slightly altered), which eventually meant working with a motivation scale adapted from Guiot and Roux (2010).

1 https://insse.ro/cms/sites/default/files/com_presa/com_pdf/popdom1ian2020r.pdf.
2 http://www.recensamantromania.ro/rezultate-2.

Hypotheses and research questions were equally formulated in our research.

Hypothesis 1: Our research rests on the assumption that, given the economically disadvantaged position of the region, the structural features manifested through the large number of second-hand shops, and the relatively low share of other kind of clothing stores, it is most likely that economic motivations will be the most dominant elements.

Hypothesis 2: The second hypothesis relied on assertions found in the literature according to which the motivations behind thrift shopping may reach beyond scarcity explanations even with economically disadvantaged groups. Therefore, it was hypothesized that, although less dominantly, some other motivations for second-hand shopping may appear such as experiences and critical consumer attitude.

Besides these two hypotheses, our research focused on exploring some research questions as well: 1) Which are those individual-level socio-demographic and axiological variables that influence the different motivational basis of second-hand shopping? 2) Which are the specific segments of second-hand clothes shoppers? 3) To what degree do these segments resemble those revealed by previous international research? In order to explore the hypotheses and answer these questions, we have performed a deeper analysis of the motivations behind thrifting. Three multivariate analysis methods were adopted as follows: as a first step, we carried out an exploratory factor analysis (in lack of similar regional research, confirmatory modelling was discarded); secondly, linear regression analysis was performed to examine the variables explaining factor variables; finally, in a similar vein to Guiot and Roux's (2010) and Balsa-Budai and Kiss's (2019) research, the major groups of second-hand shoppers were explored using the method of non-hierarchical (K-Means Cluster) cluster analysis.

The dependent variables of the factor analysis were represented by 19 Likert-type statements which explored respondents' motivations for opting for second-hand clothes shopping (*Table 1* in the *Appendix*). As outlined in the section below, the analysis resulted in five motivational factors, which then were considered dependent variables in five linear regression analyses, in which we explored the influence of socio-demographic (i.e. age, gender, educational attainment, type of locality, employment status, financial situation,[3] presence/number of children[4]) and axiological (the importance of several values for the respondents – i.e. family, friends, work, material objects, politics, etc.) variables. Some variables regarding

3 In the case of this variable, we have accounted for households' monthly net income/person because in this way we were able to better control the financial disparities among the respondents.

4 The inclusion of this variable was motivated by prior results of the literature showing that shopping for second-hand clothes is a widespread practice among parents. Due to economic reasons and to the relatively short lifecycle of children's clothes, parents frequently opt for shopping for their children's clothes from second-hand stores (e.g. Clarke, 2000). Similar findings were signalled by the qualitative study which preceded the present investigation (Nistor, 2021).

second-hand shopping, i.e. the frequency of shopping and shopping alone/with friends, were also included among the independent variables.[5] For the list of the independent variables, see *List 1* and *List 2* in the *Appendix*.

4. Results and Discussions

4.1. Results of the Principal Component Analysis

We ran a factor analysis based on the 19 statements measured on a 5-point Likert scale (see *Table 1* in the *Appendix*). The situation of multicollinearity can be excluded (the highest r = 0.678), and the measure of sampling adequacy is good since according to the anti-image correlation matrix each variable fits the factorial model (the values of the diagonal range between 0.682 and 0.925). The value of the KMO[6] test is 0.832, and Bartlett's Test of Sphericity is significant (approx. chi-square = 2659.495, p = 0.000), so that the data were highly suitable for the purposes of factor analysis.

The final factor model (principal component method based on the Kaiser Criterion and Varimax rotation) contained only 15 variables. Four of the initial variables (the b, k, l, and q statements from *Table 1* in the *Appendix*) had high factor loadings on more factors, so that they were left out of the final model. The KMO value of the final model is 0.798, Bartlett's Test of Sphericity is significant (approx. chi-square = 1956.237, p = 0.000), and the communalities of the original variables have values ranging between 0.424 and 0.825. The resulted 5-factor solution explained 68.556% of the original variance. *Table 2* presents the motivational dimensions as reflected by the five factors.

Table 2. *Factor structures (Model 1)*

1. **Economic/austerity motivations**
f) For the same amount of money, I can buy more things in second-hand shops compared to traditional shops.
g) Second-hand shops tend to come up with such good offers that it would be a pity not to buy them.
e) By buying in second-hand shops, I can experience the feeling of not having to leave the product in the shop.

5 Their inclusion in the models was based on the results of international literature (e.g. Guiot and Roux, 2010) and those of the qualitative investigation preceding this study (Nistor, 2021): those who shop more frequently in second-hand shops usually opt for shops with lower price offerings, i.e. they are more motivated by the economic factor; those who shop with friends use second-hand shopping as a pretext for leisure and socialization, i.e. they can be more motivated by the hedonistic, self-indulging aspects of second-hand shops.

6 The Kaiser–Meyer–Olkin (KMO) test measures sampling adequacy for each variable in the model and for the complete model.

h) I have often found new products in second-hand shops for a fraction of their regular price.
i) I consider that second-hand shops have fair prices.
j) I think that new products on sale in traditional shops are overpriced.
2. **Critical/environmental motivations**
d) By buying in second-hand shops, I can contribute to reducing waste.
c) I like to buy in second-hand shops because this way I can save clothes intended to be discarded but that are still in a good condition.
a) By buying in second-hand shops, I can distance myself from the consumer society.
3. **Originality motivation**
n) One can find products in second-hand shops that are not available in traditional shops.
m) Unique and special products can be found in second-hand shops.
4. **Social interaction motivation**
o) In second-hand shops, there is often opportunity to initiate a conversation with other people.
p) Visiting second-hand shops is, for me, a way of spending leisure time in the company of others.
5. **Nostalgic and self-expression motivation**
r) I am more into old-time fashion than today's trends.
s) I can express myself better with products bought in second-hand shops.

The value of Cronbach's alpha is higher than 0.7 in the case of each factor, and in the case of the 1st and 3rd factors it is even higher than 0.8, which means that the internal consistency of the variables corresponding to the specific factors is good (see *Table 2* in the *Appendix*).

The results confirm our first hypothesis: the economic/austerity motivations are the most important determinants of second-hand clothing shopping. This result is similar to those found in Hungary by Balsa-Budai and Kiss (2019) and is in contrast with recent results found in Norway (Laitala and Klepp, 2018), where the sustainability motivations were dominant. Thus, it can be suspected that in economically less developed settings the economic/austerity motivations are more dominant in shaping consumers' preferences for second-hand shopping. The second hypothesis is also confirmed: the existence of the other four factors shows that even in less developed contexts the motivations are more diverse than the austerity/economic reasons (Bardhi and Arnould, 2003; Laitala and Klepp, 2018): the second most important set of motivations is made up by the critical/environmental motivations. The following three factors can be subscribed under the stimulation/hedonic dimension, as each of them refers to specific preferences linked to second-hand shopping: the possibility to find unique, original articles, nostalgia, and social interaction.

The obtained motivational dimensions are consistent with the previous international results presented in the section dedicated to literature review (e.g. Bardhi and Arnould, 2005; Steffen, 2017; Laitala and Klepp, 2018) as well as with the results of the Second-Hand Shoppers' Motivation Scale developed by Guiot

and Roux (2010). While it is true that the present research made use of the adapted, modified version of the original scale and we found five motivational dimensions, yet these five dimensions point in the direction of the dimensions corresponding with the original scale, as the nostalgia, interaction, and uniqueness factors related to thrifting are also categorized by Guiot and Roux (2010) under stimulation/hedonism. Consequently, it can be stated that besides economic/scarcity and critical/environmental reasons, thrift shopping has some distinctive individual motivations that are bound up with the thrifting context and the characteristics of the products to be found there, and as such it can be associated with experiences related to second-hand shopping (stimulation/hedonism) (see also Cassidy and Bennett, 2012). Hence, our results suggest that the motivations behind thrift shopping in the Szeklerland region are not of economic nature alone.

It is also interesting to note that, e.g. thrifting as a treasure hunt experience or second-hand shops as "scouting grounds", which are both typical components of the hedonic motivational dimension (e.g. Guiot and Roux, 2010; Cassidy and Bennett, 2012), have a high factor loading for all factors in our case (ergo we excluded them from the final model). This outcome indicates at the same time that this stimulative, adventurous element of thrift shopping essentially defines our respondents' thrifting-related activities and thus is also linked to the scarcity motivation, for instance.

4.2. Determinants of the Motivations for Second-Hand Shopping

With a view to explaining the various motivations behind second-hand shopping, a linear regression analysis (stepwise and enter selection methods) was performed to examine the independent variables included in the research. Eleven out of the twenty-five explanatory variables used during the analysis (*List 2* in the *Appendix*) do not contribute significantly to the explanation of any of the motivations for thrift shopping. It can be said therefore that the amount spent during a thrifting session, shopping alone or with someone else in a second-hand setting, living in cohabitation/marital relationship, the number of own children, the number of members in the household, having a full-time job, subjective financial situation, recent experiences about working abroad, and the importance of acquaintances and leisure time are not related to the various motivations behind second-hand shopping.

As we have seen in the previous subchapter, the economic/scarcity motivation is the most essential item of the five well-defined motivations for thrift shopping (Model 1). Therefore, the first regression model (Model 2 from *Table 3*) looks into the effects on this motivation. As the table summarizing the significant correlations indicates, frequent thrifting increases while the average net income of the households as well as growing older reduce financial motivation. In other

words, the older the second-hand shopper and the greater the household income, the less typical financial motivation becomes. Frequent second-hand shoppers are financially more motivated to shop in such settings than individuals who rarely pursue this kind of activity. Thus, our case reinforces the findings according to which the so-called "excluded consumers" (William and Windebank, 2000; Williams and Paddock, 2003), whose limited financial resources prevents them from accessing new products, prefer to shop in second-hand settings where the lower price of the products allows them to take part in the consumer society. This outcome is consistent with the qualitative study preceding the research at hand (Nistor, 2021), whose results indicate that frequent thrifters tend to buy small stuffs, which makes it essential for them to make cheap bargains. The three variables included in the regression model jointly account for 6.1% of the dispersion of financial motivation, the biggest one being the impact of the frequency of second-hand shopping – results thus continue to underline the fact that it is important for frequent thrifters to get their products at a fair price. Apart from the already indicated variables (11), financial motivation does not appear to show any correlation at all with any measured value variable (importance of work, friends, family, material resources, politics, and religion) and is not significantly affected by higher educational attainment, settlement type, or economic status.

Table 3. *The significant determinants of the economic/austerity motivational factor (Model 2)*

	Coefficients		T-values	P-value (t)	VIF
	B	Beta			
Frequency of shopping	0.421	0.210	4.120	0.000	1.005
Age	-0.010	-0.119	-2.313	0.021	1.018
Households' monthly net income/person (RON)	-0,000	-0.104	-2.025	0.044	1.023
Adjusted R^2	0.061				
F-statistic	8.806				
P-value (F-statistic)	0.000				
Number of observations	364				

Note: B – Unstandardized Regression Coefficient, Beta – Standardized Regression Coefficient, VIF – Variance Inflation Factor.

The second most important factor variable was the ecological and anti-consumerist motivation behind thrift shopping. The six variables (Model 3 from *Table 4*) included in our second model jointly account for 9.9% of the dispersion of the factor variable, and the influence of age shows the greatest significance: the older the second-hand shopper, the less likely it is to shop out of ecological and anti-consumerist motivation. Additionally, it also appears that the more important one considers the financial side, the less relevant this motivation becomes for

them. Also, the more important politics and friends are and the higher the net monthly income per capita and educational attainment, the more predominant this motivation is.

Table 4. *The significant determinants of the environmental/critical motivational factor (Model 3)*

	Coefficients		T-values	P-value (t)	VIF
	B	Beta			
Age	-0.0019	-0.209	-3.968	0.000	1.121
Upper level education	0.347	0.161	3.052	0.002	1.122
Material values are important	-0.277	-0.138	-2.663	0.008	1.082
Politics is important	0.601	0.140	2.773	0.006	1.027
Friends are important	0.324	0.128	2.502	0.013	1.058
Households' monthly net income/person (RON)	0.000	-0.123	-2.351	0.019	1.105
Adjusted R^2	0.099				
F-statistic	7.633				
P-value (F-statistic)	0.000				
Number of Observations	364				

Note: B – Unstandardized Regression Coefficient, Beta – Standardized Regression Coefficient, VIF – Variance Inflation Factor.

Our results are consistent with previous results in the literature, according to which the importance of material values are negatively related to the critical motivations of second-hand shopping (Guiot and Roux, 2010) since individuals seeing possession as a relevant feature usually invest in new products and are less open to recycling and environmentalism. Analyses in environmental sociology reinforce the finding that environmental awareness is linked with the post-material value system (e.g. Mayerl and Best, 2018). Variables with a significant influence on the motivational dimension point to the consumer profile typically referred to as the LOHAS (Lifestyle of Health and Sustainability) consumer segment: they are knowledgeable due to their high level of educational attainment, tend to espouse post-material values, are open to public affairs, have a good financial status, and are mostly young people (Natural Marketing Institute, 2002; Szakály et al., 2015). Therefore, it appears that among the consumers in the region of Szeklerland there is an emerging LOHAS group, whose members tend to associate second-hand shopping with sustainability and responsible consumption.

The originality motivation behind thrifting is related solely to the frequency of second-hand shopping (Model 4 from *Table 5*): frequent thrift shoppers are more characterized by the originality motivation compared to individuals shopping for second-hand goods on rare occasions.

Table 5. *The significant determinants of the originality motivational factor (Model 4)*

	Coefficients		T-values	P-value (t)
	B	Beta		
Frequency of shopping	0.389	0.193	3.837	0.000
Adjusted R^2	0.035			
F-statistic	14.725			
P-value (F-statistic)	0.000			
Number of Observations	381			

Note: B – Unstandardized Regression Coefficient, Beta – Standardized Regression Coefficient, VIF – Variance Inflation Factor.

The social interaction motivation indicates a relationship with five independent variables, which jointly have an explanatory power of 13.7% (Model 5 from *Table 6*). Individuals who consider religion and friendship important, go to thrift stores more often, live in rural areas, and have a lower educational attainment usually visit second-hand shops because of the social interaction motivation. The qualitative study preceding the research at hand (Nistor, 2021) included several interview subjects who referred to thrift shopping as a recreational activity that is in many cases rather about looking around in second-hand shops in the company of friends. Our results strongly corroborate this social capital component of thrifting and are similar to the findings described by Bardhi and Arnould (2005) and Guiot and Roux (2010), i.e.: recreational motivation assumes shopping around in groups.

Table 6. *The significant determinants of the social interaction motivational factor (Model 5)*

	Coefficients		T-values	P-value (t)	VIF
	B	Beta			
Frequency of shopping	0.257	0.128	2.666	0.008	1.011
Upper level education	-0.522	-0.244	-5.013	0.000	1.044
Importance of friends	0.324	0.129	2.687	0.008	1.014
Importance of religion	0.326	0.159	3.268	0.001	1.047
Size of locality	-0.221	-0.104	-2.109	0.036	1.070
Adjusted R^2	0.137				
F-statistic	13.064				
P-value (F-statistic)	0.000				
Number of Observations	381				

Note: B – Unstandardized Regression Coefficient, Beta – Standardized Regression Coefficient, VIF – Variance Inflation Factor.

The final factor variable is the nostalgia and self-expression motivation. This regression model (Model 6 from *Table 7*) includes four independent variables with a significant role, which jointly account for 4.8% of the variability of the nostalgia and self-expression motivation. This motivation is a characteristic feature of individuals who have no children, are economically active, and see friendship and work as relevant values. This has a very-difficult-to-explain rationale: it is most likely that a specific clothing (vintage) subculture emerging along independent, economically active respondents is what lies behind this motivation (Jenss, 2005; Cassidy and Bennett, 2012).

Table 7. *The significant determinants of the nostalgic and self-expression motivational factor (Model 6)*

	Coefficients		T-values	P-value (t)	VIF
	B	Beta			
Presence of children	-0.242	-0.120	-2.240	0.026	1.065
The importance of work	-0.331	-0.147	-2.771	0.006	1.051
The importance of friends	-0.287	-0.111	-2.108	0.036	1.033
Economically active	0.287	0.132	2.481	0.014	1.048
Adjusted R^2	0.048				
F-statistic	5.431				
P-value (F-statistic)	0.000				
Number of Observations	356				

Note: B – Unstandardized Regression Coefficient, Beta – Standardized Regression Coefficient, VIF – Variance Inflation Factor.

Summing up the last three motivational factors that together outline the stimulation/hedonism dimension, we can find personal lifestyle, various value preferences, social capital, and the frequency of second-hand shopping to be included among the explanatory variables. All of this leads to the conclusion that there is a group whose members see second-hand shopping as neither an economic nor a sustainability issue but as a specific ground and opportunity for spending their free time and expressing themselves.

4.3. The Size and Patterns of Specific Second-Hand Shopping Groups

Similarly to other scholars' works (specifically: Guiot and Roux, 2010; Balsa-Budai and Kiss, 2019), in order to reveal the composition of specific second-hand shoppers' segments, we ran a cluster analysis (K-Means method) on the motivations of second-hand shopping as well as on the already presented independent variables (see the list of variables in the *Appendix*, *lists 1–2*). Following 13 iterations, a stable and homogenous 3-cluster solution along 14 variables was obtained (Model 7). According to the 7th model of our analysis (*Table 3* from the *Appendix*), the most

important variable of cluster segmentation is represented by age, followed by importance attached to work, post-secondary education, material values, the environmental/critical motivation, and the monthly net income/person in a household.

Thus, contrary to the results of Guiot and Roux (2010) as well as Balsa-Budai and Kiss (2019), which revealed four clusters, we managed to discover three segments (Model 7 from *Table 8*). None of these segments are extremely clear in their composition, i.e. there exist specific second-hand-shopping-related and socio-demographic variables that can be found across each cluster, which means that there is a polymorphous background in each of the segments (see Guiot and Roux, 2010). However, there are certain aspects that clearly differentiate the segments and based on which it is possible to denominate the revealed clusters.

Table 8. *The final cluster centres (Model 7)*

	Clusters		
	1	2	3
Zscore: Household monthly net income/person	-0.44478	0.64171	-0.16844
Zscore: Age	-0.71650	0.69715	0.12983
Zscore: Type of locality	-0.40755	0.42974	0.01287
Economic/austerity motivations	0.20200	-0.06914	-0.15001
Originality motivation	-0.09710	0.24390	-0.10898
Social interaction motivation	0.46914	-0.22679	-0.27207
Nostalgia and self-expression motivation	-0.35618	-0.06861	0.47064
Zscore: Importance of work	0.34268	0.40395	-0.77379
Zscore: Importance of friends	0.30291	-0.09380	-0.23886
Zscore: Importance of material values	0.60583	-0.10132	-0.55983
Environmental and critical motivations	0.02700	-0.59365	0.57357
Zscore: Importance of politics	0.18876	0.09962	-0.30238
Zscore: Level of education	-0.67274	0.34853	0.41804
Zscore: Frequency of shopping in second-hand shops	-0.19522	0.42595	-0.22728

The first cluster comprises 127 respondents (34.9% of the sample) and can be defined as the thrifty social interactionist segment. This cluster comprises respondents who have the lowest monthly net income/person in the household, are the youngest, and are mostly from rural areas. The two major motivations determining their second-hand shopping are the economic/austerity and the social interaction motivation. Those belonging to this segment have a medium level of education, and show a moderate frequency of second-hand shopping. Work and friends are important to them, and they put importance on material values as well, the latter showing that this thrifty segment considers material belongings important, and thus second-hand shopping can offer them an avenue for taking

part in the consumer society (i.e. excluded consumers – William and Windebank, 2000). This result is also a proof that – contrary to the study of Guiot and Roux (2010) or Balsa-Budai and Kiss (2019) – our segment of thrift shoppers are not critical towards the consumer society: on the contrary, they find pleasure in locating lower-price products in second-hand shops, which can lead to overconsumption in the long run. However, our result is similar to that of Guiot and Roux (2010) and Balsa-Budai and Kiss (2019) in the sense that the cited authors did not find themselves a segment attributable to purely economic motivations. The authors of both studies found economic motivation to be accompanied by critical motivation (i.e. thrifty critics). All the same, there are also differences between our results and the antecedents in the literature, as we did not find ecological and critical motivation to be associated with economic motivation.

The second cluster comprises 119 respondents (32.7%), and its members can be defined as originality seekers. They are respondents to whom the most important motivation of second-hand shopping is the originality motivation and who visit these shops in order to find unique, original clothes. They are the oldest respondents (above 40 years old) with the highest monthly income, mostly living in urban areas, generally having a higher level of education, and visiting second-hand shops frequently. This segment was not clearly revealed either by Guiot and Roux (2010) or by Balsa-Budai and Kiss (2019). The closest segment to ours is the so-called polymorphous enthusiast group (Guiot and Roux, 2010): in the case of this segment revealed in France, the authors found respondents who were middle-aged, had above the average income, and were frequent customers of different second-hand shops; however, the originality motivation was present together with other reasons (this being the reason why they are named polymorphous). Thus, compared to the cited sources, our segment revels a clearer profile.

The third cluster includes 118 respondents (32.4%). Given that the two most important motivations for second-hand shopping are represented in this segment by the environmental/critical as well as the nostalgia and self-expression motivation, we define this segment as nostalgic critics. They are middle-aged individuals, mostly city dwellers with a higher level of education who visit second-hand shops with a lower frequency. They do not attach importance to material values, which is also a proof in the direction that this is a critical segment towards the consumption society. They do not use second-hand shops as a form of consumerism, i.e. in order to frequently shop lower-price products, but rather as a context in which they can sporadically shop for original items and a context through which they can prolong the lifecycle of products and thus can formulate a criticism at the address of the consumer society.

As already mentioned, Guiot and Roux (2010) found the critical motivation to be tied to thriftiness (cf. thrifty critics), while the nostalgic motivation was found to be linked to hedonism in the already indicated France-based research

(cf. nostalgic hedonist), which thus means that in our socio-cultural context the second-hand shoppers' segment is different. Balsa-Budai and Kiss (2019) in their Hungary-based study found that the critical-environmental motivation (the so-called decisive segment) is linked to the frugal, less frequent use of second-hand shops, and this is in accordance with our data: nostalgic critics visit second-hand shops with the lowest frequency.

The fact that we revealed three clusters (compared to four, which are more specific in the literature), whose bases are more or less different compared to what has been found in the literature, calls for three possible explanations. The first is a methodological explanation linked to the surveys and questionnaires: the variables used in our research are not the same as the ones explored in the previously mentioned two studies. Neither Guiot and Roux (2010) nor Balsa-Budai and Kiss (2019) use the same set of variables in their study. The other explanation is linked to the different socio-geographical context of the research: in western countries, such as France, second-hand shopping can be traced back to the same set of motivations; however, these motivations can be combined in different ways by shoppers (e.g. thriftiness can go hand in hand with critical motivations), so that the resulted segments are different from ours. The role of the context is just as much important since our results obtained at the level of the Szeklerland-based ethnic Hungarian population are closer to those found previously in Hungary (Balsa-Budai and Kiss, 2019). The third explanation is again a methodological standpoint, which also accentuates the limitations of our research: we made use of a non-representative, non-probability sample, which makes it possible that a stricter methodology could bring slightly different results.

5. Conclusions

Second-hand shops are becoming increasingly widespread across the globe: besides economically less developed countries, the developed countries of the Western world are also home to an ever-growing number of second-hand settings (Williams and Paddock, 2003; Gregson and Crewe, 2003; Laitala and Klepp, 2018). The literature therefore seems to break away from the earlier paradigm according to which second-hand shops provide spaces for the so-called excluded consumers, individuals struggling with financial constraints (William and Windebank, 2000). A question ever more frequently raised by researchers inquires about what other motivations, pointing beyond material considerations, there can exist behind second-hand shopping; consequently, most research on thrifting is built around the issue of motivations (Guiot and Roux, 2010; Laitala and Klepp, 2018). Research so far has revealed numerous motivations for shopping related to second-hand settings. These can be broadly divided into two – thrifting as a constraint vs.

thrifting as a choice (Williams and Paddock, 2003; Waight, 2013) – and more specifically into three – economic/austerity, ecological/critical, and hedonic/experience-oriented (e.g. Guiot and Roux, 2010; Laitala and Klepp, 2018; Hur, 2020) – motivational groups.

The ambition of our research was to conduct a survey among the population of three counties in Romania (Covasna, Harghita, and Mureş) in order to look into the characteristics of second-hand consumption related to clothing products. The research was carried out in the Szeklerland area at large and made use of a non-representative, online, Hungarian-language questionnaire. These conditions come with a number of research limitations, which makes us view our analysis as a preliminary, exploratory work whose results may serve as starting-points for future research. Despite its shortcomings, we believe our research is an important step forward since, as to our present knowledge, no similar surveys have been made so far in Romania and more specifically in the region under study (aside from the qualitative study (Nistor, 2021) serving as a point of departure for the present research), while there is but a single work addressing the topic in relation to Hungary (Balsa-Budai and Kiss, 2019).

In this paper, we have presented customers' motivations for second-hand shopping. To that end, our research made use of the adapted, abridged version of Guiot and Roux's (2010) Second-Hand Shoppers' Motivation Scale. In designing our research, we were interested in finding out whether the motivations for shopping mentioned in the literature can be detected among our respondents, which motivations are the most typical of them, and what variables each motivation has. Finally, we also undertook a cluster analysis with a view to exploring the consumer segments associated with thrifting.

Results of the exploratory factor analysis revealed five motivational factors: economic/austerity, critical/environmental, originality, social interaction, and nostalgic and self-expression. Out of these, the last three correspond to the motivations categorized by the reviewed literature under the group of hedonic motivations (e.g. Bardhi and Arnould, 2005; Guiot and Roux, 2010; Laitala and Klepp, 2018) – hence, it can be stated that motivations behind thrift shopping as discussed in our case coincide with those presented in the literature. Considering that our research territory covered a region that is in a more vulnerable economic position within the national context, it came as no surprise that the economic/austerity motivation was the most representative feature. Further, results also suggest that critical/environmental motivation is the second most essential reason underlying second-hand shopping.

With regard to the variables accounting for the motivations, it can be said that the variables adopted in our research helped us make only a rough model of each motivation. Having said that, all of our cases included an independent variable that was found in significant correlation with the motivations under study. It can be

therefore established that the economic/austerity motivational dimension is related to modest financial situation, frequent thrifting, and younger age-group, while the critical/environmental motivational dimension is linked to higher educational attainment, younger age-group, post-material values, and good financial standing. Motivations falling under the hedonic motivational dimension are connected with social capital and the frequency of thrift shopping, i.e. with specifics of second-hand shopping/settings that make thrifting an experience.

We were able to reveal three segments of second-hand shopping with the help of cluster analysis as follows: thrifty social interactionists, originality seekers, and nostalgic hedonists. As the cluster names also indicate, various shopping-related motivations or combinations of them can be demonstrated in these cases, while some typical sociodemographic and consumption-related variables can also be associated with each segment. The clusters identified more or less coincide with consumer segments described in previous research (Guiot and Roux, 2010; Balsa-Budai and Kiss, 2019). We take the view that differences can be accounted for by the dissimilar geographical-cultural context of the research and the distinct methodological approaches. At the same time, we find it remarkable to have results consistent with the cited sources: the coexistence of motivations in certain segments, the connection between critical environmental motivation and frugal shopping, etc. We therefore believe that despite the previously mentioned limitations, our research results live up to the expectations of an exploratory study and can be used as a starting-point for further regional research.

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Appendix

Table 1. *The 19 items from the Second-Hand Shoppers' Motivation Scale (adapted from Guiot and Roux, 2010)*

To what extent do you agree with the following statements?

(1 – strongly disagree, 2 –disagree, 3 – neither disagree nor agree, 4 – agree, 5 – strongly agree)

a) By buying in second-hand shops, I can distance myself from the consumer society.	1	2	3	4	5
b) By buying in second-hand shops, I can take revenge on consumer society.	1	2	3	4	5
c) I like to buy in second-hand shops because this way I can save clothes intended to be discarded but that are still in a good condition.	1	2	3	4	5
d) By buying in second-hand shops, I can contribute to reducing waste.	1	2	3	4	5

e) By buying in second-hand shops, I can experience the feeling of not having to leave the product in the shop.	1	2	3	4	5
f) For the same amount of money, I can buy more things in second-hand shops compared to traditional shops.	1	2	3	4	5
g) Second-hand shops tend to come up with such good offers that it would be a pity not to buy them.	1	2	3	4	5
h) I have often found new products in second-hand shops for a fraction of their regular price.	1	2	3	4	5
i) I think that new products on sale in traditional shops are overpriced.	1	2	3	4	5
j) I consider that second-hand shops have fair prices.	1	2	3	4	5
k) I like to visit second-hand shops just to have a look around.	1	2	3	4	5
l) In second-hand shops, I often get the feeling that I am on a treasure hunt.	1	2	3	4	5
m) Unique and special products can be found in second-hand shops.	1	2	3	4	5
n) One can find products in second-hand shops that are not available in traditional shops.	1	2	3	4	5
o) In second-hand shops, there is often opportunity to initiate a conversation with other people.	1	2	3	4	5
p) Visiting second-hand shops is, for me, a way of spending leisure time in the company of others.	1	2	3	4	5
q) Things bought in second-hand shops have their own history.	1	2	3	4	5
r) I am more into old-time fashion than today's trends.	1	2	3	4	5
s) I can express myself better with products bought in second-hand shops.	1	2	3	4	5

Table 2. *The results of the exploratory factor analysis (Model 1)*

Factor	Item	Factor Loading	Communality	Variance (%)	Cronbach's alpha
Economic motivation	f	0.802	0.698	30.42%	0.808
	g	0.731	0.618		
	e	0.713	0.576		
	h	0.679	0.613		
	j	0.643	0.424		
	i	0.573	0.440		
Critical/environmental motivations	d	0.877	0.796	12.02%	0.752
	c	0.852	0.762		
	a	0.634	0.504		
Originality motivation	n	0.875	0.825	10.95%	0.808
	m	0.862	0.823		
Social interaction motivation	o	0.872	0.804	7.95%	0.789
	p	0.871	0.812		
Nostalgic and self-expression motivation	r	0.881	0.817	7.21%	0.727
	s	0.768	0.770		
Total	15			68.56%	

Table 3. *The cluster model's statistics (Model 7)*

	F	P-value	Minimum	Maximum	N
Zscore: Household monthly net income/ person	48.978	0.000	-1.33312	4.43039	364
Zscore: Age	93.504	0.000	-1.60355	3.10156	381
Zscore: Type of locality	24.358	0.000	-1.42920	0.69785	381
Economic/austerity motivations	4.310	0.014	-4.07108	2.20832	381
Originality motivation	4.811	0.009	-3.61559	2.17655	381
Social interaction motivation	24.075	0.000	-2.04384	2.41742	381
Nostalgia and self-expression motivation	24.057	0.000	-2.16737	2.91310	381
Zscore: Importance of work	71.287	0.000	-3.15267	1.19938	381
Zscore: Importance of friends	10.160	0.000	-3.74996	0.86631	381
Zscore: Importance of material values	55.814	0.000	-2.63366	1.64078	381
Environmental and critical motivations	51.435	0.000	-3.04147	1.97154	381
Zscore: Importance of politics	8.446	0.000	-0.76630	3.52724	381
Zscore: Level of education	62.650	0.000	-1.44639	0.68956	381
Zscore: Frequency of shopping in second-hand shops	17.773	0.000	-0.89167	1.11855	381

List 1. *The list of the independent variables with significant influence introduced in the regression and cluster analyses*

Frequency of shopping in second-hand shops. 0 – once or less than once a month, 1 – frequently, at least several times a month

Income. Households' monthly net income/person (in RON)

Age. Numerical age

Presence of children. 1 – at least one children, 0 – no children

Education. 0 – not upper level, 1 – upper level

Economically active. 1 – economically active, 0 – economically inactive

Household's income. Appreciated by class mean.

Type of locality. 1 – urban, 0 – rural.

Importance of work. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Importance of family. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Importance of friends. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Importance of politics. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Importance of material possessions. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Importance of religion. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

List 2. *The list of the independent variables without significant influence introduced in the regression and cluster analyses*

Amount of money spent in second-hand shops. Appreciated by class mean.

Number of children.

Employment. 0 – not full time, 1 – full time

Family arrangement. 1 – has a spouse/partner, 0 – single

Household's members. How many people live in the household (together with the respondent)?

Subjective social status. Measured on a 1–10 scale.

Importance of acquaintances. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Importance of leisure time. 0 – not important (somewhat or less then somewhat important), 1 – important (important and very important)

Working abroad in the last 6 months. 1 – yes, 0 – not

Subjective income status. 1 – above the average, 0 – below the average

Shopping alone in second-hand shops. 1 – yes, 0 – not

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The Impact of Tourism Development and Economic Growth on Poverty Reduction in Kazakhstan

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Abstract. The paper examines the long-run relationship between poverty reduction, economic growth, and tourism development in Kazakhstan during the period of 2001–2017. We expand the basic model by including other poverty determinants such as inequality, unemployment, and spending on health. We use the Autoregressive Distributed Lag (ARDL) approach to test the co-integration of variables, as the ARDL bound test of co-integration is less restrictive and provides more reliable coefficients than other time series econometric models. The ARDL bound test results show that there exists a long-run relationship between the said variables. The coefficients of all variables have the expected signs in the long run.

Keywords: growth, tourism, poverty, ARDL, Kazakhstan

JEL Classification: F2, F29, F43

1. Introduction

The tourism sector is a top priority in the Republic of Kazakhstan. The country has a rich and diverse tourism that offers unique opportunities for related cognitive visits to various cultural and historical sites. The country is blessed with numerous national parks. It has about 900 historical sites and more than 100 water clinics. The government of Kazakhstan is developing the tourism industry to make it highly competitive and efficient and to integrate it with the global tourism market. The tourism development programme was launched in the period of 2003–2005, and after successfully completing it, a new tourism programme was launched in 2011. In 2000, tourism receipts amounted to 403 million US dollars, and they

increased to about 2.65 billion US dollars in 2018. Within 18 years, the number of tourists had increased from 1.68 million to 8.79 million in 2018. Also, per capita, tourism receipts have increased from 239 dollars in 2017 to 302 dollars. Therefore, Kazakhstan has a high potential to utilize its tourism sector for the country's economic growth.

One of the United Nation's MDGs (Millennium Development Goals) is to eliminate hunger and poverty among people living below the poverty line. To fulfil this goal, the UNWTO (United Nations World Tourism Organization) launched the ST–EP (Sustainable Tourism – Eliminating Poverty) initiative (Kim et al., 2016). Tourism is used as one of the strategies to reduce poverty and improve the economic conditions in developing countries. About 80% of 56 countries adopt tourism as a strategy for poverty reduction coupled with other policies that focus on the labour market and human resource development (Hawkins and Mann, 2007; Saayman et al., 2012). The main reason behind this is the tourism-led growth hypothesis. According to this hypothesis, there is empirical evidence of a strong correlation between GDP growth and the country's tourism development. Tourism is regarded as a synonym for exports since it acts as a source of foreign exchange receipts and increases consumption in the recipient country. Foreign exchange earnings obtained through tourism facilitate the import of capital goods, contributing to capital goods that can be used in the country's production process and that pay for the other imports to maintain the country's balance of payment (McKinnon, 1964).

Jamieson et al. (2004) used the term pro-poor tourism to explain how tourism generates net benefits for the poor. Tourism is pro-poor as it provides opportunities by creating part-time or full-time employment and development of small and medium-scale enterprises through sales to the tourism sector. It also offers other livelihood benefits such as access to drinking water and the development of roads, which leads to improved education, health, and easy access to the market. Njoya and Seetaram (2018) include four channels for the pro-poor tourism hypothesis. These are income, price, tax, and risk channels. Tourism brings income to poor people through their direct or indirect participation. It increases the tax base for state and central governments, and additional revenue can be used for social infrastructure development. Also, tourism development leads to an increase in demand for domestic goods and services, increasing the local price level. The impact of an increase in local price levels on the poor depends on the amount of these goods purchased by the poor (Blake et al., 2008). The fourth channel describes the risk and other dynamic impacts of tourism. The dynamic impact may have either positive effects, such as allocation of resources towards preserving cultural, historical, and natural resources, or negatively impacting environmental resources such as air, noise, and water pollution.

Furthermore, income elasticity associated with the tourism sector is generally higher relative to the conventional exports of developing countries. It can also develop initially on low-skilled labour, and it is even more labour-intensive than

other sectors. Some countries with insignificant international trade may be an alternative export option available (Roe et al., 2004).

In their multivariate analysis of tourism development, poverty reduction, and economic growth in Nicaragua, Vanegas and Croes (2007) used the co-integration approach and found a significant positive impact of tourism on poverty reduction. According to this study, tourism helps eradicate poverty by increasing income, infrastructure development, and skill level. Using the Autoregressive Distributed Lag (ARDL) model, Vanegas (2012) also found a positive impact of tourism development on poverty reduction in a group of developing countries. Wasudawan and Rahim (2017) found the positive impact of entrepreneurial tourism activity, economic growth, and tourism employment generation on Sarawak's poverty alleviation. Dongguk et al. (2016) examine the relationship between poverty reduction, tourism, and economic growth among 56 developing countries from 1995 to 2012. By applying panel models of pooled regression analysis, fixed effect, and random effect, the authors found an insignificant impact of tourism development on poverty reduction. However, through the interaction of tourism with the country's economic growth, the authors found a significant impact on poverty reduction.

Zhao and Ritchie (2007) stated that very few studies had examined the empirical relationship between tourism development and poverty reduction. In addition, the debate on the relationship between the contribution of tourism development and economic growth to poverty reduction continues (Namhyun et al., 2016). The present study contributes to the debate on poverty reduction, tourism development, and economic growth using available time series data for the largest Central Asian region, Kazakhstan. We employed the more robust technique of the ARDL model for establishing the said relationship. Also, the Error Correction Model (ECM) is used to estimate the short-run and long-run coefficients.

The paper is structured as follows. Section 2 deals with the economic model. Section 3 provides the various econometric techniques used. Section 4 provides results and discussion. Lastly, Section 5 presents the conclusions.

2. Economic Model

HakJun and Pyun (2016) applied the following time series regression to examine the effect of tourism and economic growth on the poverty ratio:

$$Pov_t = \beta_0 + \beta_1 Tor_t + \beta_2 Gro_t + \mu_t, \tag{1}$$

where Pov_t is the poverty headcount ratio, and β_0 is a constant term. *Tor* denotes tourism receipts per arrival, *Gro* is the GDP growth, and μ_t is the error term.

We augment the equation (1) by including the other macroeconomic determinants of poverty reduction based on various literature studies. The augmented equation of poverty reduction is:

$$Pov_t = \alpha_0 + \alpha_1 Tor_t + \alpha_2 Gro_t + \alpha_3 Un_t + \alpha_4 Health_t + \alpha_5 Gini_t + \in_t, \quad (2)$$

where Un_t is the unemployment rate, $Health_t$ is the health sector, and $Gini_t$ is the country's inequality. $\in_t$ is the error term. Other variables are the same as discussed in equation (1).

Inequality is having both positive and negative impacts on poverty reduction in economic theory. The positive relationship is based on the assumption that wage inequality provides an incentive for higher skill and education, and it generates more entrepreneurial activity and innovations (Galor and Tsiddon 1997; Hills et al., 2019). A positive relationship is also supported by Kaldor's (1957) theory of economic growth. According to this theory, inequality generates more savings, and savings positively impact economic growth through saving-induced investment (Hills et al., 2019). However, economists such as Stiglitz (2016) believe in the attitude of the rich to invest their earnings in non-productive commodities and assets. Also, unequal access to education due to inequality leads to sub-optimal investments in human capital and negative economic growth (Galor and Zeira 1993). Therefore, inequality is an essential variable in determining the poverty reduction of the country.

The link between poverty reduction and employment is that an increase in employment can reduce poverty by increasing wage employment, real wages, self-employment, the productivity of self-employment, and the exchange of self-employment output (Khan, 1976). Health and poverty are interrelated. When disease or illness hits the poor, they are unable to earn money for themselves. Therefore, the study incorporates the effects of these variables on poverty reduction. The descriptions of the variables used in the present study are shown in *Table 1*.

Table 1. *Description of variables*

Variable	Description	Notation	Data sources
Poverty	Poverty headcount ratio at $3.20 a day (2011 PPP) (% of population)	Pov	worldbank.org
Growth	GDP growth (annual %)	Gro	worldbank.org
Tourism	International tourism, receipts (% of total exports)	Tor	worldbank.org
Inequality	Gini index (World Bank estimate)	Gini	worldbank.org
Unemployment	Unemployment, total (% of total labour force) (national estimate)	Un	ILOSTAT database
Health	Domestic general government health expenditure per capita (current US$)	Health	worldbank.org

Source: calculated by the authors

i. **Poverty.** Poverty is the dependent variable of the present study. There are various measures of poverty. The present study uses "Poverty headcount ratio at $3.20 a day (2011 PPP) (% of the population)". It is the percentage of the population living on less than $3.20 a day at 2011 international prices. The time series data of poverty are obtained from the World Bank database.

ii. **Economic Growth.** Economic growth is measured by the annual percentage growth rate in Gross Domestic Product (GDP). The expected sign of economic growth is negative, i.e. an increase in the country's economic growth leads to a decrease in poverty. The World Bank database provides the annual time series data of annual growth rate.

iii. **Tourism.** International tourism receipts as a percentage of total exports are used as a proxy of a country's tourism development. Tourism is expected negatively on poverty. The data on tourism is obtained from the World Bank database.

iv. **Inequality.** The distribution of income in a country is an important dimension of welfare and plays a vital role in reducing poverty. Various measures define the inequality within the country. The present study uses the Gini index as a proxy of inequality. The Gini coefficient shows the deviations of income among persons/individuals from equal distribution. The expected sign of inequality is positive, implying that greater inequality leads to greater poverty. The time series data of inequality are obtained from the World Bank database.

v. **Unemployment.** The definition of unemployment and labour force varies from country to country. The present paper uses the definition of the International Labour Organization (ILO), which defines unemployment as a share of the total labour force that is without work but is available for and seeking employment. The expected sign of unemployment is positive. High and substantial unemployment leads to resource inefficiency and high poverty. The annual data of unemployment are obtained from the ILOSTAT database.

vi. **Health Development.** The proxy used for health development is total government expenditure as a percentage of GDP. The expected sign of human development is negative. The annual data series of human development is the World Bank database.

3. Econometric Technique

Various econometric approaches can be applied to examine Equation (2). These include numerous co-integration tests such as that of Engle and Granger (1987), Johansen and Juselius (1990), or Johansen (1998). The weaknesses of these models are that they are sensitive to sample size and stationarity of data. To overcome these problems, we applied the ARDL approach of co-integration. The ARDL approach has various advantages over other methods. It performs better both with

non-stationary and mixed orders of integration. It takes p and q optimum lags of dependent and independent variables to generate data processing from general to specific. Also, it provides robust and super-consistent estimators (Pesaran and Shin, 1999). However, it underperforms when data is of order two, i.e. I (2). The general form of the ARDL (p, q) model used in the present study has the following form:

$$Pov_t = \alpha_0 + \sum_{i=1}^{p} \beta_1 \Delta Pov_{t-i} + \sum_{i=1}^{q} \beta_2 \Delta Tor_{t-i} + \sum_{i=1}^{q} \beta_3 \Delta Gro_{t-i} + \sum_{i=1}^{q} \beta_4 \Delta Gini_{t-i} + \sum_{i=1}^{q} \beta_5 \Delta Un_{t-i} + \sum_{i=1}^{q} \beta_6 \Delta Health_{t-i} + \alpha_1 Pov_{t-1} + \alpha_2 Tor_{t-1} + \alpha_3 Gro_{t-1} + \alpha_4 Gini_{t-1} + \alpha_5 Un_{t-1} + \alpha_6 Health_{t-1} + e_t, \quad (3)$$

where Δ is the first difference operator, and p, q are the optimal lag operators. The first step in the ARDL bounds testing from Equation (3) is to examine the existence of long-run relationship among variables by conducting the F-test for joint significance, that is, the null hypothesis, H_0: $\beta_1 = \beta_2 = \beta_3 = 0$, against the alternative hypothesis, H_0: $\beta_1 \neq \beta_2 \neq \beta_3 \neq 0$. Two sets of critical values (lower bound and upper bound critical values) are generated by Pesaran et al. (2001). If the computed F-statistic lies above the upper bound critical value, the null hypothesis is rejected, implying that long-run co-integration exists among variables. After determining the co-integration of variables, the next step is to determine the long-run ARDL for poverty ratio by selecting the orders of ARDL (p, q) model using AIC (Akaike Information Criterion) as shown below:

$$\Delta Pov_t = \alpha_0 + \sum_{i=1}^{p} \beta_1 \Delta Pov_{t-i} + \sum_{i=1}^{q} \beta_2 \Delta Tor_{t-i} + \sum_{i=1}^{q} \beta_3 \Delta Gro_{t-i} + \sum_{i=1}^{q} \beta_4 \Delta Gini_{t-i} + \sum_{i=1}^{q} \beta_5 \Delta Un_{t-i} + \sum_{i=1}^{q} \beta_6 \Delta Health_{t-i} + e_t. \quad (4)$$

In the final step, we estimate the short-run coefficients by estimating an error correction model associated with long-run coefficients as shown below:

$$\Delta Pov_t = \alpha_0 + \sum_{i=1}^{p} \beta_1 \Delta Pov_{t-i} + \sum_{i=1}^{q} \beta_2 \Delta Tor_{t-i} + \sum_{i=1}^{q} \beta_3 \Delta Gro_{t-i} + \sum_{i=1}^{q} \beta_4 \Delta Gini_{t-i} + \sum_{i=1}^{q} \beta_5 \Delta Un_{t-i} + \sum_{i=1}^{q} \beta_6 \Delta Health_{t-i} + \emptyset ECM_{t-1} + e_t, \quad (5)$$

where *ECM* is the error correction term derived from the estimated equilibrium relation from Equation (3), ∅ is the speed of adjustment parameter, and β_1, β_2, β_3, β_4, β_5, β_6, are the short-run coefficients of the model's convergence to equilibrium.

4. Empirical Results and Discussion

Before using the application of the ARDL model to assess the relationship between poverty, tourism development, economic growth, and other determinants of poverty reduction in Kazakhstan during the period from 2001 to 2017, the first step is to present an overview of the variables. Accordingly, we began our analysis by examining the descriptive properties of the variables under consideration, which are given in *Table 2*.

Table 2. *Descriptive statistics*

	Gini	Gro	Health	Pov	Tor	Un
Mean	3.40	1.65	4.81	0.69	1.08	1.87
Median	3.33	1.98	5.12	0.53	0.95	1.87
Maximum	3.68	2.61	5.54	3.38	1.78	2.34
Minimum	3.28	0.09	3.36	-1.61	0.49	1.58
Std. Dev.	0.11	0.81	0.72	1.81	0.39	0.25
Skewness	1.09	-0.94	-0.96	0.25	0.22	0.33
Kurtosis	3.04	2.61	2.57	1.61	1.89	1.69
Jarque–Bera	3.38 (0.18)	2.64 (0.26)	2.75 (0.25)	1.55 (0.45)	1.01 (0.61)	1.52 (0.46)
Sum	57.81	28.05	81.85	11.76	18.47	31.93

Source: calculated by the authors using EViews 10

Note: Values in brackets show the p-value of the Jarque–Bera test.

Table 2 shows the mean of variables is greater than the standard deviation. Therefore, all variables under consideration have stable variation over the period. The p-value of the Jarque–Bera test of normality confirms that all variables are normal. Following descriptive statistics, the next section presents the correlation/covariance among variables.

Table 3. *Correlation matrix*

	Gini	Gro	Health	Pov	Tor	Un
Gini	1					
Gro	0.63	1				
Health	-0.81	-0.56	1			
Pov	0.91	0.58	-0.91	1		
Tor	0.35	-0.01	-0.65	0.35	1	
Un	0.86	0.64	-0.91	0.96	0.32	1

Source: calculated by the authors using EViews 10

Correlation provides the information for detecting multicollinearity between the variables of interest. According to *Table 3*, the correlation between the variables is less than one. However, the correlation between variables does not imply causation. After determining the correlation, the next step is to check whether the data is stationary to avoid spurious regression. The standard Augmented Dickey–Fuller (ADF) test is carried out both at the level and first difference to examine whether the data has a unit root or not. The results of the ADF test are given in *Table 4*.

Table 4. *Unit root test*

Variables	ADF statistics	Probability	Durbin Watson	Decision rule
Pov	-1.02	0.717	1.93	Non-stationary
Tor	-1.31	0.591	2.25	Non-stationary
Gro	-2.22	0.206	1.71	Non-stationary
Un	-2.59	0.114	1.89	Non-stationary
Gini	-1.44	0.531	2.21	Non-stationary
Health	1.64	0.96	1.22	Non-stationary
D(Pov)	-3.52**	0.02	1.96	Stationary
D(Tor)	-5.17***	0.00	1.67	Stationary
D(Gro)	-4.25***	0.00	2.001	Stationary
D(Un)	-3.28**	0.03	2.05	Stationary
D(Gini)	-6.83***	0.00	2.25	Stationary
D(health)	-2.19**	0.03	1.99	Stationary

Source: calculated by the authors using EViews 10

*Notes: *** significant at 1%, ** significant at 5%.*

In *Table 4*, all the variables under consideration have a unit root level. However, they become stationary at first difference. Therefore, data is a I (1) order that provides precise application for ARDL modelling and bound testing. Before applying ARDL testing, the next step is to examine the presence of co-integration

among variables of interest. *Table 4* reports the results of the F-test on the joint significance of long-run coefficients under the null hypothesis, indicating that there is no long-run co-integration among variables against the alternative hypothesis that there is long-run co-integration.

Table 5. *Co-integration test*

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n = 1,000		
F-statistic	5.22	10%	2.08	3
		5%	2.39	3.38
		2.5%	2.70	3.73
		1%	3.06	4.15

Source: calculated by the authors using EViews 10

It can be seen from *Table 5* that F-statistic is higher than I (1) critical values at all levels of significance. It rejects the null hypothesis that there is no long-run co-integration. Therefore, we conclude that the variables under consideration have a long-run relationship. After examining the long-run relationship, we estimated the long-run and short-run responses of poverty to tourism and economic growth in Kazakhstan. *Table 6* presents the long-run coefficients.

Table 6. *Long-run estimates*

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
GRO	-0.74**	0.181	-4.132	0.014
UN	1.51	1.197	1.268	0.273
GINI	6.34**	1.591	3.992	0.016
TOR	-2.21**	0.541	-4.106	0.014
HEALTH	-2.36**	0.567	-4.165	0.014
EC = POV - (-0.7440*GRO + 1.5196*UN + 6.3484*GINI -2.2176*TOR -2.3624 *HEALTH)				

Source: calculated by the authors using EViews 10

*Notes: Maximum dependent lags: 1 (automatic selection); model selection method: Akaike Info Criterion (AIC); White (HC0) heteroscedasticity consistent standard errors and covariance; ** significant at 5%.*

From *Table 6*, the chosen model is based on the Akaike Info Criterion (AIC) with automatic lag selection. We have also reported white (HCO) heteroscedasticity consistent standard errors and covariance rather than ordinary errors. *Table 6* reveals that the variables have an expected sign. Economic growth, tourism receipts,

and spending on health have a significant negative impact on poverty reduction in the long run. Therefore, poverty has an inverse relation with economic growth, tourism receipts, and spending on health in the long run. The long-run elasticity of poverty reduction with economic growth is -0.77, which implies that a one per cent increase in economic growth leads to a 0.77% decrease in poverty. The significant negative relationship between poverty and economic growth is also empirically supported by Mulok et al. (2012) and Richard (2003).

The long-run elasticity of poverty reduction with tourism is -2.21, indicating that a one per cent increase in tourism leads to a 2.21% decrease in poverty in the long run. The negative impact of tourism on poverty reduction is empirically validated by Croes (2014), who found the coefficient of tourism to be -1.23 in the case of Nicaragua. The coefficient of government spending on health is -2.36, what indicates that a one per cent increase in government spending on health leads to a decrease of 2.36 per cent in poverty. The negative impact of government expenditure on poverty is empirically supported by Fan et al. (2000).

Other variables of model unemployment and inequality are showing a positive long-run impact. One per cent increase in unemployment and inequality leads to an increase of 1.51 and 6.34 per cent increase in poverty, respectively. However, the unemployment coefficient is insignificant in the long run. The reason may be the inclusion of other variables in the model. The positive impact of unemployment and inequality is supported empirically by Akinbobola and Saibu (2004). A decrease in unemployment and inequality improves human development and therefore reduces poverty.

Table 7. *Short-run coefficient estimates*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-10.23***	1.13	-9.04	0.001
D(GRO)	-0.27***	0.05	-4.75	0.009
D(UN)	6.18***	1.22	5.06	0.007
D(GINI)	5.26***	0.41	12.92	0.001
D(TOR)	-1.64***	0.28	-5.73	0.004
D(HEALTH)	-1.741***	0.25	-6.83	0.002
ECM(-1)	-1.19***	0.13	-8.98	0.001

Source: calculated by the authors using EViews 10

*Note: *** significant at 1%.*

The short-run coefficient estimates are presented in *Table 7*. The error correction model (ECM) is negative and statistically significant at 1%, and it reflects that 119% disequilibrium is corrected in the next period after a shock to the system. The variables in the short run are showing the same sign as in the long run. One

per cent increase in economic growth, tourism development, and spending on health lead to a 0.27, 1.64, and 1.74 per cent decrease in poverty in the short run. In comparison, a 1 per cent increase in unemployment and inequality leads to a 6.18 and 5.24 per cent increase in poverty in the short run.

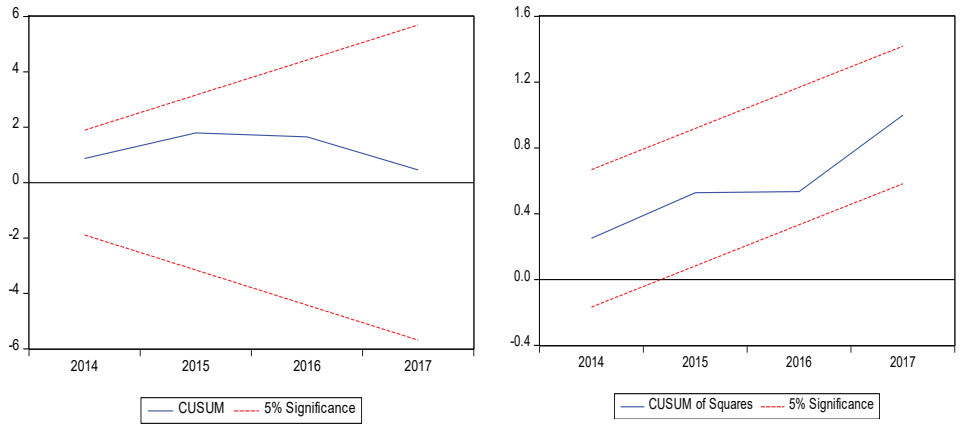
However, these results may appear to be influenced by the variance, covariance, and independence of the residual term. Therefore, it is customary to perform various types of residual diagnostic testing. The various types of residual testing are shown in *Table 8*.

Table 8. *Residual diagnostic testing*

Test	F-statistics	Prob
Breusch–Godfrey Serial Correlation LM Test	0.608	0.62
Heteroscedasticity Test: Breusch–Pagan–Godfrey	1.189	0.47
Heteroscedasticity Test: ARCH	0.522	0.48
Heteroscedasticity Test: Harvey	0.731	0.69

Source: calculated by the authors using EViews 10

Table 8 presents the residual diagnostic test of heteroscedasticity and serial correlation. The Breusch–Godfrey Serial Correlation LM Test is based on the null hypothesis that residuals are serially uncorrelated. Similarly, the Breusch–Pagan–Godfrey, the ARCH, and the White tests of heteroscedasticity are based on the null hypothesis that there is no heteroscedasticity. According to *Table 5*, the reported p-value associated with F-statistic is above the critical values. Therefore, we conclude that residuals are homoscedastic and are serially uncorrelated. The graphical presentation of the stability test is shown in *Figure 1*.



Source: calculated by the authors using EViews 10

Figure 1. *Stability test*

The CUSUM (cumulative sum of residuals) and CUSUM of a square shown in panels 1 and 2 of *Figure 1* confirm that residuals lie within the critical range. Therefore, parameters are stable over the said period. Overall, *Table 8* and *Figure 1* indicate that the model has desirable statistical properties and can be used for policy analysis.

5. Conclusions

Kazakhstan is the largest Central Asian country. Therefore, the findings of the paper will apply to Kazakhstan, other Central Asian countries, and other developing countries with macroeconomic characteristics similar to those of Kazakhstan. The findings of the study indicate that poverty reduction, economic growth, tourism development, inequality, spending on health, and unemployment in the country are co-integrated in the long run. The error correction model (ECM) is negative and statistically significant at 1% and reflects that 119% disequilibrium is corrected in the next period after a shock to the system. The residual diagnostic testing indicates that the model has desirable properties and can be used for policy analysis.

The elasticity of poverty reduction with respect to economic growth is -0.27 in the short run and -0.74 in the long run. Sound macroeconomic policies are essential for reducing poverty. These policies operate mainly through their impact on the economic growth of the country. Countries with better macroeconomic policies grow faster, and this faster growth eventually reduces poverty. The elasticity of poverty reduction with respect to tourism receipt is -1.64 in the short run and -2.21 in the long run. The result suggests that tourism matters for the poor. The government should frame various policies for developing the tourism sector by developing airports, railways, roads, and other infrastructure. Tourism will help poor people by empowering local people in planning and decision making regarding tourism policies. The elasticity of poverty reduction with respect to inequality is 5.26 in the short run and 6.34 in the long run. Therefore, the government should manage inequality through proper income distribution through social securities and an appropriate tax system. Another policy variable of interest is unemployment. The elasticity of poverty reduction with unemployment is 6.18 in the short run and 1.51 in the long run. Therefore, the government should have economic regimes that help in the creation of more jobs. Also, incentives should provide for more labour-intensive techniques. Another variable of policy implication is spending on health. It has a significant impact on reducing the poverty in Kazakhstan. The elasticity of poverty reduction with respect to government spending on health is -1.74 in the short run and -2.36 in the long run. The government should direct more financial support by providing universal healthcare for the poor.

However, poverty is a multi-factor problem. Further research could include non-economic determinants. Also, different types of international tourism can impact poverty reduction and, therefore, be a further research topic. Another research method can be using a direct measurement of poverty rather than a proxy variable as done in the present study.

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Supplier Selection during the COVID-19 Pandemic Situation by Applying Fuzzy TOPSIS: A Case Study

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Abstract. During the COVID-19 pandemic situation, many factories, companies, and organizations faced difficulties supplying raw materials. Multi-criteria decision-making techniques (MCDM) could be a proper solution that helps managers to make an appropriate and fast decision in supplier selection in such unusual situation. The goal of my research is not only to employ the technique for order of preference by similarity to ideal solution (TOPSIS) in a fuzzy environment but also to use a new criterion, namely "number of employees", for evaluating suppliers during the COVID-19 pandemic situation. Applying fuzzy logic during unstable conditions helps decision makers to make a logical and more precise decision. In this study, five criteria, that is, quality, delivery, price, number of employees, and lead time, are considered to compare and select an appropriate supplier. The results show that "number of employees" is an essential criterion in supplier selection during abnormal conditions like the COVID-19 pandemic situation.

Keywords: multi-criteria decision-making, alternatives, number of employees

JEL Classification: C44, D70

1. Introduction

The COVID-19 have had a significant effect on different sections of international society. Some organizations had to stop working, and some other organizations have fired a great many of their employees. Manufacturing factories have encountered some problems in supplying raw materials, and education has shifted to the online sphere. Economy faced stagnation, and financial issues were raised for international societies.

Therefore, making an optimized decision in different sections of society, such as businesses, economy, healthcare, and some other parts, would not be easy for the decision makers.

To make a proper and stable decision regarding an issue in an organization during the COVID-19 pandemic situation, applying multi-criteria decision-making (MCDM) techniques may help decision makers. In the current research, a decision-making problem during COVID-19 in a small part of the business section is studied. A MCDM technique was used to solve a problem in an Iranian petrochemical factory.

Within the subject of supplier selection, this study tries firstly to identify different attributes (criteria) for selecting suppliers. Secondly, it attempts to choose the most appropriate supplier by applying a MCDM technique. Finally, this study tries to show the importance of "number of employees as one of the main criteria in selecting suppliers during COVID-19 pandemic situations.

Different MCDM techniques, such as Analytic Hierarchy Process (AHP), ELimination Et Choice Translating Reality (ELECTRE), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), etc., can be employed to find a way of dealing with a decision-making problem. In this study, decision makers decided to apply the TOPSIS technique due to some advantages of TOPSIS such as having negative and positive criteria at the same time, converting qualitative criteria to quantitative ones, and a good mathematical basis (dealing with distances) (Orji and Wei, 2015; Shen et al., 2013; Govindan et al., 2013; Awasthi et al., 2010).

The rest of this study is structured as follows. Literature review is presented in Section 2. Section 3 describes the methodology of the study. The case study is explained in Section 4. Finally, the conclusions and recommendations are presented in Section 5.

2. Literature Review

TOPSIS was firstly initiated by Hwang and Yoon (Hwang and Yoon, 1981). Specifying the ideal and the anti-ideal solution is the principle logic in TOPSIS. The anti-ideal solution minimizes affirmative criteria and maximizes negative criteria, while the ideal solution does it vice versa. In TOPSIS technique, alternatives are ranked according to their similarity to the ideal solution. The more similar an alternative to the ideal solution, the higher its ranking. This technique selects the proper alternative on the basis of the proximity of the selected alternative to the affirmative ideal solution and its distance from the negative ideal solution. Some researchers believe that the TOPSIS should be extended to a fuzzy environment (Chen, 2000; Liang, 1999; Raj and Kumar, 1999).

A remarkable stream of previous studies also attempted to integrate TOPSIS and the fuzzy set theory to augment the accuracy of the ultimate selection made by decision makers.

Chen et al. (2006) applied fuzzy TOPSIS in evaluating and selecting the supplier. The supplier's profitability, relationship closeness, capability in technology, quality of conformity, and conflict resolution are considered as the criteria for evaluating suppliers.

Javad et al. (2020) used fuzzy TOPSIS to prioritize various suppliers according to weighted green criteria, such as collaborations, economic advantages, capabilities, resources, etc., for selecting the most effective supplier.

A study in Sweden was conducted to compare fuzzy TOPSIS and fuzzy DEA in selecting sustainable suppliers. Six criteria – cost, energy and resource consumption, quality, management of environment systems, health of staff and safety of work, and social responsibility – are considered in evaluating suppliers (Rashidi and Cullinane, 2019).

To select a proper supplier providing raw material for a small-scale steel industry company in India, fuzzy TOPSIS was used by Kumar et al. (2018). Suppliers are assessed based on four criteria: cost, delivery capabilities, quality of product, performance, and reputation (Kumar et al., 2018).

Gupta and Barua (2017) applied fuzzy TOPSIS to choose a supplier based on green innovation ability in small and medium-sized enterprises. Weights of criteria are computed by using the best worst method.

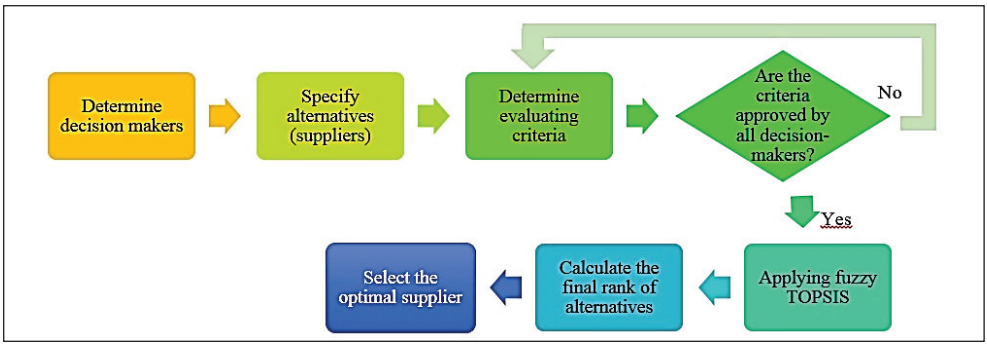
In some previous studies, research focused on important criteria, such as cost, quality, lead time, and delivery, for selecting suppliers (Amindoust et al., 2012a–b; Azadi et al., 2015; Azadnia, et al., 2015; Tavana et al., 2016; Girubha et al., 2016).

A review of previous literature has shown there is extensive research on supplier selection, some of the studies being either theoretical or practical and some others case studies. Although the earlier studies used different criteria in selecting suppliers, none of them considered the number of employees as one of the main criteria. In Iran, this criterion is not considered in selecting a supplier selection.

3. Methodology

A methodology is proposed in *Figure 1* to select an efficient supplier in this study. The first step is identifying decision makers who can help in making decisions for supplier selection. In the second step, suppliers that can supply the required material would be determined. Then, the criteria for supplier selection are determined by studying the literature. The criteria are sent for advisement to senior managers to remove or add on any criteria. If the decision makers approve all selected criteria, the process may continue. Otherwise, the evaluating criteria should be revised. After the approval of all criteria by decision makers, fuzzy

TOPSIS is employed to calculate the final suppliers' rank. Finally, an efficient supplier will be revealed.



Source: author's compilation

Figure 1. *Methodology diagram*

3.1. Fuzzy TOPSIS

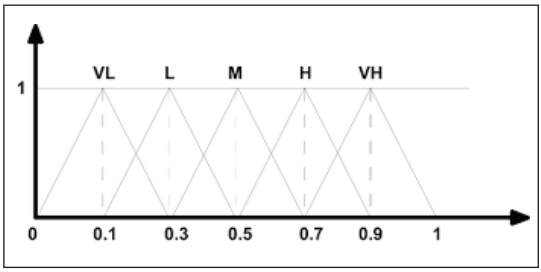
The TOPSIS technique was first introduced in 1981 by Hwang and Yoon. In this method, the best alternative in the company among all the other alternatives would be the one with the shortest interval from the affirmative ideal solution and the outmost interval from the negative ideal solution (Ajripour et al., 2019).

TOPSIS is a helpful technique for prioritizing alternatives, but it utilizes firm values for choosing the alternatives. In some cases, such as pairwise comparisons and superiority ratings, human judgment cannot be accurate because of the firm value rating of alternatives (Chang et al., 2008). To dominate this constraint in my study, fuzzy TOPSIS is utilized by applying linguistic variables.

The Fuzzy TOPSIS steps applied in this paper are as follows:

Before introducing the fuzzy TOPSIS steps, let us assume there are i alternatives named $S = \{S_1, S_2, S_3, \ldots, S_i\}$ and j criteria named $C = \{C_1, C_2, C3, \ldots, C_j\}$.

Step 1: The first step of the fuzzy TOPSIS determines the criteria weights ($\widetilde{W_j}$), where j = 1,2,…, m. All decision makers should use linguistic variables to evaluate the importance of each criterion. Triangular fuzzy numbers were applied in this study. It would often be suitable to get on with triangular fuzzy numbers because of the simplicity in computational processes. A triangular fuzzy number is characterized as $M = (l,m,u)$, where "l" shows the lowest likely number, "m" represents the most propitious number, and "u" the greatest likely number for expressing a fuzzy occasion (Deng, 1999). Triangular fuzzy numbers are depicted in *Figure 2*.



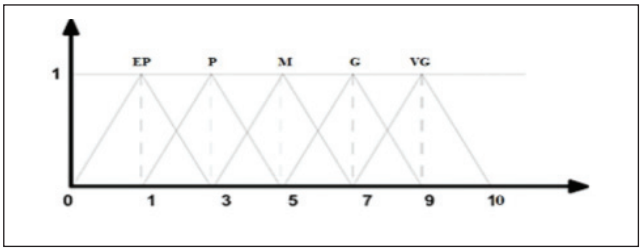
Source: Chen et al., 2006

Figure 2. *Triangular fuzzy numbers (TFNs)*

Step 2: Make fuzzy decision matrix ($\widetilde{D_{ij}}$) including n alternatives and m criteria. Then, by applying fuzzy triangular linguistic variables in *Figure 3*, decision makers should define the value of each alternative based on each criterion.

$$\widetilde{D_{ij}} = \begin{bmatrix} \tilde{X}_{11} & \cdots & \tilde{X}_{1j} \\ \vdots & \ddots & \vdots \\ \tilde{X}_{i1} & \cdots & \tilde{X}_{ij} \end{bmatrix} \qquad \begin{matrix} \text{i} = 1,2,\ldots, \text{n} \\ \text{j} = 1,2,\ldots, \text{m}, \end{matrix}$$

where $\tilde{X}_{ij}$ is the value of alternative i based on criterion j.



Source: Chen et al., 2006

Figure 3. *Triangular fuzzy numbers*

Step 3: If the number of decision makers is more than one, the aggregated fuzzy value for $\widetilde{W_j}$ and $\widetilde{D_{ij}}$ should be calculated using equations (1) and (2) respectively.

$$w_{j1} = \min_k \{w_{j1}^k\}\,,\ w_{j2} = \frac{1}{K}\sum_{k=1}^{k} w_{j2}^k\,,\ w_{j3} = \max_k \{w_{j3}^k\}$$

$$a_{ij} = \min_k \{w_{ij}^k\}\,,\ b_{ij} = \frac{1}{K}\sum_{k=1}^{k} b_{ij}^k,\ c_{ij} = \max_k \{c_{ij}^k\},$$

where $W_j^k = (w_{j1}^k, w_{j2}^k, w_{j3}^k)$, and $X_{ij}^k = (a_{ij}^k, b_{ij}^k, c_{ij}^k)$.

$$\widetilde{W}_j = \frac{1}{K}\left[\widetilde{W}_j^1 + \widetilde{W}_j^2 + \cdots + \widetilde{W}_j^k\right] = \frac{1}{K}\sum_{k=1}^{k}\widetilde{W}_j^k \tag{1}$$

$$\widetilde{D_{ij}} = \begin{bmatrix} \frac{1}{K}[\tilde{X}_{11}^1 + \tilde{X}_{11}^2 + \cdots + \tilde{X}_{11}^k] & \cdots & \frac{1}{K}\left[\tilde{X}_{1j}^1 + \tilde{X}_{1j}^2 + \cdots + \tilde{X}_{1j}^k\right] \\ \vdots & \ddots & \vdots \\ \frac{1}{K}[\tilde{X}_{i1}^1 + \tilde{X}_{i1}^2 + \cdots + \tilde{X}_{i1}^k] & \cdots & \frac{1}{K}\left[\tilde{X}_{ij}^1 + \tilde{X}_{ij}^2 + \cdots + \tilde{X}_{ij}^k\right] \end{bmatrix} = \begin{bmatrix} \frac{1}{K}\sum_{k=1}^{k}\tilde{X}_{11}^k & \cdots & \frac{1}{K}\sum_{k=1}^{k}\tilde{X}_{1j}^k \\ \vdots & \ddots & \vdots \\ \frac{1}{K}\sum_{k=1}^{k}\tilde{X}_{i1}^k & \cdots & \frac{1}{K}\sum_{k=1}^{k}\tilde{X}_{ij}^k \end{bmatrix}, \tag{2}$$

where k is the number of decision makers.

Since fuzzy triangular numbers are used in this study, the two important operations for these numbers are as follows:

Let us suppose $K_1 = (l_1, m_1, u_1)$ and $K_2 = (l_2, m_2, u_2)$ are the two affirmative triangular fuzzy numbers; thus, the two primary functions of TFNs are denoted as below (Kaufmann and Gupta, 1991):

$$K_1 \oplus K_2 = (l_1 + l_2, m_1 + m_2, u_1 + u_2)$$

$$K_1 \otimes K_2 = (l_1.l_2, m_1.m_2, u_1.u_2)$$

The distance between two triangulate fuzzy numbers could be calculated as follows:

$$\mathrm{d}(K_1, K_2) = \sqrt{\frac{1}{3}\left[(l_1 - l_2)^2 + (m_1 - m_2)^2 + (u_1 - u_2)^2\right]}$$

Step 4: Fuzzy decision matrix $\widetilde{D_{ij}}$ normalization:

Fuzzy decision matrix normalization would be calculated as shown below:

$$\tilde{R} = \left[\tilde{r}_{ij}\right]_{m.n} \qquad i = 1, 2, \ldots, n \text{ and } j = 1, 2, \ldots, m, \tag{3}$$

where

$$\tilde{r}_{ij} = \left(\frac{l_{ij}}{u_j^*}, \frac{m_{ij}}{u_j^*}, \frac{u_{ij}}{u_j^*}\right), u_j^* = max\, u_{ij} \qquad \textit{If criterion is positive (benefit criterion)} \tag{4}$$

$$\tilde{r}_{ij} = \left(\frac{\acute{l_j^-}}{l_{ij}}, \frac{l_j^-}{m_{ij}}, \frac{l_j^-}{u_{ij}}\right) l_j^- = min\, l_{ij} \qquad \textit{If criterion is negative (negative criterion)} \tag{5}$$

Step 5: Using Equation (6), the weighted normalized fuzzy decision matrix $(\widetilde{V})$ would be computed by multiplying the normalized fuzzy decision matrix $(\tilde{r}_{ij})$ by the criteria weights $(\widetilde{W_j})$.

$$\tilde{V} = \left[\tilde{v}_{ij}\right]_{m.n} \text{ i= 1,2,…, n and j= 1,2,…, m, where } \tilde{v}_{ij} = \tilde{r}_{ij}.\tilde{W}_j \quad (6)$$

Step 6: Determining alternatives' positive and negative ideal solution.

$$S^* = \{\tilde{v}_1^*, \tilde{v}_2^*, \dots, \tilde{v}_n^*\} \; where \; \tilde{v}_j^* = \{1,1,1\} \quad j = 1,2, \dots, n \quad (7)$$

$$S^- = \{\tilde{v}_1^-, \tilde{v}_2^-, \dots, \tilde{v}_n^-\} \; where \; \tilde{v}_j^- = \{0,0,0\} \quad j = 1,2, \dots, n \quad (8)$$

Step 7: Computing the distances of all alternatives from the affirmative and negative ideal solution.

$$d_i^* = \sum_{j=1}^{n} d_v\left(\tilde{v}_{ij}, \tilde{v}_j^*\right), \quad i = 1, \dots, n \quad and \quad j = 1, \dots, m \quad (9)$$

$$d_i^- = \sum_{j=1}^{n} d_v\left(\tilde{v}_{ij}, \tilde{v}_j^*\right), \quad i = 1, \dots, n \quad and \quad j = 1, \dots, m, \quad (10)$$

where $d_v(.,.)$ is the distance measurement between two fuzzy numbers.

Step 8: Computing the closeness coefficient by applying Equation (11). Considering the value of the closeness coefficient, alternatives would be prioritized. The value of the closeness coefficient varies between zero and one. The ideal alternative is the one with a closeness coefficient close to one.

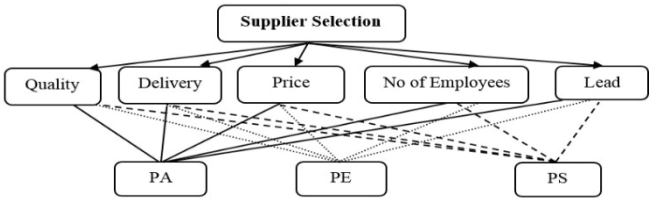
$$CC_i = \frac{d_i^-}{d_i^* + d_i^-} \quad (11)$$

4. Case Study

The primary goal of this research is selecting an efficient supplier to supply the required raw material for a petrochemical factory in Iran during the COVID-19 situation. The name of the petrochemical factory and the names of suppliers are not disclosed because of the privacy policy of the concerned petrochemical factory and the suppliers. Five senior managers involved in supply chain management in the petrochemical factory are appointed as the main decision makers. The team of decision makers selected three potential suppliers for supplying the required raw material in the petrochemical factory. To assess and choose an efficient supplier based on the literature review, four criteria, i.e. quality, delivery, price, and lead time, were considered by the decision makers. In addition to the four criteria, senior managers decided to take into account the number of the suppliers' employees. Due to the COVID-19 pandemic situation, some factories have encountered financial problems. To overcome such a problem, some of the factories downsize human resources. Decision-makers believed that a decrease in employees' number affects the output of suppliers' production. After initial consensuses regarding the criteria and the alternatives, the fuzzy TOPSIS was applied. Finally, the rank of suppliers will be calculated, and the efficient supplier will be revealed. This study will help

the managers of the petrochemical factory to select an appropriate raw material supplier during the COVID-19 pandemic situation.

To solve a multi-criteria decision-making problem, one can first make a hierarchal decision-making tree. In the first level, a goal should be determined. In our study, the goal is supplier selection. Then, the criteria should be placed on the next level and, finally, alternatives on the last level. If there are some sub-criteria, those should be placed on the third level and the alternatives on the fourth level (see *Figure 4*).



Source: author's compilation

Figure 4. *Decision-making tree*

In order to solve a decision-making problem by applying fuzzy TOPSIS, one should first determine the importance of the criteria using linguistic variables (*Table 1*). If there is more than one decision maker, all decision makers should determine the value of each criterion based on linguistic variables. Fuzzy triangular numbers are utilized to convert linguistic variables (*Table 2*).

Table 1. *Criteria weights based on decision makers' ideas*

Criterion	D1	D2	D3	D4	D5
Quality	VH	VH	VH	VH	VH
Geographical Distance	H	M	M	M	L
Price	M	H	VH	M	M
Number of Employees	VH	H	VH	H	VH
Lead Time	H	M	M	H	H

Source: author's work based on decision makers' opinions

Table 2. *Linguistic variables for pairwise comparison of criteria*

Linguistic Variables	Fuzzy Numbers
Totally Low (TL)	(0,0,0.1)
Very Low (VL)	(0,0.1,0.3)
Low (L)	(0.1,0.3,0.5)
Medium (M)	(0.3,0.5,0.7)
High (H)	(0.5,0.7,0.9)
Very High (VH)	(0.7,0.9, 1)
Totally High (TH)	(0.9,1,1)

Source: Chen et al., 2006

The next step is calculating the aggregated fuzzy values of the criteria by applying Equation (1). The criteria's fuzzy weights are represented in *Table 3*.

Table 3. *Criteria fuzzy weights*

Quality	**0.7**	**0.9**	**1.0**
Geographical Distance	0.3	0.5	0.7
Price	0.5	0.7	0.57
Number of Employees	0.6	0.8	0.95
Lead Time	0.4	0.6	0.8

Source: author's calculation

After determining the criteria weights, a decision-making matrix should be formed. Using linguistic variables, all decision makers compared the alternatives according to each criterion (*Table 4*).

Table 4. *Decision matrix*

Criteria	**Alternatives**	**D1**	**D2**	**D3**	**D4**	**D5**
Quality (The quality of raw material)	PA	VG	G	VG	G	G
	PE	G	VG	VG	G	G
	PS	G	G	VG	G	VG
Geographical Distance (The geographical distance of suppliers from the factories)	PA	P	EP	P	M	EP
	PE	VG	G	VG	VG	VG
	PS	G	M	M	G	M
Price (The price of raw material provided by suppliers)	PA	M	P	EP	P	M
	PE	VG	G	M	VG	VG
	PS	M	P	P	P	M
Number of Employees (The number of staff working at the supplier companies)	PA	VG	G	G	G	VG
	PE	G	M	G	M	M
	PS	P	P	M	P	EP
Lead Time (The time between order and the receipt of raw material)	PA	G	VG	M	VG	G
	PE	P	P	EP	G	P
	PS	M	M	P	P	EP

Source: author's calculation

Applying fuzzy linguistics (*Table 5*) to convert linguistic variables, one should then normalize the decision-making matrix using equations (4) and (5). If a criterion is a positive one, Equation (4) should be used at first. If a criterion is a negative one, Equation (5) should be employed. A positive criterion is the one that has an advantage for the petrochemical factory; for example, quality and number of employees are the positive criteria. A negative criterion is the one that does not have an advantage for the factory such as price, delivery, and lead time.

Table 5. *Linguistic variables for the pairwise comparison of alternatives based on criteria*

Linguistic Variables	Fuzzy Numbers
Totally Poor (TP)	(0,0,1)
Extremely Poor (EP)	(0,1,3)
Poor (P)	(1,3,5)
Medium (M)	(3,5,7)
Good (G)	(5,7,9)
Very Good (VG)	(7,9,10)
Excellent (E)	(9,10,10)

Source: Chen et al. 2006

Using Equation (2), the final normalized decision matrix is represented in *Table 6*.

Table 6. *Normalized decision matrix*

Criteria	Alternatives	l	m	u
Quality (+)	PA	5.8	7.8	9.4
	PE	5.8	7.8	9.4
	PS	5.8	7.8	9.4
Geographical Distance (-)	PA	1	2.6	4.6
	PE	6.6	8.6	9.8
	PS	4.2	6.2	8.2
Price (-)	PA	1.4	3	5
	PE	5.8	7.8	9.2
	PS	1.8	3.8	5.8
Number of Employees (+)	PA	5.8	7.8	9.4
	PE	3.8	5.8	7.8
	PS	1.2	3	5
Lead Time (-)	PA	5.4	7.4	9
	PE	2	3.4	5.4
	PS	1.6	3.4	5.4

Source: author's calculation

Calculating the weighted normalized fuzzy decision matrix would be the goal. The final results are represented in *Table 7*. After calculating the weighted decision matrix, the fuzzy positive and negative ideal solution is determined.

The Positive Ideal Solution (P.I.S.) in each column is an element with the maximum value among all the others, and the Negative Ideal Solution (N.I.S.) is the component with the minimum value among all the other components in a column.

Table 7. *Weighted decision matrix*

Criteria	Alternatives	l	m	u
Quality	PA	0.43	0.75	1
	PE	0.43	0.75	1
	PS	0.43	0.75	1
	P.I.S	0.43	0.75	1
	N.I.S	0.43	0.75	1
Geographical Distance	PA	0.30	0.19	0.15
	PE	0.05	0.06	0.07
	PS	0.07	0.08	0.09
	P.I.S	0.30	0.19	0.15
	N.I.S	0.05	0.06	0.07
Price	PA	0.500	0.327	0.159
	PE	0.121	0.126	0.086
	PS	0.389	0.258	0.137
	P.I.S	0.500	0.327	0.159
	N.I.S	0.121	0.126	0.086
Number of Employees	PA	0.370	0.664	0.950
	PE	0.243	0.494	0.788
	PS	0.077	0.255	0.505
	P.I.S	0.370	0.664	0.950
	N.I.S	0.077	0.255	0.505
Lead Time	PA	0.119	0.130	0.142
	PE	0.320	0.282	0.237
	PS	0.400	0.282	0.237
	P.I.S	0.400	0.282	0.237
	N.I.S	0.119	0.130	0.142

Source: author's calculation

To find the final ranks of alternatives, firstly, the sum of Euclidean distance for each component from a positive fuzzy ideal solution and fuzzy negative ideal solution is computed by employing equations (9) and (10). Then, using Equation (11), the closeness coefficient of the alternatives is calculated (*Table 8*).

Table 8. *Closeness coefficient*

	d_i^*	d_i^-	CC_i
PA	0.33	0.85	0.72
PE	0.60	0.49	0.45
PS	0.73	0.62	0.46

Source: author's calculation

Applying fuzzy TOPSIS to choose the most proper supplier for supplying the raw material during the COVID-19 situation, supplier "PA" ranked the first and suppliers "PS" and "PE" ranked the second and third ones respectively (PA ≻ PS ≻ PE).

5. Conclusions and Recommendations

Due to the unexpected and unstable situation created by the COVID-19, most businesses, companies, and factories have encountered different kinds of problems. One of the most important issues that many factories have faced during the COVID-19 pandemic situation was selecting the most appropriate supplier. To select an applicable supplier for the Iranian petrochemical company based on the literature review, four criteria (quality, delivery, price, and lead time) were selected. Although various kinds of criteria have been studied for supplier selection in previous research, "number of employees" has not been studied as a significant criterion in supplier selection. Based on the five decision makers' opinions, the number of employees affects the supplier's production outputs during the COVID-19 pandemic situation. Besides the four criteria, "number of employees" was considered to assess the three suppliers in this research.

Employing a MCDM technique would be an appropriate solution when assessing different alternatives based on several criteria. In this study, the fuzzy TOPSIS technique was employed to assess three suppliers based on five criteria.

The fuzzy set can be applied in case one encounters a vague situation. Due to the unexpected and unpredictable COVID-19 pandemic situation, in this study, fuzzy TOPSIS is applied to assist decision makers in reaching a specific solution.

Applying fuzzy TOPSIS and considering "number of employees" as one of the main criteria, supplier "PA" with a closeness coefficient of 0.72 was selected as the first appropriate supplier for the Iranian petrochemical company. If "number of employees" as one of the main criteria were not considered by decision makers in supplier selection, the rank of the suppliers would be PE ≻ PA ≻ PS, i.e. supplier "PE", which has previously received the lowest closeness coefficient, is the most appropriate supplier for the petrochemical factory. Therefore, considering the number of employees as one of the main criteria in selecting suppliers will help decision makers choose an appropriate supplier during the COVID-19 pandemic situation.

Most previous studies considered cost (Azadi et al., 2015; Orji and Wei, 2014; Wen et al., 2013; Sarkis et al., 2012), quality (Tavana et al., 2016; Jia et al., 2015; Singh et al., 2014; Govindan et al., 2013), lead time (Girubha et al., 2016; Su et al., 2015; Chaharsooghi and Ashrafi, 2014; Wen et al., 2013; Lin et al., 2012), and delivery (Girubha et al., 2016; Azadi et al., 2015; Kuo et al., 2010) as the main criteria for the supplier selection problem. In my study, in addition to the

mentioned criteria, "number of employees" is introduced as one of the main important criteria to select the appropriate supplier during an unstable situation such as the COVID-19 pandemic situation. Ignoring such an important criterion may result in a wrong decision regarding supplier selection.

The limitations of this study are as follows: firstly, this study uses only the fuzzy TOPSIS technique for selecting a proper supplier. Other MCDM techniques, such as VIekriterijumsko KOmpromisno Rangiranje (VIKOR), ELimination Et Choice Translating REality (ELECTRE), or a combination of these two, could also have been applied in this study. The Best Worst Method (BWM) could also be employed to achieve criteria weights. Secondly, in this study, a single company is considered as a case study.

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SAFE: The New-Age Service Marketing Mix for the New-Age Internet-Based Services

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Abstract. Internet-based services have emerged at a fast pace, but the literature thereon has not kept pace with it. Researchers and marketers still refer to the traditional marketing frameworks to define and manage these services. This paper argues that this approach is detrimental both to the academicians and the practitioners. The paper attempts to establish that Internet-based services are significantly different from the traditional services and require contemporary marketing frameworks. Further, a new-age marketing mix, SAFE, is proposed, which is expected to help marketers manage Internet-based service more efficiently.

Keywords: marketing mix, SAFE, 4Ps, McCarthy's mix, service mix, Internet-based services

JEL Classification: M310

1. Introduction

Services have undergone major transformation in terms of their business models, offering, pricing structure, and fundamentals, which have made them more ubiquitous, accessible, and engaging (Panwar and Khan, 2020). The shift in services has followed a systematic pattern that is led by a host of technologies such as the Internet, the cloud, big data, robotics, machine learning, and now artificial intelligence (Arthur, 2017). Technologies have further helped the evolution of service into entities that draw upon intelligent elements of (service) functions and often render some traditional human activities obsolete. The coming of age of the spatial and temporal boundaries has broken the myth that service can be provided

only in a face-to-face set-up (Heinonen and Pura, 2006; Vargo and Lusch, 2004b). Thus, a Netflix user can watch his/her favourite series from wherever s/he wants to, and a Book My Show user can book his tickets without any spatial restrictions.

Internet-based technology has significantly transformed how services work in sectors such as retail, banking, transport, healthcare, and hospitality. While having a traditional footprint, these sectors have received a major fillip with the advent of technology. These businesses have been able to integrate their tech platforms in a customer's daily routine making mundane tasks redundant. For example, payment by Paytm wallet has become a habit for a lot of customers, which does not require a lot of decision making on the customer's end while paying for certain products or services. Internet-based new-age consumer services (detailed in *Section 2.2 – How Different Are Internet-Based Services Anyway?*) offer a solution while leveraging their core competencies, which are often the technical expertise, a transformed business process, and an innovative business model (Panwar and Khan, 2020a).

The core solution of these Internet-based services may not be particularly different from the traditional services, but the way it is adopted, accessed, and experienced by the customer is what creates the difference. For example, Swiggy delivers food to the customer's doorstep, but the core service, the food remains the same. It is not the change in the core offering but rather how easily a customer can access the platform and how pleasant is the overall experience (Panwar, 2020). Often it is the convenience, reliability, and flexibility that these Internet-based services provide to the customer through their service platforms, which are major factors why customers adopt and reuse these apps (Jeon, Kim, and Jeong, 2016).

Despite the emergence of these Internet-based services, a lot of service literature is still founded on the older characteristics defined for services, which may not be relevant anymore. Kohli and Haenlein (2021a) in their recent paper mentioned that a large number of researchers have voiced the concern that much of the current academic research in the area of marketing is not particularly useful. They further presented three possible reasons that lead to this limitation in research. Lack of awareness of the contemporary marketing issues has been highlighted as a critical reason, which in a way resonates with the idea for this paper. Further, Wierenga (2021) expressed that it is a perfect time to contribute to the body of knowledge of marketing and to solve practical marketing problems. He further presented three shifts that would lead the research, and ICT revolution has been highlighted as one of these three shifts. This view also resonates with this paper, as the Internet-based services are a function of the underlying ICT revolution.

Kohli and Haenlein (2021b) made further clarifications in their paper on these thoughts, especially related to the importance of theory and the self-identities of researchers. This was in response to the reflection article by Stremerch (2021), who argued that it is required to funnel more resources from the applied and puzzling science to thought leadership. To do so, a research funnel was proposed

to guide research in the right direction, based on three approaches. This paper is in line with the "embrace residual ambiguity" approach defined in the paper by Stremerch (2021). Thus, the extant literature needs a new set of frameworks and guiding principles that can help Internet-based services achieve more than what they would by the adoption of frameworks and processes that were never made for them. A forced adaptation to these frameworks by Internet-based services is often inefficient, and at worst it can also harm the service brand.

This paper has adopted the systematic review of service marketing literature for finding topics that are discussed in detail, to give a structure to service marketing with an emphasis on marketing mix. Further, on the basis of the thematic literature review, an Internet-based marketing mix is proposed towards the end of the paper. We believe that the Internet-based service marketing framework proposed in this paper would open doors not only for other research on the Internet-based service domain but also for service marketers to invest their resources more efficiently than before.

Further sections of the paper shall deliberate on the topics found during the literature review and on the proposition of the new-age marketing mix. Section 2 discusses the evolution of the Internet-based consumer services, while Section 3 discusses various traditional marketing mix frameworks with their nuances. Section 4 argues about the limitations the existing frameworks have in defining and addressing needs for Internet-based services, while Section 5 introduces and explains SAFE framework in detail. Finally, Section 6 provides conclusions and discussions, while Section 7 presents some limitations and future research.

2. Evolution of the Internet-Based Consumer Services

2.1 Traditional Definitions of Services

Traditionally, services have been defined as deed, act, or performance (Berry, 1980) that brings about a desired and requested change in the condition of a person or possession belonging to a person or entity. Services and products can be differentiated based on tangibility (Levitt, 1981).

The most authoritative definition about services came from Parasuraman et al. (1985), who defined services being different from goods due to inherent characteristics – intangibility, heterogeneity, inseparability, and perishability.

Rao and Ruekert (1994) argued that since a buyer cannot ascertain the quality of a service before purchasing it (unlike in the case of a product), information asymmetry is a peculiar aspect of services which is not necessarily present for products. Thus, engaging with customers in case of service offerings is different from engaging with customers for product offerings. Vargo and Lusch (2004a) added

a new perspective to service while defining the service-dominant logic (SDL), which emphasized that service is nothing but the application of specific skills on people or their products, and it is co-created with the customer. Further, Vargo and Lusch (2004b) presented a different view about services while contending that the differences between the services and goods must be abandoned and replaced with a strategy of understanding how they are related. In fact, they suggested that service is the common denominator in exchange, with or without goods being involved.

2.2 How Different Are Internet-Based Services Anyway?

Traditionally, the aim of classifying services was to differentiate services from products. However, most classifications did not look at newer channels of service dissemination, including e-channels (Heinonen and Pura, 2006). Meuter et al. (2000) added a classification for service encounters based on the technology interface and its usage. While Internet-based services are ubiquitous now, this is a credible way to differentiate between traditional services and new-age services.

For example, traditional services, such as banks, which had to have a physical presence for providing services to customers, have now transformed into physical plus Internet service platforms. This is to say that services offered by banks are not dependent only upon the physical infrastructure anymore. These functions can very well be performed via the Internet, which would transcend the otherwise prevalent temporal and spatial constraints in service operation.

Does that make a bank like ICICI bank or a retail set-up like D-Mart, which in addition to its physical chain of stores also has an app for customers to order, new-age services? Not really.

We propose that all services can be segmented into four categories based on what the core (enabler) of their business model is. This finds its foundation in the classical segmentation offered by Lovelock (1983) for services.

One classification of services was based on who goes to whom for service, the customer or the service? Internet-based services almost always reach out to the customers, and not the other way around. In the context of this paper, a classification of services, based on the requirement of Internet or connectivity for its functioning, has been identified as the key towards this segregation. Four categories are thus created, which are:

– **Pure-Play Internet Services:** The core of these services is Internet-based functionality, and the service is completely dependent upon this functionality for connecting with customers. Customers cannot access these services without the Internet, and hence there is a critical dependence upon Internet access in order for these services to penetrate the market. These services may or may not have a physical service component in the overall service offering. Netflix users can stream movies and their favourite shows from Netflix, but they need Internet access to

access the services. However, there is no physical component of this service. Uber also has a strong Internet-based functionality, which makes it imperative for its customers to have Internet to access the Uber app and make themselves avail of its services from its app. However, it also has a strong physical contact aspect since once the booking has been made, an actual car and a driver is expected to pick up the customer and take him/her to his/her destination.

– **Internet Plus Services:** These services are similar to pure-play Internet services, but they have extended their access points and reach through physical infrastructure as well. So, while the core of these services remains to be Internet-based functionality, they have branched out to a brick and mortar set-up too. This is done to increase coverage or to simply provide a touch and feel experience to the customers. Since the physical set-up is an additional pillar to their business over and above the core Internet-based access, these services are called Internet plus services. Lenskart started as an online platform for delivering a wide variety of eyewear quickly to their customers. The platform leveraged the technology aspect to learn about user preferences and shopping behaviour to improve its service. But Lenskart then forayed into the physical set-up by opening retail stores all across India.

– **Plus Internet Services:** Traditional service businesses understand the importance of integrating the Internet-based functionalities into their service operations. That is why a substantial number of traditional companies have developed alternatives for their customers (Khalifa and Liu, 2003).

So, customers can continue to buy from traditional channels but also have an option to reach out to an additional Internet-based access point providing them with ease of access and convenience. However, the Internet-based functionalities exist in addition to their core physical set-up for services, i.e. it is just a "plus" on its existing service structure. D-Mart has its core as a chain of physical retail stores across the country. However, to reach out to more people and reduce their cost of operation, they also launched an app for customers to order from. The app in this case is only an addition to the core offline channel.

– **Non-Internet Services:** Given the speed at which technology has caught up with businesses, almost all of the traditional companies in the organized sector have managed to create an online presence. However, a lot of unorganized services are still working without any Internet presence or technological intervention. Local services such as two-wheeler repair service stations, local barbershops, and even unorganized local transportation have kept away from the Internet-based services in their business and have stuck to the traditional format of access and delivery.

As per this paper, "Internet-based services" are those services that have Internet-based capabilities and functionalities for access, delivery, and customer management as their core elements. These services may or may not have a physical brand overarching their service, but they must have Internet-based access as

central to the service operation. In accordance with this definition, the Internet-based services from the above classification are: *Pure-Play Internet Services* and *Internet Plus Services*. Since the other two categories do not have Internet-based capabilities as core or central to access, delivery, and customer management for the service offered, they do not qualify as Internet-based services.

2.3 Emergence of Internet-Based Services

Advancement in technology leading to a rise in smartphones, storage mechanisms such as cloud, social platforms, and means to make sense of data analytically through big data and data analytics have transformed services' organization and their business models (Maglio et al., 2019). More services with digital as their core feature are making their way into the most valued companies in terms of market valuation. A host of researchers have recognized and written on the importance of technology in the delivery of services (Bitner, Brown, and Meuter, 2000). What was once a playground of industrial giants like Exxon and GE's is now ruled by the likes of Amazon, Google, and Facebook (UNCTAD, 2019).

Internet-based services with technology as their core feature are equipped with the ability to collect, use, and analyse the massive amount of data (Bhave, Jaun, and Roy, 2013) that is collected from the social as well as business digital footprints (UNCTAD, 2019). The social footprint generates tranches of behavioural data that is used in making services stickier and customer friendly while offering superior convenience and personalization as compared to traditional services (Clarke and Flaherty, 2003). So, while traditional personal transportation promises point A to point B commute, Uber added the convenience of calling a cab to home or work. Netflix added local content to cater to its new users, while Zomato showed restaurants in the vicinity, and Spotify gave its customers "Podcasts for you" and "Made for you" features based upon previous content consumption patterns, the common thread in all these services being accessibility driven by Internet technology.

Affordable smartphones, better technological infrastructure leading to improved network connectivity and faster speed (Panwar, 2020), increasing storage ability, and the miniaturization of digital devices (making them comfortable to carry and use) (Sundararajan, 2016) are some of the key enablers that led to the rise of Internet-based services. Global service organizations such as Netflix, Uber, Khan Academy, Coursera, and Trivago, as well as Indian service organizations such as Ola, Byju's, Zomato, Swiggy, MakeMyTrip, Oyo, etc. owe a lot of their success to these enablers which have accentuated their acceptance and adoption. Finally, the Internet-based services are often designed and developed using processes and frameworks that are based on human-centric model of service design, which renders them easily adoptable as well as highly engaging (Panwar and Khan, 2021).

3. Traditional Marketing Mix Frameworks

In his seminal research on marketing mix, Borden (1964) proposed the idea of Marketing Mix, where a mix of 12 elements was put forward as a mix of ingredients "that provides an ever-ready checklist of areas to consider while dealing with marketing problems". McCarthy (1964) consolidated the list of 12 ingredients into four and called it the 4Ps – Product, Price, Place, and Promotion. The objective was to turn the marketing planning concept into the practical implementation of the concept (Bennett, 1997). McCarthy (1964) defined marketing mix as a combination of all the factors that a marketing manager has at disposal to satisfy the needs of the target market. This definition was further tuned by McCarthy and Perreault (1987), who defined the marketing mix as controllable variables that an organization can co-ordinate to satisfy its target market.

Kotler and Armstrong (1989) defined the marketing mix as the set of controllable marketing variables that the firm uses to produce the response it wants in the target market. However, several researchers have highlighted flaws in the traditional 4P marketing mix. Early on, Kent (1986) argued that the 4Ps framework given by McCarthy was weak and too simplistic to be applied in a practical scenario.

As the criticism of the 4Ps continued, Rafiq and Ahmed (1995) contended that there is a high degree of dissatisfaction with the 4Ps framework in the researcher community. One of the criticisms of the 4Ps framework was that a customer typically experiences the effect of each of the 4Ps individually in different situations (Jain, 2009), and hence an integrated framework which is unable to transcend the theoretical boundary may not be useful unless the organizations take pains to fully integrate their marketing activities internally (Constantinides, 2006). It was also criticized for being overtly production-oriented, which often ignored the customers (Popovic, 2006; Goi, 2009). The inability of the traditional marketing mix to represent service marketing was also brought up because it was derived from manufacturing companies (Shostack, 1977).

The most stringent criticism of the 4Ps framework of marketing mix came from the service marketing researchers. Service marketing is considered to be different from products due to its four inherent characteristics – intangibility, heterogeneity, inseparability, and perishability (Berry, 1984), and the 4Ps framework was argued to be inadequate for service marketing (Shostack, 1977; Goi, 2009). Services required a different and more exhaustive marketing mix framework (Booms and Bitner, 1981a), and hence, appreciating its differences from products, the researchers demonstrated the importance of three more factors that were left out of the 4Ps.

These were: Physical Evidence, People (personnel and customers), and the Process of service delivery. With these additions, Service Marketing Mix (Extended Marketing Mix) was brought to the fore with focus on services. However, despite general support for the 7Ps mix, the new variables added have not been accepted as

is by most researchers. The physical evidence variable is the least accepted one and is often blamed for the lack of conceptualization (Rafiq and Ahmed, 1995). More recently, Moller (2006) questioned the relevance of the basic premise on which the marketing mix is built, especially in the contemporary context. She further argued that the evolution of marketing mix into something relevant for the current practitioners is critical, and research scholars must put their hat in the game to accept and discover the most relevant foundation of the influencer but traditional marketing mix. Service marketing and electronics marketing, which is based on the Internet as a medium, are cited as areas where the marketing mix seems to be lacking the real application (Constantinides, 2006). This has been further reinforced by two key weaknesses of the traditional mix, its internal orientation and the missing case on personalization. Both of these weaknesses are critical from the current new-age services point of view. These views were also echoed in more recent literature too albeit with different perspectives (Martin, 2009; Bruin-Reynolds, Roberts-Lombard, and Meyer, 2015; Londhe, 2014).

4. Limitation of Existing Marketing Mix Frameworks for Internet-Based Services

Internet-based services have a different process and value landscape as compared to traditional products and services. These services are based on the promise of offering convenience, flexibility, and control to customers. They have unconventional business models, innovative payment structure, high and constant engagement with customers, the concept of value co-creation, and all of this bundled in a technology package (Panwar and Khan, 2020a). The solution offering of the Internet-based service is not just the core product or service but also the ease of access and simplified process adding value to the customers while also empowering them in the process. In the case of Internet-based services, the service is not a single offering but a set of primary and tertiary benefits offered to customers. For example, the food aggregator Zomato does not necessarily offer a different end product, i.e. food, but it offers ease of access to an ordering while providing an exhaustive menu. The food is also guaranteed to reach the customer within 30-45 minutes.

Customers also have access to the rating system on the app, which creates trust among the customers. Customers are delivered food prepared by their restaurant partners through delivery partners. So, what was the product or service here? It is a combination of food, ease of access, convenience, trust, speed, and choices. It is not any one but all of them together. Similarly, the "place" variable under the marketing mix is not a different variable anymore. The ease of access provided by the Internet-based service through its platform or omni-channel set-up itself is the offering.

The "promotion" element under the traditional marketing mix is often explained as being the communication pillar. Goi (2011) argued that promotion is a vital part of a business and is an integral ingredient of the overall marketing process.

Traditionally, communication was considered important as it helped disseminate information to the target audience to persuade them about the offering (Kumar and Patra, 2017). However, the boundary for "promotion" in the marketing mix is too restrictive for the Internet-based services. Customers of Internet-based services are technology natives and communicate on multiple platforms with multiple services. Due to this exposure, their involvement in the services and propensity to react to a specific service experience is high. Add to that the personalization that the customers expect in the communications that the brand is directing to them.

With multiple customer-to-customer platforms, the company's service quality expectation is as much created by its explicit communication, which is controllable, as it is by the external factors such as e-WOM (electronic word of mouth), which is uncontrollable. The traditional "promotion" element is also restrictive in explaining the social cause effect on the young customers who find social causes powerful and important (Schaeffer, 2019). These are implicit signals which a service provider relays to the customers as part of its communication.

These consumers have been described as existential, less responsive to traditional marketing stimuli, and less sensitive to brands and marketing cues (Constantinides, 2006). Similarly, the "process" variable is not separate for these consumers. A process that reflects convenience is the part of a service offering in itself. For instance, consumer convenience has been given insufficient attention in services and is often bundled for services and goods together into an overall convenience construct (Berry, Seiders, Grewal, and Dhruv, 2002) even when it is a component of service quality perception.

This in itself is a result of overall service experience (Chang, Chen, Pang, Chen, and Yene, 2013). As mentioned earlier, "Physical evidence" has not been accepted unanimously as the seventh "P" of the extended marketing mix. With Internet-based services, the physical evidence is not as distinct and isolated as it was in traditional services such as bank branches or classrooms. Physical evidence is either minimal or tightly integrated with the service itself. "People" has been identified as one of the most important variables of the service marketing mix by multiple researchers (Bettencourt and Gwinner, 1996; Zomerdijk and Voss, 2010).

However, in the case of Internet-based services, frontline workers or people, for example, delivery partners for Swiggy or driving partners of Uber, are part of the service offering itself. The partner rating system has integrated these partners into the overall service offering.

So, these partners are not just the ones who provide the service, but they are the service. Today's services are hence a bundle of offerings, including,

but not limited to, core products. One of the important variables of marketing mix frameworks has been "price" at which the product or service is offered to the customer. Internet-based services usually have a complex pricing structure that is used to attract customers. The pricing structure implemented by these services is often different from traditional services' pricing structure, which is based on traditional models like "cost-plus". Internet-based services have more complex decisions to make on pricing than the traditional service's singularly focused questions – "At what price should I sell to make enough profit?" (Evans and Schmalensee, 2016).

These could be related to value definition, partner pricing, bundling, etc. The influence of price perception on consumer behaviour (Liao, Tsou, and Shu, 2008) makes such divergences critical to be analysed differently than the traditional services. Traditional marketing mix frameworks are restricted to pricing and its attributes such as discounts, credit limit, payment timeline, etc. Internet-based services need a more nuanced discussion on the payment structures and their connection with pre-defined marketing objectives.

The global wave of the rise of individualism over collectivism has also played its part. The influence of family or other types of reference groups on the new consumer's behaviour is changing or diminishing (Christopher, 1989). Additionally, the knowledge and sophistication of customers are also increasing due to the easy availability of information online, which makes the new-age consumer quite discerning. Customers appreciate a direct dialogue with the companies and brands, seeing one-sided communication as useless and often frustrating. Also, Internet-based services need to be available for customers at various platforms and at all times.

Traditional mass-market approaches, including the marketing mix frameworks, have to be questioned for their relevance for the Internet-based services (Constantinides, 2006). While the traditional service marketing mix framework falls short of appreciating the above factors, the definition of what a marketing mix framework should do remains the same. It continues to be a set of controllable marketing variables available with a firm to work upon and satisfy its target market needs (Kotler and Armstrong, 1989).

We have argued in this section that there exist knowledge gaps as well as a theoretical gap in the subject matter for the Internet-based service, as far as the marketing mix framework for the Internet-based services is concerned. With the help of a comprehensive literature review on the origins, adoption, limitations, and expectations of marketing mix frameworks, we now propose a marketing mix framework that can address the challenges manifested by Internet-based services. The framework encompasses the key controllable variables that an Internet-based service business has at its disposal to meet its marketing objectives.

5. SAFE – A Marketing Mix Framework for the Internet-Based Services

In this section, we propose a conceptual framework, SAFE, as a marketing mix framework specific to Internet-based services, as depicted in *Figure 1*. The SAFE framework is based on a holistic approach that incorporates the internal business and external service-scape aspects of Internet-based services. Thus, it transcends the traditional boundaries set for such a framework and allows the marketing function to be managed as a more holistic management function. However, the end result and application objectives of the framework lay centrally in the marketing domain with customers as the core. The model is based on a foundation that answers the below questions:

- What is on offer to satisfy customer needs?
- What core superiority does the organization possess internally over its competitors?
- How does the firm reduce friction towards adoption and payment for its services?
- How does the organization engage with its customers during their customer journey?

With these questions, SAFE lays down the foundation of a 360-degree framework that touches all aspects of an Internet-based service from the service point of view.

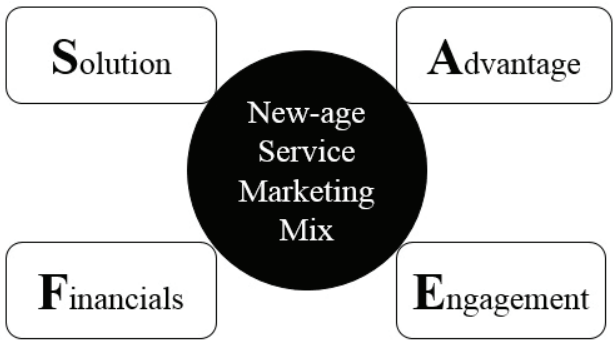

Figure 1. *SAFE Model for Internet-based Services*

The SAFE framework stands on the following pillars and their underlying constructs (elements) that businesses should manage to achieve their marketing objectives:

Solution

Customers look at brands and organizations to solve their problems or satisfy an unmet need. Brands in turn create and offer services that would encourage the customers to access and acquire the service. However, seldom is service experience a factor of the core service offering only. A service experience is the sum total of all experiences that the customer had while accessing and acquiring a service. Solution hence should not be looked at with the narrow view of the service offering, which seems to be the single deed or performance but in reality is a spectrum of aspects associated with the solution. Internet-based services have a large number of parameters under the "Solution" umbrella, as depicted in *Figure 2*. These are: Core Offering, Customization, Partners, Phygital Integration, Ease of Access, and Efficiency.

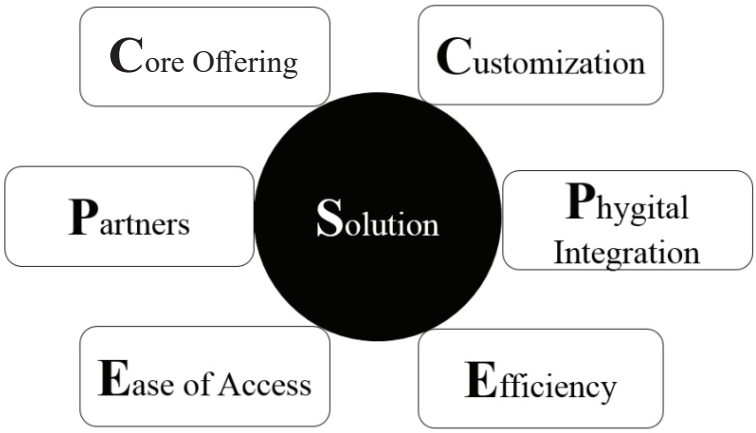

Figure 2. *"Solution" pillar of the SAFE framework*

Core Offering – The most easily identifiable element under "Solution" is the core solution that the firm provides to its customers. Firms that have a solution that is best suited for solving the given customer's problem, with an appropriate level of standardization as well as required customization, is appreciated by the customers. Core offering is also the one that defines the outcome quality of the service experience that the customer ends up having in the service set-up. While there are peripheries of other elements that define service experience, the core offering remains to be the most critical one.

Customization – It often leads to a positive evaluation of service by the customer if it is relevant and the customer is involved in the process (Mugge, Brunel, and

Schoormans, 2012). Customization can create short-term as well as well as long-term preference for the brand if the customers find the customization relevant and impactful (Coelho and Henseler, 2012).

Phygital Integration – The core solution offered by some new-age services is also about the integration of the physical and digital parts of the service. Phygital (physical + digital) refers to a blend of physical and digital aspects of services that cover the access as well as delivery of a service. Lenskart's physical stores, which were an extension from its online setup, helped customers not just as a new access point but also to double up as a physical store that conveyed the brand offering and promise more visually. The eye-testing facility acted as an additional service to the otherwise simplistic eyewear delivery business. Nykaa.com did the same with its new offline stores doubling up as experience stores to enhance the overall service experience with the brand touch points. As mentioned, these stores are as much part of the solution as is the delivery of the product or service.

Efficiency – It is at play in Internet-based services in two scenarios. First, when it is about the efficient use of resources that a firm possesses. Such efficiency allows the service firm to improve its cost-revenue equation, thus leading to higher profitability (Zanakis, Mandakovic, Gupta, Sahay, and Hong, 1995; Gerrard, 2005). The second application of efficiency is in the service delivery aspect, where efficiency in service operation is closely tied to marketing objectives such as customer satisfaction, brand preference, brand loyalty, and profitability.

This has been discussed for Internet-based service companies such as Airbnb and Uber (Oral and Yolalan, 1990; Edelman and Geradin, 2016; Cramer and Krueger, 2016). Service delivery efficiency also includes "access efficiency", which has to do with the app launch parameters such as launch time and launch features. One reason for people preferring apps for service access instead of a website is the time it takes to launch a service on the phone.

Datta and Kajanan (2013) argued that time taken by an app service to launch on a phone has an impact on how easily the app can penetrate in its target audience and how fast the adoption is. Efficient service delivery thus plays a critical role in the positive perception of a solution.

Ease of Access – It has helped services penetrate better in the markets with high acceptability and adoption rate. The solution thus is not just the service but also the ease with which the service is accessed. The personal credit category has exploded in recent times, and while the interest rate is no more a differentiating factor, the solution is not just a loan anymore. The solution is the ease (Indian Express, 2020) and the speed with which a loan can be secured. Thus, ease offered by a platform to access service is critical for the customers.

So, Byju's has been able to reach 50 million users, out of which 3.5 million paid users, not only because it has great content but also because it is easy for users to access the application (Rawat, 2020). The platform is both what is called frictionless and sticky. So, for example, Byju's free "Live Classes" hosted on its platform are not only lapped up for its content worthiness but also because the platform can be accessed and navigated through easily (Mitter, 2020).

Partners – The solution is also about service workers. This is different from the "people" aspect of the extended marketing mix because the "people" variable was isolated from the "product" variable. In Internet-based services, the service worker is as much a solution as the offered service.

For example, for the same pick-up and drop service which will be offered by Uber, it is not uncommon for customers to cancel a ride which had a driving partner with a poor rating (Mahapatra and Telukoti, 2018; Rutkin, 2016). Frontline employees have long been argued to be drivers leading to customer loyalty and have a strong role in creating customer loyalty towards the service firm (Bettencourt and Gwinner, 1996). Also since the service employee's part is the manual aspect of service, it is often during this interaction that the service customization can happen fairly easily (Gwinner, Bitner, Brown, and Kumar, 2005). Employees and partners must be empowered to add customization in the service as per their judgment to delight customers.

Merchants who accept the Paytm wallet for payment are part of this service-scape. So, a customer can pay by Paytm for the milk or groceries or even at a salon. For a customer, it is important to have a wide variety of merchants who would accept Paytm in order for him/her to see reasons for having a Paytm account him-/herself. Similarly, more merchants will only be interested in facilitating payments from Paytm when many customers would want to use that. These are known as network effects, as explained by Evans and Schmalensee (2016).

Advantage

The sweeping rise of Internet-based services means that having a natural advantage through certain core competencies is critical for differentiation against the competition. Aaker (1989) argued that competitive advantage is an outcome of the bases of competition, which are assets and skills that the firm possesses. In the case of new-age services, Advantage is based on Resources, Asset ownership, Skills, and Experience, as depicted in *Figure 3*.

Resources – Access to superior resources that are critical to business play a differentiating role for an Internet-based service. For example, access to easy and inexpensive funds (Gill, 2019), technological excellence (BGR, 2018), a vast integrated network of multiple products and services (Robischon, 2017), or even access to

huge tranches of data (Rodriguez, 2020) are some of the resources that could be very helpful for Internet-based services to exercise superiority over the competition.

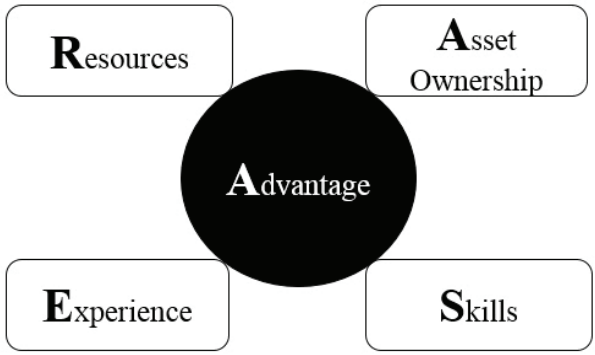

Figure 3. *"Advantage" pillar of the SAFE framework*

Asset Ownership – It is the firm's business model that determines the nature of these assets and their ownership. For example, a firm can decide to adopt an asset-light mode like Uber where it does not own any fixed high-value assets. On the other hand, firms may also opt for owning the inventory of the product that they sell, for example, Lenskart. Some other firms opt for a hybrid model where they own part inventory only, such as Nykaa.com. Often the choice of owning an asset is driven by cost rationale or when the service provider believes that it can offer more efficient services with or without the ownership of those services.

For example, while Byju's owns its content, Oyo simply acquires the maintenance right of part of the hotel to keep the costs low and still offer efficient services. The advantage is exploited by firms in a way that would help them be differentiated from their competitors. For example, content ownership of online streaming platforms has become a differentiating resource for platforms, and the success of an online video streaming platform depends upon the pipeline of the content that it can own or create in the future. The online streaming platform war can simply be called content ownership war because that is what would decide the winner (Statt, 2019).

Skills – Barney (1991) argued that the advantage that a firm holds due to a resource or asset need not be a permanent one if the resource is not valuable, rare, inimitable, and organized. So, the mere availability of a resource of advantage is not enough, but its being valuable, rare, and inimitable is important. Likewise, the firm being organized or capable enough to exploit this source effectively also plays a crucial role. Hence, the presence of skills in an organization, which can be used to extract advantage from the available resources, is equally important.

Experience – However, it may happen that despite the availability of resources and requisite skills the service firm is unable to create any sort of advantage. This may be because there has not been any precedent for the firm to follow and implement. Thus, experience to turn these sources and positions of advantage into a real advantage over competitors is critical.

Finally, the advantage accumulated by firms by choosing to control certain assets can go a long way in achieving its marketing objectives. With the cost or differentiation advantage achieved due to asset ownership decisions, firms can then follow one or more goals such as market penetration, market dominance, low-cost leadership, or higher profitability.

Financials

It is often argued that firms must take aggressive financial decisions, including that of pricing strategies, since customer's decision to patronize a service is a factor of the price of the service (He, Cheng, Dong, and Wang, 2016). For Internet-based services, the pricing strategy is not based on a simple exchange of possession (service effort with money) but is made more complex with various uncommon pricing objectives.

These are driven by market penetration constraints due to the novel nature of services and lack of trust in these services by the customers because of a lack of human touch and missing visual identity. To overcome this handicap, Internet-based services often adopt novel pricing structures and techniques to win customer trust, for example: Customized pricing, "Buying" customers, Demand- and supply-side pricing, and Dynamic pricing, as depicted in *Figure 4*.

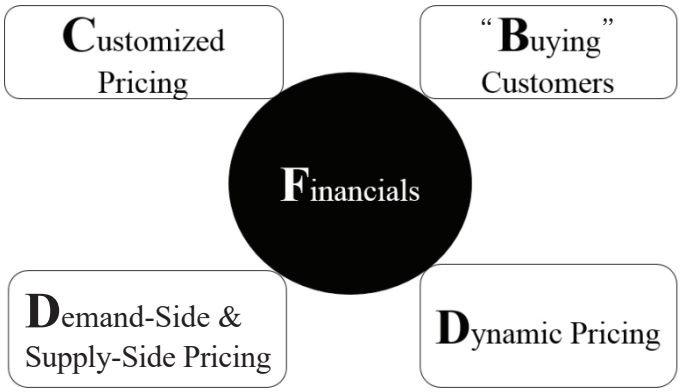

Figure 4. *"Financials" pillar of the SAFE framework*

Customized Pricing – Pricing strategies and pricing structures for Internet-based services aim at establishing an optimum price for services with novel payment conditions where the end-goal is seldom the profit maximization, unlike with most traditional services and products (Dolgui and Proth, 2010).

Some of the Internet-based pricing techniques to instil confidence in customers are freemium and subscription-based pricing. This means offering services to customers at a lower price for a limited time or for free for a limited period (usually for a month) or by reducing the commitment level required from the customer for acquiring the service (subscription-based).

Buying Customers – Customers are often "bought" by offering them a monetary benefit (cash back or coupon) for adopting the service and using it (usually done by payment wallets like Paytm and Google Pay). Additionally, once the consumer is on board, these services try to enhance the relationship by offering a price that would be acceptable for the individual customer.

The prospect theory suggests that once customers have agreed to spend a certain amount of money, getting them to spend more is much easier than one would think (Shoemaker, 2003). Yearly packages for service users are offered to existing customers to ensure customer retention as well as a stable revenue stream for the service provider. Zomato Gold is one such service where patrons are offered special prices and packages at partner restaurants. The service is valid for one year after buying the "Zomato Gold" scheme (Sengupta, 2019).

Dynamic Pricing – Internet-based services also try to create a free marketing pricing-scape for its services through dynamic pricing by leaving the pricing to the market supply-demand dynamics. For example, through "rush-hour pricing" or "surge pricing", Uber offers its customers different prices at different hours of the day depending upon the demand-supply equation. This not only allows the customer to take advantage of lower demand by accessing services at a lower price but also allows the firm to take advantage of higher demand, thus crafting a win-win strategy for both. Castillo et al. (2017) contended that surge pricing can prevent demand-/supply-constrained service markets like the cab-hailing service market from crippling.

Multi-Sided Platform Pricing – As another aspect of pricing strategies, multi-sided platforms (MSPs) are specific of Internet-based services, as highlighted by Evans and Schmalensee (2016). MSPs are service platforms that bring together two sets of customers on board.

On the one hand, there are the demand-side customers, that is, people who need a service, and, on the other, the supply-side customers, i.e. people who want to sell their services. For example, restaurants are the supply-side customers for Zomato, while the patrons who order food are the demand-side customers. MSPs

follow different financial models, wherein they have to balance the two sides of customers through the right pricing.

Hagiu (2015) argued that MSPs have to offer their services either for free or at a subsidized price to at least one side of the platform (loss leader side) and derive their profits on the other side (profit-making side). For example, payment systems, such as VISA, that have merchants on one side of the platform and customers on the other choose to subsidize the customers, making them the loss leader side. In turn, they make a profit from the merchants, making them the profit-making side (Evans and Schmalensee, 2016). The same is also true for social media platforms where the platform does not charge the customer, making the service free for the customers, while making money from the advertisers who show their ads to these customers on the platforms – for example, Facebook.

Engagement

The Internet has democratized access to information and knowledge. This means that customers who are looking to acquire a service are already exposed to a great deal of information and are not necessarily dependent upon communication from the service provider to know more about the service. Also, customers and target audiences of new-age services are usually people from the Gen. Y and Gen. Z age groups, who have a higher propensity for dialogue instead of a one-way messaging which was a traditional form of communication. Internet-based services have access to the following elements of the "Engagement" pillar to enhance positive engagement with the customers: C-2-C communication, Personalized conversations, Social-cause-based engagement, Social listening, and Rewards and recognitions, as depicted in *Figure 5*.

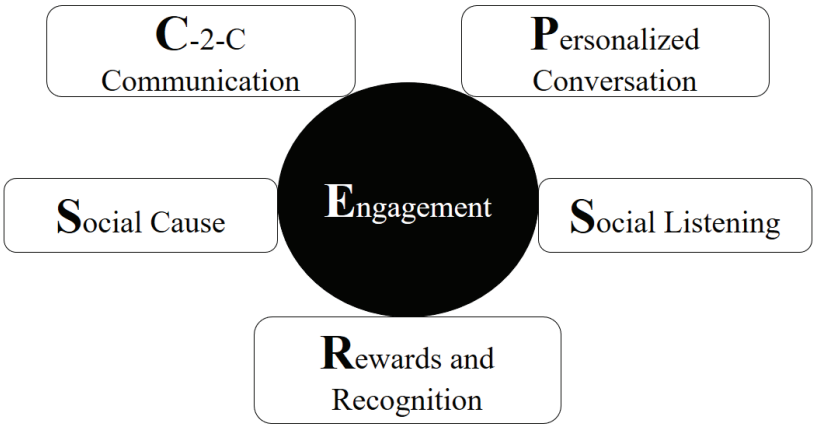

Figure 5. *"Engagement" pillar of the SAFE framework*

C-2-C Communication – Customers are talking to other customers as well as potential customers about the services, with service providers missing from the conversation. There are a host of platforms available to customers to talk about service before, during, or after using it – for example, social media platforms, review websites, and other web forums. Service firms must encourage such customer-to-customer conversations and add value to them wherever they can.

This makes it imperative for the service providers to engage customers on all possible platforms to forge a positive relationship. These customers would in turn spread positive word of mouth about the service on all platforms they engage on, irrespective of the presence of the service provider on these.

Personalized Conversation – Personalization is a critical part of engagement for Internet-based services. Customers of these services are hardly moved by communication tone, ideas, and messages that are not specific or relevant to them. These services must attempt to personalize communication with the help of insights they have about their customers. Goldsmith (1999) argued that personalization has to be part of the new marketing design process for all organizations. By opening a dialogue with customers, service providers can engage with their target audience better, which can also lead to unearthing useful information about consumer needs to help in developing newer products and services (Goldsmith, 1999).

Marketers must be able to identify the right medium and message to reach out to this customer cohort. Traditionally, when the objective of the "Promotion" element was to communicate, these details were often overlooked. Social media sites have become an important part of "millennial" life. Social media is instrumental in assisting consumers in making decisions about what product to buy, when to buy, and where to buy (Weigand, 2009). Internet-based services are modelled to engage with customers and also encourage them to share their experiences and advocate these services. This also manages the trust aspect, as potential customers are more trusting of reviews and endorsement by fellow customers than marketing communication by the service provider itself.

Rewards and Recognition – Khan Academy offers rewards to its users upon solving certain questions or groups of questions (Zellner, 2015). Similar patterns are observed across most new-age services. The associated reward function here is the ability to share these certificates online with your friends and peer, which makes it lucrative for people (Panwar and Khan, 2020a).

While rewards and recognitions have been known to motivate customers for one-time as well as repeat purchase, the large-scale imitation of this strategy by a lot of organizations has diluted the efficacy of such rewards and recognition (Sällberg, 2010).

Social Listening – As a communication strategy, it is important for Internet-based services. This is because a majority of their customers are active on social media due to the presence of a major chunk of target audience on social media, and they often discuss about brands within their relationship networks on social media (Panwar and Khan, 2020b).

Organizations must equip themselves with various skills to be part of these customer conversations and make them more effective and engaging. Stewart and Arnold (2016) defined social listening as "an active process of attending to, observing, interpreting, and responding to a variety of stimuli". Crawford (2009) argued that social listening is not a stand-alone strategy but an embedded part of the overall communication strategy. These services must encourage conversations about the service and its strengths.

Social Cause Association – It can play a critical role in creating higher engagement between service providers and customers. This is especially true for customers of Internet-based services, which happen to be Internet natives, i.e. millennials and members of Gen Z. These customers do not hide their inclination towards a particular social cause and often judge organizations based on their stance on a specific social cause (Schaeffer, 2019). Thus, engagement created around a social cause is a strong non-service source for the association that a customer can have with the service provider.

6. Conclusions and Discussion

The marketing mix has been a key element in the overall marketing strategy for any firm for decades. It acts as a direction as well as a framework for firms to achieve their marketing objectives. As the business landscape has changed over the decades, led by the change in consumer behaviour and expectations, the marketing mix has evolved too. From the 12-element marketing mix offered by Borden (1964) to the 4Ps of marketing mix postulated by McCarthy (1964) and the extended service marketing mix given by Booms and Bitner (1981a), the marketing mix framework has evolved together with the evolution of the product and services. These frameworks have had their share of criticism from researchers, especially from the service domain (Vargo and Lusch, 2004a; Constantinides, 2006; Jain, 2009; Popovic, 2006), who argued that the overt product inclination of marketing mix lays bare its inadequacy to handle services.

The advent of the Internet saw a wave of Internet-based services that were operated and delivered with Internet and technology at their core. The evolution of these services further strengthens the need to build marketing frameworks, including the marketing mix, which can handle the services more efficiently. The

SAFE framework proposed in this paper takes into consideration the changing nature of services and consumer expectations, specific to the new-age services as defined in this paper. Internet-based services are based on the promise of offering convenience, flexibility, and control to customers. They have unconventional business models, innovative payment structure, constant engagement with customers, and a concept of value co-creation with customers. The overall package is delivered through a strong core of Internet-based functionality. In this paper, Internet-based services have been defined as services accessed via the Internet and that may have a physical presence only as a secondary platform.

It must, however, be noted that SAFE does not attempt to change the core objective of the marketing mix. SAFE is positioned as a marketing mix framework aimed to help service managers with controllable elements within the organization, specifically for the Internet-based services. Thus, the framework can extend support to service firms in achieving their pre-defined marketing objectives. SAFE defines four pillars that service organizations can work on to achieve their marketing objectives. These are: Solution, Advantages, Financials, and Engagement. The "Solution" aspect of SAFE looks at solution as a spectrum of offerings and not just the core service. Hence, it touches upon aspects such as customization, partners, ease of access, efficiency, and phygital (physical and digital) integration, with the core offering as one of the elements of the overall solution. "Advantage" looks at four elements that are manageable from the organization's point of view and can hand over an advantage to the organization if managed efficiently. These are resources, assets, skills, and experience. Hence, managers must remain true to the value offering of Internet-based services, not just in ensuring convenience yet efficiency but also in striving to develop their own assets and skills in doing that.

Internet-based services have very complex pricing structures, which they use to attract customers, build a customer base, and reach as many people as possible. Customized pricing, customer acquisition with the help of upfront benefits, demand- and supply-side pricing decisions in case of multi-platforms in these services, and dynamic pricing are key tenets of the third pillar of SAFE, "Financials". The fourth pillar, "Engagement'", is defined under SAFE as a set of engagement strategies that the service organization can adopt for building a long-term association with the customers. Some of these strategies, such as C2C and personalized communication, social listening, and rewards and recognition, are proven to have an enduring effect on the target group.

Thus, while SAFE offers a guiding framework for services in its marketing mix for new-age services, it also offers an exhaustive list of elements under each of the pillars of the SAFE framework for service managers. It must, however, be noted that a strategy is as good as its implementation. So, while SAFE provides an excellent framework for marketing mix for Internet-based services, if the structure and capabilities to use these elements to the firm's advantage are not present, it will not lead to desired results.

7. Limitations and Scope for Future Research

This paper has certain limitations that are important to highlight for the readers' benefit. This research is purely conceptual in nature, which is based on an exhaustive literature review of a range of studies available within the service marketing literature, which spans several decades. However, the proposed model has not been tested empirically, and no primary research was conducted for this research. Thus, as a future scope of work of this paper, the relevance of the SAFE framework must be proved with the help of empirical research. Further, it would be worthwhile to see the application of the framework on different Internet-based services in order to measure divergences, if any, within them upon the adoption of this framework. Finally, this research paper is expected to spur further academic research on the lines of evolution of existing marketing frameworks, which need a relook in terms of their relevance, efficacy, and applicability in the real world.

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Asset Allocation Strategies Using Covariance Matrix Estimators

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Abstract. The covariance matrix is an important element of many asset allocation strategies. The widely used sample covariance matrix estimator is unstable especially when the number of time observations is small and the number of assets is large or when high-dimensional data is involved in the computation. In this study, we focus on the most important estimators that are applied on a group of Markowitz-type strategies and also on a recently introduced method based on hierarchical tree clustering. The performance tests of the portfolio strategies using different covariance matrix estimators rely on the out-of-sample characteristics of synthetic and real stock data.

Keywords: portfolio optimization, covariance matrix estimators

JEL Classification: G11, C61

1. Introduction

Portfolio optimization is the process of selecting the best possible allocation among certain assets (e.g. individual stocks, asset classes, bonds, cash) according to some specific objective such as risk minimization, return, risk-adjusted return, diversification maximization, and so on. Asset allocation is generally a challenging task due to a lot of factors that can influence the results. The outcome may be influenced by the investment period and asset universe, by the risk tolerance of the investor, and so on.

Henry Markowitz (1952) revolutionized the portfolio optimization by considering the expected return and standard deviation as the key components for quantifying an asset return and risk. This theory formulates portfolio construction as a quadratic optimization problem, where the goal is to maximize return for risk, or equivalently, minimize risk for a given level of expected return. Although the Markowitz model is theoretically sound and has a major impact on portfolio research, its application

in real-life situations is challenging. Practically, the researcher or the portfolio manager should estimate the unknown expected value and variance of the returns of the securities in order to apply them in the model. The risk and return are usually calculated inaccurately by using the historical sample, leading to unacceptable solutions with worse out-of-sample performance. Therefore, the portfolios hold a small number of stocks with extreme weights, thus making these portfolios less diversified. Furthermore, small changes in the inputs often cause substantially modified weights in the optimal portfolio. Based on the Markowitz model, in DeMiguel et al. (2009), the constraint variant of the model was investigated. In Scutellà and Recchia (2013), a slightly different approach was proposed based on robust optimization.

Tremendous efforts have been devoted by the researchers to handle estimation errors to improve the performance of the Markowitz model. Considering the estimation errors, the literature on the portfolio selection problem has been extended in several directions. Jorin (1986) proposed shrinkage estimator for expected returns. This kind of estimator usually shrinks the sample estimate towards some average value. Ledoit and Wolf (2003, 2004) presented a transformation procedure of the empirical covariance matrix called shrinkage. Another approach to reducing the risk estimate is to denoise (Bun, Bouchaud, and Potters 2017; López de Prado, 2020) the sample covariance matrix. The denoising procedure eliminates those eigenvalues of the covariance matrix that are affected by noise. Michaud (1998) tries to overcome the uncertainty associated with the estimated parameters using a technique called resampling. A detailed comparison of the Michaud and Markowitz strategies can be followed in Becker, Gürtler, and Hibbeln (2015). The subset resampling (Gillen, 2016; Shen and Wang, 2017) method tries to improve Michaud's algorithm by sampling subset-size portfolios. Recently, the Hierarchical Risk Parity (HRP) by López Prado (2017) has received substantial attention. The method calculates the covariance matrix by hierarchical clustering and avoids the matrix inversion procedure.

In this paper, we analyse the effects of covariance matrix estimators that are applied on a group of Markowitz-type strategies and a recently introduced method based on hierarchical tree clustering. The performance tests of the portfolio strategies using different estimators rely on the out-of-sample characteristics of synthetic and real stock data.

The paper is structured as follows. In Section 2, we review the mean-variance model and its special variant, the minimum variance optimization model. Furthermore, we describe the covariance matrix estimators examined in this study and the reference strategies as well. In Section 3, we conduct two experiments: at first, the three Markowitz-type algorithms are assessed using a Monte Carlo experiment with synthetic data, while in the second experiment all the methods are compared based on the S&P 100 stocks data. Finally, Section 5 concludes.

2. The Mean-Variance Optimization Model

Markowitz formulated his portfolio allocation model as a quadratic optimization problem called mean-variance optimization (MVO). According to this formulation for each level of expected return, the portfolio with the smallest variance is preferable. If the return constraints are omitted from the previous model, we get the global minimum variance or simply the minimum variance portfolio (MV). This approach is popular among researchers since the covariance matrix estimation induces a smaller estimation error than the return estimation.

For a given N risky assets, the minimum variance strategy can be defined as:

$$\min_{\mathbf{w}\geq\mathbf{0}} \mathbf{w}^{\mathrm{T}}\sum\boldsymbol{w} \text{ subject to } \boldsymbol{w}^{\mathrm{T}}1 = 1,$$

where $\mathbf{w} = (w_{t1}, w_{t2}, \ldots, w_{tN})^{\mathrm{T}}$ represents the portfolio weights at time $t = 1, \ldots, T$, while $\sum$ denotes the covariance matrix. Usually, the real covariance matrix is unknown, hence requiring a suitable estimator.

2.1 Covariance Matrix Estimators

The covariance matrix is an important element of many asset allocation strategies. The widely used empirical covariance matrix estimator is unstable, especially when the number of assets (N) is larger than the time observations (T). Furthermore, during the mean-variance optimization, the covariance matrix inverting procedure amplifies the noise and numerical instability. In the following, we present three covariance matrix estimators assessed during our experiments. A more detailed description of covariance matrix estimators can be followed in Senneret et al. (2016) and Choi, Lim, and Choi (2019).

The Sample Covariance Estimate

The sample covariance matrix for N assets with return r_t can be formulated as follows:

$$\widehat{\sum}^{S} := \frac{1}{T}\sum_{t=1}^{T}(\mathbf{r}_t - \boldsymbol{\mu})\,(\mathbf{r}_t - \boldsymbol{\mu})^{\mathrm{T}},$$

where $\boldsymbol{\mu} = \frac{1}{T}\sum_{t=1}^{T}\mathbf{r}_t$ is the expected return.

Ledoit–Wolf Linear Shrinkage Estimator

Shrinkage is a transformation procedure of the sample covariance matrix adopted in order to get a more robust covariance matrix. The linear shrinkage estimator

proposed by Ledoit and Wolf (2004) combines the sample covariance matrix with the identity matrix. An important ingredient of shrinkage is the shrinkage intensity, which has a weighting role in the procedure. The Ledoit–Wolf estimator is defined by

$$\widehat{\sum}^{LS} := (1-\alpha)\widehat{\sum}^{S} + \alpha \frac{\mathrm{tr}[\widehat{\sum}^{S}]}{N}\mathbf{I},$$

where the optimal shrinkage intensity $\alpha \in [0,1]$ is chosen to minimize some risk function. A nonlinear variant of the shrinkage estimator is proposed by Ledoit and Wolf (2012). Furthermore, the nonlinear shrinkage estimator is combined with the composite likelihood method and applied to some special models (see Engle, Ledoit, and Wolf, 2019).

Denoising Covariance Matrix

Cleaning large-dimensional covariance matrices is a common task in different research areas as finance, physics, or multivariate statistics. Recently, some interesting works (see, for example: Bouchaud and Potters, 2011; Bun, Bouchaud, and Potters, 2017) have been conducted to find more robust covariance estimators. These experiments are usually relying on tools from Random Matrix Theory (RMT) in order to distinguish the signal part from the noisy part of the covariance matrix. More concretely, the cleaning process relies on correcting the eigenvalues of the covariance matrix by using the Marcenko–Pastur distribution.

Bouchaud and Potters (2011) proposed a cleaning procedure (eigenvalues clipping) where all eigenvalues below some threshold value are shrunk. Furthermore, Bun, Bouchaud, and Potters (2017) investigated a rotationally invariant estimator with promising results.

In this study, we apply a Targeted Shrinkage Denoising procedure (López de Prado, 2020) to the sample covariance matrix. Basically, this implementation is based on the clipping procedure proposed by Bouchaud and Potters (2011).

2.2 Reference Algorithms

In this subsection, we review the portfolio allocation methods considered in this study. The starting point of our comparisons is represented by the previously presented minimum-variance algorithm. The assessments also include two bootstrapped variants of the minimum-variance method and a recently proposed strategy that follows a slightly different approach than the others. The main subject of the investigations is how these algorithms perform using the different covariance matrix estimators.

Resampling Method

Michaud (1998) proposed the resampling (RES) method in order to overcome the instability of the estimated parameters of the mean-variance optimization method by applying Monte Carlo simulations during the portfolio construction process. The algorithm generates random resamples of asset returns based on the historical data by considering all securities simultaneously. For each of the resample, the optimal weights of mean-variance portfolio are computed, aggregating across all the samples by averaging the optimized weights. As a result, the obtained portfolio has less extreme final compositions and is well-diversified.

Subset Resampling

The subset resampling (SRES) procedure is a recently proposed (Gillen, 2016; Shen and Wang, 2017) variant of the resampling method. Rather than calculating weights for all assets, subset resampling constructs portfolios considering a smaller number of assets. By aggregating a sufficiently large number of subset portfolios, we obtain a well-diversified portfolio. This approach may be useful when there are many securities with short return histories. The performance of the method depends a lot on the two input parameters of the algorithm: the subset size and the number of subsets. In Shen and Wang (2017), the authors conducted detailed experiments and found that the subset resampling procedure is superior to other strategies. Subset resampling has the advantage that usually the subset size is smaller than the size of the observations, hence a more stable estimation of the covariance matrix can be obtained. Applying new estimators, we hope that further improvements can be achieved.

Hierarchical Risk Parity

The Hierarchical Risk Parity (HRP) algorithm was introduced recently by López de Prado (2017) as an alternative asset allocation strategy that alleviates the main pitfalls of the general mean-variance approach. The method performs asset allocation without the need to invert the covariance matrix. Unlike the Ledoit–Wolf and denoising methods, the HRP algorithm simply reorganizes the covariance matrix to place similar assets (in terms of linear co-movements) together and then employs an inverse-variance weighting allocation. The algorithm has three main steps:

– Tree clustering: the procedure transforms recursively the correlation matrix into smaller groups considering some distance metrics.
– Quasi-diagonalization: it is a technique where the covariance matrix is rearranged in order to reflect the similarity of the securities (see *Figure 1*).

– Recursive bisection: split portfolio weights between subsets based on inverse proportion to their aggregated variances.

Portfolios generated by HRP exhibit better out-of-sample performance than other traditional portfolio allocation algorithms (López de Prado, 2017). Although the covariance matrix transformation technique seems to be efficient, a question is arising whether further improvement can be achieved by using Ledoit–Wolf or denoised covariance estimators instead of the sample estimate.

Figure 1. *Quasi-diagonalization (see PortfolioLab)*

3. Empirical Comparison

The main aim of this section is to compare the previously described strategies considering different covariance estimator techniques. At first, the three Markowitz-type algorithms are assessed using a Monte Carlo experiment with synthetic data, while in the second experiment all the methods are compared based on the S&P 100 stock data.

3.1. Monte Carlo Experiment

This experiment is based on a novel approach (Gautier Marti, 2020) for sampling realistic financial correlation matrices. The method (called CorrGAN) relies on a generative adversarial network. CorrGAN generates correlation matrices that have many "stylized facts" seen in empirical correlation matrices based on asset returns. We simulate data using a 0-mean multivariate Gaussian parameterized by CorrGAN-

generated correlation matrices with 80 stocks. An in-sample and an out-of-sample dataset of daily returns are generated based on the computed distributions. We use different observation numbers: $T = 50$, 100, and 200. The comparison methodology is based on in-sample and out-of-sample results as follows: the empirical covariance matrix is estimated by using the in-sample dataset. Then the asset allocation strategy computes the optimal weights which are further used to find the portfolio returns and their associated volatilities. The main performance metric is the portfolio volatility in- and out-of-sample.

The presented methodology is applied to the MV, RES, and SRES Markowitz-type asset allocation strategies, each of them using the following covariance estimation methods: sample estimate, Ledoit–Wolf estimator, and denoising covariance. In the case of RES, the results are averaged over 1,000 draws, while SRES used 21 as the size of the subsample and 3,000 for the subsample number. A single experiment is repeated for 1,000 generated correlation matrices, and the portfolio volatilities (in-sample and out-of-sample) are computed.

Table 1 contains the root-mean-square errors (RMSE) of volatilities of the examined methods using different covariance matrix estimators and observation numbers. Based on the results, SRES provides the best RMSE values indifferent of the sample size and covariance estimator. Obviously, the differences become smaller as the sample size increases, because the covariance matrix becomes more stable. Considering the effects of covariance estimators on the individual strategies, it can be stated that the Ledoit–Wolf approach managed in all cases to improve the results obtained by the sample estimate. On the other hand, the denoised variant provides better values than the sample estimate just using MV and RES for $T = 50$.

The distributions of the volatilities with 50 observations can be followed in *figures 2–4*. The figures also reflect the fact that the SRES is more stable than the MV and RES strategies independently of the covariance estimator.

Table 1. *RMSE for different covariance estimators and sample sizes*

Covariance estimation methods	T = 50			T = 100			T = 150		
	MV	**RES**	**SRES**	**MV**	**RES**	**SRES**	**MV**	RES	SRES
Sample estimate	0.1659	0.1449	**0.1313**	0.0987	0.0896	**0.0801**	0.0726	0.0680	**0.0622**
Ledoit–Wolf shrinkage	0.1559	0.1397	**0.1256**	0.0955	0.0878	**0.0786**	0.0713	0.0672	**0.0616**
Denoised covariance	0.1592	0.1429	**0.1339**	0.0986	0.0902	**0.0829**	0.0747	0.0698	**0.0647**

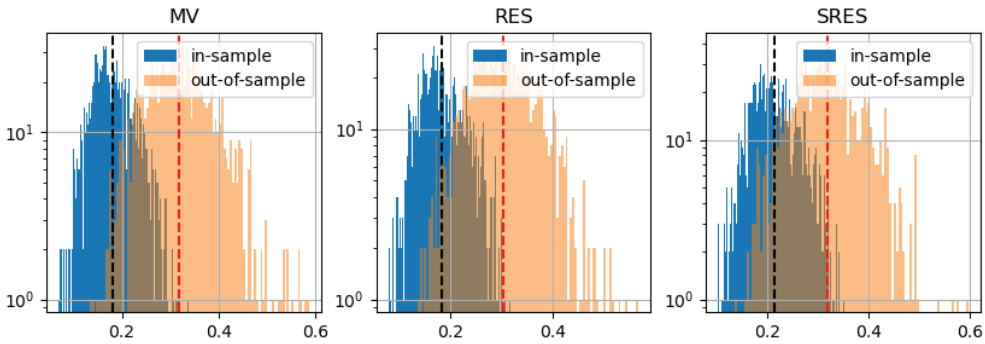

Figure 2. *Distribution of portfolio variance using the sample covariance estimator*

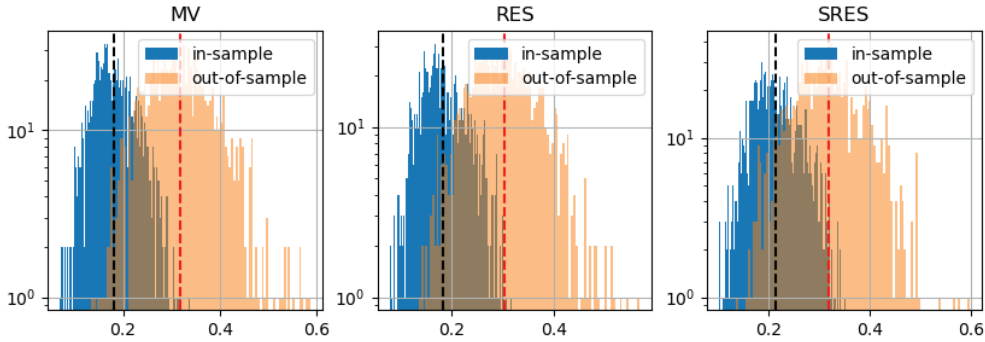

Figure 3. *Distribution of portfolio variance using the Ledoit–Wolf covariance estimator*

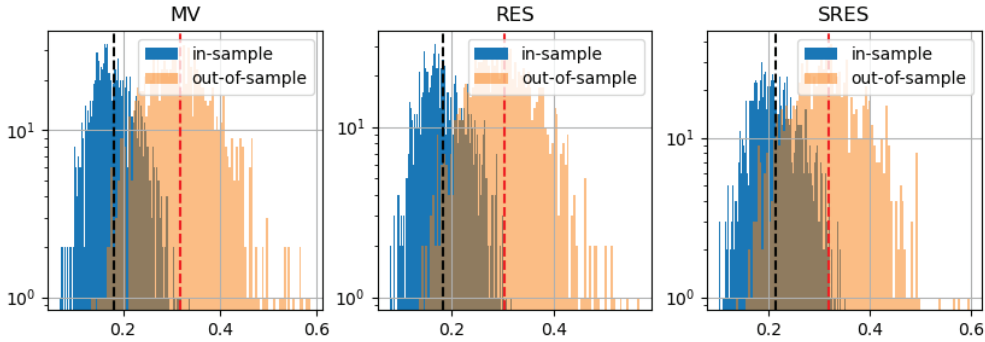

Figure 4. *Distribution of portfolio variance using the denoised covariance*

3.2. Experiments on Real Stock Data

In the following experiment, the MV, RES, SRES, and HRP asset allocation strategies are compared using different covariance matrix estimators. We provide a rolling window approach of the competitiveness of the strategies and analyse their performance on real stock data. The rolling window approach (DeMiguel, Garlappi, and Uppal, 2009) is a frequently applied procedure for performance analyses of asset allocation strategies. For a given T long dataset of asset returns, a rolling window (estimation window) of size M is chosen. The data of the first rolling window are applied to find the optimal allocation for each of the strategies. After that, the obtained weights are applied to the next period (out-of-sample) to calculate the returns. We continue this process by moving the rolling window towards the end of the dataset, getting a series of $T - M$ out-of-sample returns.

The presented procedure is applied for weekly returns of the securities of the S&P 100 from 1 January 2005 to 1 January 2020. Hence, the total observations consist of $T = 1{,}024$ weeks (15 years), and we considered those stocks without missing data resulting in 87 assets. We choose in-sample (rolling window) sizes of $M = 50, 100$, and 150 weeks and an out-of-sample size of 25 weeks.

In order to compare the performance of the selected allocation strategies, we use the following measures to evaluate the out-of-sample characteristics: the Sharpe ratio, maximum drawdown, annual growth rate (CAGR), annual volatility, and turnover rate.

Tables 2–4 report the results of the presented indicators for the MV, RES, SRES, and HRP methods using the sample covariance estimate, the Ledoit–Wolf estimator, and the denoised covariance. The Hierarchical Risk Parity strategy performs the best considering the CAGR and turnover rate indicators independently of the applied covariance estimators. This means that HRP usually provides more diversified portfolios than its counterparts. As we have expected, the impacts of the covariance estimators on the HRP method do not differ significantly. In the case of the Ledoit–Wolf estimator, HRP has the lowest turnover rates, while the denoised covariance matrix provides better CAGR values. Except for a few cases, the subsampling variant of the minimum-variance method achieves the best Sharpe ratios and annual volatilities. SRES is much more preferable in terms of diversification (turnover rate) than the MV and RES methods and achieves similar values as HRP as the estimation window size increases (see for M = 150).

Considering the individual covariance estimators, it can be concluded that the Ledoit–Wolf estimator and the denoised covariance usually improve the most important indicators obtained by the sample estimate. As we have previously observed, the differences are not significant for HRP, but we managed to improve the diversification property of the method, especially using the Ledoit–Wolf estimator. This estimator is slightly better than the denoised variant considering the Sharpe ratio and the turnover rate. In the latter case, the reduction is more significant for the MV strategy.

Table 2. *Sample covariance estimate*

Perf. measures	M = 50				M = 100				M = 150			
	MV	RES	SRES	HRP	MV	RES	SRES	HRP	MV	RES	SRES	HRP
Sharpe ratio	0.875	0.883	**0.914**	0.899	0.779	0.840	**0.860**	0.850	0.820	0.842	0.857	**0.861**
Max. drawdown	**37.394**	40.462	38.986	42.209	43.600	42.386	**39.712**	43.511	42.372	42.240	**40.156**	43.155
CAGR	11.083	11.287	11.3749	**12.599**	10.230	10.968	10.888	**12.270**	10.790	11.000	10.914	**12.651**
Annual volatility	13.008	13.119	**12.698**	14.366	13.737	13.493	**13.033**	14.961	13.670	13.499	**13.127**	15.215
Turnover rate	112.279	90.191	68.416	**41.365**	76.042	60.639	42.227	**29.822**	55.036	45.580	30.521	**25.880**

Table 3. *Ledoit–Wolf covariance shrinkage*

Perf. measures	M = 50				M = 100				M = 150			
	MV	RES	SRES	HRP	MV	RES	SRES	HRP	MV	RES	SRES	HRP
Sharpe ratio	0.886	0.911	**0.925**	0.899	0.815	0.862	**0.871**	0.862	0.835	0.856	**0.871**	0.855
Max. drawdown	**38.440**	40.015	40.012	42.543	42.088	41.347	**39.664**	42.300	41.528	41.533	**39.990**	42.966
CAGR	11.205	11.750	11.927	**12.669**	10.598	11.272	11.285	**12.495**	10.947	11.245	11.373	**12.603**
Annual volatility	**12.969**	13.181	13.141	14.455	13.497	13.470	**13.320**	14.981	13.573	13.546	**13.424**	15.266
Turnover rate	89.432	77.241	56.552	**33.976**	61.899	53.190	37.229	**26.160**	47.604	41.349	27.740	23.854

Table 4. *Denoised covariance*

Perf. measures	M = 50				M = 100				M = 150			
	MV	RES	SRES	HRP	MV	RES	SRES	HRP	MV	RES	SRES	HRP
Sharpe ratio	0.891	0.898	**0.925**	0.911	0.821	0.848	0.847	**0.861**	0.836	0.839	0.835	**0.868**
Max. drawdown	**35.576**	39.730	37.216	43.836	41.626	41.298	**38.468**	43.221	42.395	42.374	**39.536**	42.898
CAGR	11.137	11.305	11.243	**12.939**	10.959	10.976	10.480	**12.548**	10.826	10.898	10.467	**12.800**
Annual volatility	12.790	12.875	**12.378**	14.548	13.859	13.358	**12.747**	15.083	13.390	13.434	**12.958**	15.254
Turnover rate	100.273	79.947	59.668	**40.900**	72.172	54.824	37.000	**29.199**	56.159	41.601	27.898	**26.883**

4. Conclusions

In this paper, we have investigated different covariance matrix estimators applied to asset allocation strategies. We have compared the minimum variance portfolio with its resampling and subset resampling variants on synthetic data. Based on the conducted Monte Carlo experiment, we can conclude that the Ledoit–Wolf shrinkage estimator achieves the best performance independently of the applied allocation strategy. The RMSE values of portfolio volatilities between in-sample and out-of-sample show that the SRES algorithm is more robust than the MV and RES strategies. In the second experiment, the three Markowitz-type algorithms were compared with a recently proposed hierarchical tree clustering strategy using real financial data. The methods were assessed using a rolling window approach by varying the number of observations. Finally, the out-of-sample characteristics of portfolios were evaluated. The HRP method performs well considering the CAGR and turnover rate indicators. SRES usually outperforms MV and RES, especially for Sharpe ratios and annual volatilities. The diversification ability of SRES is also better than for MV and RES, and it achieves similar values as HRP as the number of observations are getting larger. The Ledoit–Wolf estimator and the denoised covariance usually improve the most important indicators obtained by the sample estimate. Using the newer nonlinear variant of the Ledoit–Wolf estimator or applying other cleaning schemes of covariance matrices, we may achieve further improvements. Another interesting research direction would be to apply clustered selection in the RES and SRES strategies.

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Do Social Interactions Really Moderate Job Productivity in Coworking Spaces?

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Abstract. A coworking space is a setup of bringing together independent professionals who do not work for the same company. This study aims to determine the impact of the coworking space environment and of social interactions on the job productivity of coworkers, as well as the influence of social interactions in the relation of coworking space environment and job productivity. A positive significant relationship was found between the coworking space environment and job productivity as well as between social interactions and job productivity. Moreover, the moderating variable "social interactions" strengthens the relationship between coworking environment and job productivity. The findings of the study highlight the importance of coworking spaces as a source of social interactions among freelancers and entrepreneurs. Furthermore, human resource managers and corporate office managers can use this study to help their staff operate in a more flexible and productive setting.

Keywords: coworking, coworking spaces, coworking environment, job productivity, social interactions

JEL Classification: L20, M14

1. Introduction

In the last few years, independent professionals, entrepreneurs, and freelancers would like to work in coworking spaces. The flexible office type will not only provide a resourceful environment for their coworkers but will also provide opportunities for social interactions (Gerdenitsch, Scheel, Korunka, and Christian, 2016). Coworking spaces are the temporary rental places which can be used for working, meeting, mini-seminars, or tutoring purposes. In the coworking

spaces, the owner will provide the necessary equipment such as tables, chairs, or meeting rooms. Some have projectors, printers, including free water and snacks for the coworkers. Coworking spaces are environments where freelancers and microbusinesses will coexist and collaborate on various tasks and actions. They can create a sense of community and trust among themselves by escaping the competitive framework. As a result, we may conclude that coworking spaces offer their institutional or individual users a high level of autonomy in both social and office spaces, influencing personal connections among coworkers for business, cultural, social, and learning-related purposes. Different intensities of social connection can lead to innovation, inspiration, and increased understanding among coworkers (Bouncken, 2018).

Hence, there is a development of a complex socio-economic organization where old and new organizational practices would leverage the social interactions among coworkers to access network resources with an expected economic return. These coworking spaces will help to improve the social interactions, collaborations, job satisfaction, learning, and job performance of the coworkers (Gandini, 2015). Hence, the phenomenon of management practice of sharing economy is introduced in this paper.

Despite the growth of coworking spaces worldwide, a few empirical studies were found on them, especially in the Indian context. Also, this study is different from previous studies, as those studies are related to only the benefits of using these coworking spaces and its factors (environment, cost, culture) that influence coworking (Leclercq-Vandelannoitte and Issac, 2016; Uda, 2013), while only a few explored the relationship between coworking space environment and social interactions with job productivity. So, this paper aims to fill this gap and serve as an addition to the existing literature.

This paper is organized as follows: Section 2 will set up the conceptual framework and formulate the hypotheses, section 3 presents the methods and procedures to be used for analysis, section 4 discusses the findings and results from the analysis, and section 5 offers conclusions and gives possible directions for future studies.

2. Conceptual Background

The idea of these coworking spaces was credited to Brad Neuberg, who launched the first coworking environment in San Francisco in 2005 with the name "Hat Factory", which was growing at a very rapid rate annually in the countries with advanced economies, and more than one million employees had already used coworking spaces by 2018 (Marzloff, 2013). These spaces are designed to host entrepreneurs and creative people, which helps to break isolation and favours collaborations and meetings (Moriset, 2014). Gandini (2015) and Garrett (2014)

classified coworking spaces based on participants (such as knowledge professionals, remote workers, freelancers, entrepreneurs, or peers), collaboration (such as social interaction, networking, side-by-side working, or work in parallel), infrastructure (such as Wi-Fi connection, kitchen, desks, office supplies, conference rooms), and community factors (such as sense of community, social environment, or daily routines) (Bouncken and Reuschl, 2016). Coworking space is based on the idea of a sharing economy consisting of two dimensions as follows: providing access to sharing intangible assets such as knowledge and information and physical assets such as office, cafes, infrastructure, etc.

A sense of coworking culture and community can be developed by attracting similar individuals, who can have shared sets of behaviour, norms, and rules. Coworking spaces is a setup of bringing together independent professionals who do not work for the same company. These are mostly used by freelancers, self-employed, micro-enterprises, and entrepreneurs. Coworking spaces ensure the sharing of resources and a common area for working. It is an open environment that provides opportunities for coworkers to interact with members of other companies or request their help if necessary. It will help coworkers share more ideas and give participants a chance to expand their businesses. They can build partnerships with one another. Socializing with like-minded people or creative minds helps to increase the talent, skills and reach the goals easily, which results in high productivity, income, and growth rate. So, coworking spaces ensure a sense of community, collaboration, and belongingness (Garrett, 2014). In addition to these collaborations, coworkers can choose whether they need to work in a peaceful space so they can focus or in an increasingly synergistic space with shared desks where cooperation is encouraged. Coworking spaces provide an opportunity for minimum investment. Membership costs are flexible, entirely depending on the user's preference of shared desk or personal rooms. Coworking spaces are regularly open all day, every day. Coworkers can choose whether to put in a long day when they have a due date or need to show productivity or can choose to enjoy a long break amidst the day to go anywhere. Coworking helps to make a person successful both personally and professionally. Therefore, it can be said that coworkers will not only share a space or facilities but can also share and create new ideas (Bouncken and Reuschl, 2016). However, in spite of all these benefits, there are some concerns as well such as when coworking spaces are far from the participants' homes, which makes them lose valuable time. Moreover, overhearing coworkers' conversations about their new project that has not been launched yet is a privacy concern in coworking spaces. Although coworkers received more feedback when they discussed their projects with others, the risk of project leakage also increased. Further, the layout of the workspace may not always meet the coworkers' expectations. Some of them may want to work alone rather than share the coworking space. Entrepreneurs require different tools depending on the type

of their firm (e.g. a drawing board for designers). Further, as it is not their own office, the motivation to go to work is diminished (Leforestier, 2009). However, if a "critical mass" is not attained, the benefits of a collaborative environment are neutralized.

Also, as a coworking space is generally filled with people from various companies, there may be limited capacity to create or adjust the workplace culture to suit each company's particular value system. When employees work in multiple places with different atmospheres, it can be more challenging to retain a consistent team spirit. In a transitional coworking environment, the acoustical issues and visual distractions that might interfere with focus in any open plan room layout may be significantly more important. The diversity of enterprises, positions, and personalities that use these places can create an unpredictable environment that lacks the usual workplace courtesy.

However, it fosters a chaotic start-up culture, providing a safe environment for impromptu gigs as well as steady social networks and interactions that help people launch and promote new ideas and contacts. We also want to emphasize that coworking spaces give a lot of freedom. Access to and usage of the office infrastructure and amenities during self-regulated working hours is part of autonomy. Coworking users choose to avail themselves of the possibility – not thought of as a requirement – to connect with people on a casual or intense basis, to be honest about work and personal matters, to receive and provide feedback, and to deepen personal and professional relationships. Experimentation and inventiveness are also aided by autonomy. Furthermore, unlike shared office users, coworking users have less responsibility for administrative activities such as insurance, cleaning, or waste disposal. Users of coworking spaces are allowed to pursue both business and non-business goals. Despite the fact that the term coworking includes the word "work", customers of coworking spaces may be looking for leisure and social opportunities in addition to professional goals.

To sum up, the basic pros and cons of coworking spaces are listed in *Table 1*. So, in this study, we will see how these coworking space environments and social interactions help coworkers to enhance their productivity beyond all these limitations.

Table 1. *Pros and cons of coworking spaces*

Dimensions	Pros	Dimensions	Cons
Flexible cost	It is a variable cost, thus it is flexible.	Lack of privacy	There is a threat for companies with a large amount of confidential data.
Cost Reduction	Renting an office desk is less expensive than establishing one's own business.	Security	Many businesses are concerned about losing intellectual property, ideas, or other sensitive data.

Dimensions	Pros	Dimensions	Cons
Collaborations	To avoid being lonely and unproductive at home, this is the ideal socializing experience.	Space adequacy	The layout of the workspace may not always meet the expectations of coworkers.
Community Development	Being part of a community, feeling important, and receiving support.	Inconsistent office culture	When employees work in multiple places with different atmospheres, it can be more challenging to retain a consistent team spirit.
Innovation	All aspects are available to stimulate innovation in a friendly, innovative environment: designs, lounges, and events.	Lack of attendance	Because it is not their office, the motivation to go to work is diminished.
Services	Coworking spaces provide a wide range of services, including everything an employee would expect from his or her employer in order to work under acceptable conditions. Supplies are not an issue for coworkers.	Lack of connection	Some coworkers may prefer to work alone rather than share the coworking space, thus resulting in a lack of teamwork.
Optimize productivity	Employees may also be able to save time by reducing the amount of time they spend commuting to and from distant company facilities.	Negotiate the public/ private divide	The more the projects are disclosed, the more feedback they will get, but the project will also become more vulnerable.

Source: Roth and Mirchandani (2016), Leforestier (2009)

3. Hypothesis Development

3.1. Job Productivity in Coworking Spaces

As far as the study on the working environment is concerned, there are certain aspects that exert great influence on productivity (Maarleveld, Volke, and Voordt, 2009; Maarlevend and De Been, 2011). The environment and facilities available at a workplace can impact productivity. Elements of the infrastructure, such as ventilation system, heating, cooling, and office furniture, will affect the employees and in turn the productivity of their work. According to Haynes (2007b), the physical and behavioural characteristics of the office environment, i.e. comfort, office layout, interactions, and distractions, have a greater impact on productivity (Davis et al., 2011). In the opinion of Davis et al. (2011), Roelofsen (2002), Langston et al. (2008), Haynes (2007a), Hameed and Amjad (2009), Myerson (2009), and

Kahler Slater (2010), there are various attributes that contribute to influencing employees' attitude towards synergy and productivity, such as: proper lighting, artificial and natural; location and ambience of building, for example: distance from the city, proximity of shopping centres, ease of access through public transportation; physical environment of the workplace such as decoration, colour of the walls, arrangement of the furniture; premises and equipment, such as appropriate ICT, hardware and software, storage space; employees' ability to shift workspaces according to their personal needs; etc. Hence, according to these attributes, it can be argued that workplace environment is a dimension of great importance for an organization, which influences job productivity and satisfaction. Moreover, people frequently state that they prefer working in coworking spaces because they believe their productivity will rise more quickly than in a regular office setting or at home. Built-in peer accountability, a fast-paced environment, and flexible amenities are the major characteristics that contribute to their productivity. Individuals have more autonomy over their work in coworking facilities because they may select how, when, and where to work. This inbuilt flexibility adds to a judgment-free atmosphere in which work schedules are anticipated to be flexible and where there is no pressure from others to stick to a 9–5 work routine (Roth and Mirchandani, 2016).

According to Been and Beijer (2014), office types, such as individual and shared-roof offices, combi offices, and flex offices, influence job satisfaction and productivity. The physical environment can enhance coworkers' productivity and their experiences at the workplace. Also, the office layout can facilitate workplace satisfaction, social interactions, and teamwork effectiveness (Tucker and Smith, 2008). Further, working conditions and coworking had a significant impact on employee job satisfaction. Nurvitasari (2019) and Fassoulis and Alexopoulos (2018) examined the impact of the workplace on the productivity of the university staff of the National and Kapodistrian University of Athens (UoA). The study revealed that due to the lack of an appropriate working environment at the University of Athens (UOA), the staff's productivity is affected negatively. The internal environment of the office is the most important characteristic of the workplace, which can influence employee productivity. Moreover, coworkers may also be able to save time by reducing the amount of time they spend commuting to and from remotely located company facilities. Coworking spaces are good learning environments because of the diversity of people and available resources. Traditional seminars and presentations, as well as online coursework, peer-to-peer exchanges, and mentoring programmes, are all examples of knowledge-sharing opportunities (Roth and Mirchandani, 2016).

Hence, we can expect coworking space environments to have an impact on job productivity based on the above considerations. As a result, we propose in this study that coworking space environment is one of the most important elements determining productivity in coworking spaces. So, this study aims to explore the

impact of the coworking space environment on coworkers' job productivity. Hence the following hypothesis is proposed.

H1. The coworking space environment has a positive impact on job productivity.

3.2. Social Interactions in the Coworking Spaces

In addition to the basic corporate infrastructure, the main strength of coworking spaces is building a sense of community among the employees working there, as these spaces help them to transfer knowledge, promote cooperation, informal exchanges, and horizontal interactions with each other (Spinuzzi, 2012; Mariotti, 2017). Coworking spaces also provide opportunities for collaboration and community in flexible and furnished workspaces on a rental basis. Coworking spaces are designed to offer social interactions among coworkers, which can take the form of social support (Gerdenitsch, Scheel, Korunka, and Christian, 2016). Social interaction means the way people act and react to other people around them (Giddens, 2009). Social interactions can be positive or negative. When one or both parties get to benefit from social interactions, it will lead to social support (Shinn, Lehmann, and W., 1984). Social support is positively related to performance satisfaction. So, coworking space is an important factor in enhancing social interactions, which can enhance performance (Gerdenitsch, Scheel, Korunka, and Christian, 2016). This kind of service organization supports employees in their work by meeting their basic essential needs of working in a safe, risk-free environment (Leaman, 1995) and promoting interaction and communication among employees. As a result, coworking spaces are the best solution in terms of environment, social interaction, and work performance.

Cabral and Winden (2016) formulated the four strategies to maximize interactions and foster innovation among coworkers: coworking space management as a connector, interior design for interaction, tools for networking, and regulating the mix of workers. In coworking spaces, coworkers, such as freelancers, entrepreneurs, and independent professionals, can share knowledge, exchange ideas, build communities, cooperation, and have horizontal interaction with others (Akhavan, Mariotti, and Canevari, 2019). A model was designed by Bueno, Rodriguez-Balatnas, and Gallego (2018) to show the impact of the coworking environment and social interactions on coworkers' job productivity. They moderated this relationship with three demographic variables (age, gender, level of education) and found a positive significant influence of social interactions and the coworking environment on productivity.

Hence, we can propose that social interactions in coworking spaces are an important factor in determining job productivity. Further, this study will extend the literature by investigating if social interactions will moderate the relation

between the coworking environment and job productivity. So, the study aims to explore the impact of social interactions on the job productivity of coworkers working in coworking spaces and the moderating influence of social interactions between the coworking environment and job productivity. Hence the following hypothesis is proposed.

H2. Social interactions have positive impact on job productivity.
H3. Social interactions positively influence the relationship between the coworking space environment and job productivity.

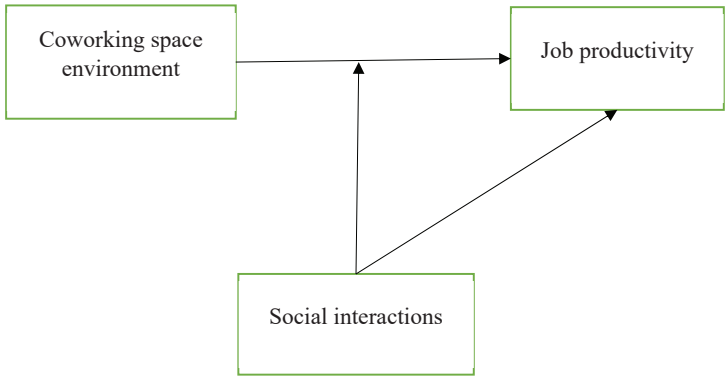

Figure 1. *Relationship between a coworking space environment, social interactions, and job productivity and their influence on each other*

4. Materials and Method

4.1. Sample and Procedure

The study was conducted in the coworking spaces of two cities of India, i.e. Chandigarh and Mohali. Data were collected from the top 10 coworking spaces of these two cities with 10 respondents from each coworking space. The respondents of the study were independent professionals, i.e. freelancers, self-employed, micro-enterprises, entrepreneurs who were related to different companies such as Mapple, Topper, Study dekho, Stackgeeks, Clikpak, Hunt career abroad, Being Dad, etc. and who worked in these coworking spaces. A total of 100 sample population was collected, including 58% male and 42% female participants. Convenience sampling was used to select the respondents. The sample survey method was used to collect the data. The respondents of the study were contacted during their office hours.

4.2. Measures

The study included four types of instruments assessing (1) coworking space environment, (2) coworkers' job productivity (3), social interactions among coworkers, and (4) demographic variables. All the instruments are self-constructed with the help of previous studies of Bueno, Rodriguez-Balatnas, and Gallego (2018) and Fassoulis and Alexopoulos (2015).

Coworking Space Environment: This instrument was measured by a self-created index based on three dimensions, namely: facilities available in coworking spaces, layout, and culture of coworking spaces consisting of ten items (e.g. "I feel coworking space provides better facilities than a normal setup." "I feel good about open and transparent spaces." I feel the culture of the coworking space is better than a normal company." – based on dimensions such as facilities). Coworkers' responses were scored on a 5-point Likert scale, where 1 is "strongly disagree" and 5 is "strongly agree". The index was reliable as the internal consistency coefficient of the scale was 0.824, which is more than the required threshold of 0.7 (Nunnally, 1978).

Social Interactions: This instrument was measured by a newly developed scale consisting of 4 items based on two dimensions, i.e. communications and team work (e.g. "I feel that in a coworking environment I have better communication opportunities than in a normal environment." "Due to the coworking set-up, I feel that I can relate to my team better than in a normal environment."). Participants rated the statements on a 5-point Likert scale, where 1 is "strongly disagree" and 5 is "strongly agree". The index was reliable as the internal consistency coefficient of the scale was 0.908, which is more than the required threshold of 0.7 (Nunnally, 1978).

Job Productivity: The instrument was a self-structured scale consisting of 2 unidimensional items (e.g. "I feel I can perform better in a coworking space than in a normal company set-up." "I feel I am able to perform my work much faster in coworking spaces than in a normal office setting."). Participants rated the statements on a 5-point Likert scale, where 1 is "strongly disagree" and 5 is "strongly agree". The index was reliable as the internal consistency coefficient of the scale was 0.817, which is more than the required threshold of 0.7 (Nunnally, 1978).

4.3. Analysis

The data was analysed using various statistical tools such as reliability measures, correlation, and regression analysis in SPSS. Also, Process macro version 3.4 in SPSS was used to check the moderation influence (Hayes, 2017). Cronbach's alpha value was computed to check the reliability of the statements in the questionnaire. Then linear correlation was applied to find out the relationship between the

items of the scale and, finally, regression analysis was used to find the cause and effect relation between coworking environment, social interaction factors, and job productivity.

5. Results and Discussions

5.1. Descriptive Statistics

A sample of 100 participated in the study. *Table 2* displays the characteristics of a representative sample of the population. The number of males working in coworking spaces (58%) is more than the number of females (42%). The education level of the participants shows an almost equal distribution between undergraduates (52%) and postgraduates (48%). The distribution of participants based on their experience was as follows: 0–2 years (37%), 3–5 years (31%), 6–10 years (23%), and 10–15 years (9%).

Table 2. *Demographic profile of the respondents*

	Categories	Frequency	Percentage
Gender	Male	58	58%
	Female	42	42%
Education	Undergraduate	52	52%
	Postgraduate	48	48%
Experience	0–2 years	37	37%
	3–5 years	31	31%
	6–10 years	23	23%
	10–15 years	9	9%

5.2. Reliability Analysis

Reliability measure is used to check the reliability of items used in the questionnaire. The value of the Cronbach's alpha is .810, which is greater than the standard value of 0.7 (Nunnally, 1978). So, the statements used in the questionnaire were considered as reliable and thus as providing reliable results.

5.3. Correlation among Coworking Environment, Social Interactions, and Job Productivity

Pearson's correlation coefficient (PCC) between coworking environment and coworkers' job productivity was 0.608 at $p < 0.01$, and between social interactions

and job productivity it was .500 at $p < 0.01$. So, coworking environment and social interactions have a positive significant relationship with coworkers' job productivity (see *Table 3*).

Table 3. *Correlation analysis*

	Job Productivity	Social interactions	Coworking environment
Job Productivity	1		
Social interactions	.500**	1	
Coworking environment	.608**	.724**	1

*** Correlation is significant at the p < 0.01 level (2-tailed).*

5.4. Regression Analysis

Linear regression analysis is used to analyse the cause and effect relationship between the dependent and independent variables.

Linear regression was applied by taking social interactions and coworking environment as independent variables and job productivity as the dependent variable, as shown in *Table 4*.

Coworking space environment has a significant relationship with job productivity, as indicated by β = .608 in the coefficient table, with t-value = 7.590 at the .000 level of significance. The independent variable "coworking space environment" explained 36.4% of the variance in the dependent variable "job productivity". So, a significant cause and effect relationship was found between coworking space environment and job productivity. Hence H1 is confirmed.

Table 4. *Results of the regression analysis between job productivity as a dependent variable and other factors as independent variables*

Independent variable	Dependent variable	Adjusted R^2	β	T-value	Supported
Coworking space environment	Job productivity	.364	0.608	7.590	yes
Social interactions		.242	0.578	5.709	yes

*Significance levels: * p < 0.05, t (0.05;1) = 1.9670; ** p < 0.01, t (0.01;1) = 2.5904; *** p < 0.001, t (0.001;1) = 3.*

Then social interactions were taken as an independent variable and job productivity as the dependent variable. Social interactions have a significant relationship with job productivity, as indicated by β = .578 in the coefficient table, with t-value = 5.709 at .000 level of significance, as shown in *Table 3*. The independent variable "social interactions" explained 24.2% of the variance in the dependent variable "job productivity". So, a significant cause and effect

relationship was found between social interactions and job productivity. Hence, H2 is also confirmed. So, coworking environment and social interactions among coworkers have a significant cause and effect relationship with job productivity.

5.5. Moderating Analysis

The moderation hypothesis was verified by using the Process macro version 3.4 in SPSS, in which the independent variable, the moderating variable, and the interactive effect variable (independent variable* moderating variable) were inserted to predict the dependent variable (Hayes, 2017).

Table 5. *Moderating analysis*

Model	Coeff.	T-value	p	LLCI	ULCI	R^2	Supported
Job productivity = coworking environment*social interactions	1.444	3.604	.0005	.6490	2.2402	.6267	yes

*Significance levels: * $p < 0.05$, $t(0.05;1) = 1.9670$; ** $p < 0.01$, $t(0.01;1) = 2.5904$; *** $p < 0.001$, $t(0.001;1) = 3$.*

The influence of social interactions was computed in the relationship of coworking environment and job productivity (see *Table 5*). The results are significant, as the confidence interval range lies between 0.64920 and 2.2402 (lower level and upper level). Also, the t-value is 3.604 at the .005 significance level. So, H3 is also confirmed, which means that social interactions positively moderate the relation of coworking space environment and coworkers' job productivity.

6. Discussions

Coworking offices can be efficient in terms of the environment, culture, and the facilities available, which will be the consequences for job productivity. Organizations can use the idea of coworking spaces to promote collaborations and social support among coworking users by weighing costs and benefits against each other (Been and Beijer, 2014). This study paid attention to how the coworking space environment will create a better working environment and how the changing face of office spaces concept can be a good source of social interactions and productivity support for the employees. The purpose of our study is to investigate the relationship between coworking space environment, social interactions, and job productivity in the coworking spaces. The questionnaire revealed the main patterns in coworking spaces i.e. job productivity and social interactions. So, the following hypotheses were proposed.

H1. The coworking space environment has a significant positive impact on job productivity.
H2. Social interactions have a significant positive impact on job productivity.
H3. Social interactions have a moderating effect on the relationship between coworking environment and job productivity.

Our study contributes to the phenomenon of coworking spaces, which allows for social interactions and serves as a source of productivity. Previous research on coworking has conceptually explained its underlying concepts and formation processes (Uda, 2013). This study is one among the few to empirically investigate the content and configurations.

In line with the previous findings of Bueno, Rodriguez-Balatnas, and Gallego (2018), this study also found a positive significant relationship between coworking space environment, social interactions, and job productivity – as shown in *Table 3* – at the $p < 0.01$ significance level (2-tailed).

Also, the results in *Table 4* have shown that there is a significant cause and effect relationship between coworking space environment and job productivity and social interactions and job productivity, with coworking space environment explaining 36.4% of the variance in the dependent variable "job productivity" while social interactions explaining 24.2% of the variance in the dependent variable "job productivity", which is consistent with the previous study of Gerdenitsch, Scheel, Korunka, and Christian (2016). Hence, H1 and H2 are confirmed. So, the results of the study indicated that an equipped and resourceful coworking space environment is a motivating tool to increase coworkers' productivity. In addition to this, coworking spaces are a source of social interactions among coworkers, which will lead to better performance (Robelski, 2019). Coworkers can form communities and share ideas, which will help them to grow professionally as well as personally.

Furthermore, the influence of social interactions (moderating variable) on the relationship of coworking environment (independent variable) with job productivity (dependent variable) was measured by the Process macro version 3.4 in SPSS (Hayes, 2017), which is also positively significant, as shown in *Table 5*, where the t-value is 3.604 at the .005 significance level. Based on the results, H3 is also confirmed. So, the findings indicated that a coworking environment will provide opportunities to coworkers for social interactions, which will enhance their productivity.

7. Conclusions, Limitations, and Future Research

To sum up, coworking spaces are the most preferred spaces among independent professionals, entrepreneurs, and micro-enterprises. The findings of the study highlight the importance of coworking spaces as a source of social interactions among freelancers, entrepreneurs, and independent professionals. Moreover, this

study was conducted to analyse the impact of coworking space environments and social interactions among coworkers on job productivity. Correlation and regression analysis were used to interpret the results. The results of the study showed that coworking environment and social interactions have a positive relationship with job productivity. Also, coworking environment and social interactions in coworking spaces had a positive cause and effect relation with coworkers' job productivity. Hence, these two constructs, coworking environment and social interactions, positively influence job productivity in coworking spaces.

Besides all these findings, this study has some limitations. First, this study has been carried out only in two cities of India (Chandigarh and Mohali), thus having a narrow scope. Therefore, future studies need to be conducted in different cities of India for the generalization of the findings. Second, the research is limited to the variables selected for inclusion. We especially encourage studies on exploring some other aspects of the work environment and ergonomics to create health-promoting and satisfying workplaces (Robelski, 2019). Other specific antecedents (availability of training, community set-up, availability of diverse skills, infrastructure or knowledge sharing) and consequences (new product development, entrepreneurial success, self-efficacy) can also be used to provide additional insights into the context of coworking spaces. Other studies can consider the risk and challenges of coworking threatening social security and job security (Bouncken and Reuschl, 2016). Moreover, other demographic characteristics can also be considered in future studies. However, this paper can help the corporate offices to create a more flexible and constructive work environment for the coworkers. Also, freelancers, independent workers, and companies will benefit from the findings of the study and can promote collaborative connections and networks.

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Global Economic Uncertainties and Exchange Rate Management in Africa: A Panel Study

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Abstract. This study investigates the effects of global economic uncertainties on exchange rate management in Africa from 1990 to 2021. Employing the quantile regression technique, findings show that both global and domestic economic uncertainties have significant influence on exchange rate management in Africa. The intensity of global economic uncertainty rises during the bearish and transitional markets, but dependence declines during the bullish markets. Moreover, the relationship between domestic uncertainty and African exchange rate management shows that the structure of dependence improves around the upper tails but declines around the lower tails. African countries should pay attention to global economy in order to combat any impending negative effects of global economic uncertainties. Also, attention should be paid to other uncertainties such as political, social, or other factors that may aggravate domestic economic uncertainties.

Keywords: global economic uncertainties, exchange rate management, Africa, panel study

JEL Classification: C21, D81, F31

1. Introduction

Globalization has exposed the world, Africa in particular, to rising and varying degrees of economic uncertainty, thus raising concerns among scholars and policy makers about its possible spillover effects on African countries. For instance, the occurrence of the 2007–2009 global financial crisis and the recent outbreak of COVID-19 have drawn the attention of scholars and policy makers towards the issues surrounding economic uncertainty because of its severe impact on global economies, including Africa. This position is also supported by economic

theory, which posited that economic uncertainty inhibits an accurate prediction of monetary policy outcomes (Kydland and Prescott, 1977).

Uncertainty is inextricably linked to issues of news shocks to both financial and macroeconomic variables, and it is an important factor to be considered with regard to the transmission and efficacy of monetary policy (Central Bank of Nigeria, 2015), though central banks often set specific monetary and macroeconomic objectives with target outcomes, such as exchange rate stability, and thus develop policy measures to enhance their success. Furthermore, their expectations take into account the uncertainty surrounding the dynamic behaviour of interest factors, which has an impact on monetary policy outcomes. Put succinctly, global economic uncertainty can trigger economic policy uncertainty (EPU), which can exert direct and indirect effects on exchange rate, hence influencing the exchange rate management policies (Beckmann and Czudaj, 2017; Olanipekun, Olasehinde-Williams, and Güngör, 2019; Olanipekun, Güngör, and Olasehinde-Williams, 2019; Leming, Ziqing, and Zhihao, 2020).

Despite the fact that African economies have been steadily improving for decades in terms of growth, the International Monetary Fund (IMF) upgraded some African countries to emerging market status, including South Africa, Ghana, Kenya, and Nigeria, to name but a few (IMF, 2013).

However, for economic progress, many African countries continue to rely heavily on advantageous economic links with developed countries, especially through increased international trade and economic cooperation (Olasehinde-Williams and Olanipekun, 2020). This high level of economic openness effects exchange rate management policies as well as the international transmission of uncertainty shocks into their exchange rate markets. The sensitivity of African economies to external variables helps to explain why uncertainty from adverse economic policy spillover from other countries can often shape their exchange rate management policies. As a result, the degree of fluctuations experienced by African currencies in recent years is exemplified by the dramatic decline in the nominal values of many of these currencies against the US dollar, as seen in appendix A1. Furthermore, substantial devaluations of African currencies occurred in the late 1980s and the early 1990s as countries sought to reduce or eliminate the impact of parallel foreign exchange markets that had emerged in many of these countries, which prompted many countries to implement these devaluations in the hope of improving their export competitiveness and boosting non-traditional exports, but the terms of trade in many African countries remain unstable, as seen in *Appendix A2*.

As a result, exchange rate management in Africa has been diverse and varied, with many countries employing various exchange rate arrangements, such as a peg to a single currency, managed floating, and an autonomously floating exchange rate system, as well as monetary zone agreements in an attempt to find an optimal and long-term exchange rate arrangement (IMF, 2013). Exchange rate regimes

in sub-Saharan African countries shifted from pegs to floats between the mid-1990s and the mid-2000s. Between 1995 and 2008, around 45 and 35 percent of the countries were classed as pegs or floats, respectively, with the remaining 20 percent classified as intermediates. Following the global financial crisis of 2008, this tendency was reversed, and the number of nations in sub-Saharan Africa, having an independently floating currency, decreased over time. Eight nations in sub-Saharan Africa (Burundi, Democratic Republic of Congo, Ghana, Guinea, Liberia, Mozambique, Rwanda, and Zambia) shifted away from de jure floats to embrace less flexible currency rate regimes in the aftermath of the global financial crisis. In 1996, 16 countries in the region had de jure independent floating exchange rate regimes, while eight others had de facto independent floats. By 2014, no country in sub-Saharan Africa had been designated as a de facto independent floater, which allows for exceptional actions to address market instability. African countries' transition to a regulated floating exchange rate regime has not been without challenges and difficulties. As a result, several monetary authorities in African countries have encountered policy challenges (IMF, 2017).

Another source of policy issues for African monetary authorities is when decision makers lack appropriate knowledge about the present economic situation or are in a dilemma about the model that best matches the dynamics and have a poor understanding of the prevailing external variables (Abid, 2020). As a result, policy makers continue to face uncertainty regarding the transmission mechanism and an insufficient knowledge of the system (Uchendu, 2009). In spite of efforts to achieve sustainable exchange rate management by adopting various types of exchange rate arrangements in the last few decades, available data shows that most African countries are still bedevilled by a high degree of exchange rate volatility. While studies in this area have concentrated on the advanced economies of Europe, America, and Asia, the attraction of most studies on Africa have been the effects of economic uncertainty on exchange rate volatility and stock markets, rather than the potential impact of economic uncertainty on exchange rate management (see, for example: Jingshan, 2020; Olanipekun, Olasehinde-Williams, and Güngör, 2019; Dai, Yu, and Li, 2017; Mehmet, Rangan, Clement, and Wohar 2016; Rober, 2014). This study aims to fill this gap by looking into the effects of economic policy uncertainty on African exchange rate management.

Specifically, this study uses the quantile regression approach to evaluate the effects of global and domestic economic uncertainty on exchange rate management in Africa on different quantiles. This method enables us to more accurately examine the effects of global and domestic economic uncertainty on the management of exchange rates in selected African countries. Our findings reveal a strong link between global economic uncertainty and exchange rate management in the African nations we studied. Furthermore, we discover a strong correlation between exchange rate management and domestic economic uncertainty. Other findings

in the empirical literature on relevant research corroborate our findings in this study (see: Krol, 2014; Aizenman and Binici, 2016; Kido, 2016; Das and Kumar, 2018; Olanipekun et al., 2019).

The remainder of the work is organized as follows. Section 2 focuses on literature review, Section 3 presents the methodology and data, Section 4 presents the results and discussion, and Section 5 concludes the paper.

2. Literature Review

Conceptual Issues

The concept of macro uncertainty has remained an area that gained relevance in the literature. Several authors have evidently viewed economic uncertainty from various perspectives. This term in traditional economic phrasing simply means variability in financial condition and economic variables. According to Kydland and Prescott (1977), predicting the outcome of monetary policy has remained problematic due to the uncertainty of the macroeconomic variable. Observation of different scenarios has made it possible for central banks to anchor their expectations on the probability of future occurrence. In the literature, the term of uncertainty, its meaning and impacts on the conduct of monetary policy have been conceptualized by many schools of thought. Some economists also understand macroeconomic uncertainty from inflation and output volatility and variability position (Bredin and Fountas, 2009), while some others have a countercyclical conceptualization behaviour of the economic/business cycle (Bloom, 2009).

From the methodological front, different methods of analysis and measurements of variables have been adopted by various authors and studies. Notable among these methods is the quartile regression analysis. This is a method of least-square estimates being used when the conditions of linear regression are not met. One major strength of this method is that the quantile regression estimate is more robust against outliers in response measurement. It is also useful when conditional functions are of interest. Studies that have adopted this method include: Mehmet, Rangan, Clement, and Wohar (2016); Dai, Yu, and Li (2017); Chen, Du, and Hu (2019).

Another method is the Generalized Method of Moments (GMM). GMM is a generic way of estimating parameters in statistical models. This method gives an estimator that can be computed after assigning proper weights to the various cost function products (Hansen 1982). This method has minimum variance among all estimates for the novel parameters and was adopted by Abid and Rault (2020).

We also have the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model, which was introduced by Engel (1982). This model allows for past

conditional variances in the current conditional variances and has been adopted in studies to measure exchange rate, volatility, exchange rate variability, and also stock volatility. Some of the studies that have adopted GARCH are Kazutaka (2016) and Noria and Bush (2019). Some studies also employed the Ordinary Least Square (OLS) and the Two-Stage Least Squares (2SLS) regression analysis. OLS estimates the parameters in a regression model by minimizing the sum of square residuals, while the Two-Stage Least Squares (2SLS) regression analysis is a statistical technique that is used for structural equation analysis. This method is an extension of the OLS analysis. It is employed when the regressands' error terms are correlated with the explanatory variables, and it has been employed by Lance and Don (1977) and Weymark (1995). Other methods of analysis include: the latent threshold time-varying parameter VAR (LT-TVP-VAR) econometric approach, ordinary least squares and instrumental variable estimators, and cross-sectional augmented IPS (CIPS) unit root test (Jingshan, 2020; Robert, 2014) Further similar studies also used binary probit model / probit regression. This is often employed when we intend to perform regression for binary outcome variables, which are regressands with two outcomes such as yes/no, male/female, etc. This technique was employed by Barry et al. (1996).

In terms of measurement of variables, the subject of global uncertainty cannot be exhausted due to the influence of nature, which cannot be predicted. However, empirical studies have recently used the EPU index as a proxy for the measurement of economic policy uncertainty. Although this is entirely bias-free, it establishes a high correlation with other quantitative uncertainty measures, such as stock volatility and exchange rate variability (Baker et al., 2016). Other measurements of uncertainty include domestic political uncertainty and domestic economic uncertainty (Noria and Bush, 2019).

Empirically, many authors have estimated the economic uncertainty and economic variables nexus. Some of the findings show conflicting while some others similar results. For instance, Liu (2020) and Chen et al. (2019) show that the responses of exchange rate volatility to economic policy uncertainty is asymmetric (EPU). The study also showed that EPU is positive and significant at all instabilities of exchange rates. According to them, it implies that governments are more likely to change economic policies with increases in volatility. Similarly, findings from Robert (2014) and Dai et al. (2017) show that economic policy uncertainty results in high level of exchange rate volatility. Results from Mehmet, Rangan, Clement, and Wohar (2016) show that EPU disparities have predictive ability for both exchange rate returns and the return variance over the entire conditional distribution for four exchange rates. The result further shows that there is no causality of EPU differentials to either exchange rate returns or return volatility.

Kurasawa (2016) worked on "policy uncertainty and foreign exchange rates: the DCC-GARCH model of the US/Japanese foreign exchange rate". The study's

findings reveal that dynamic conditional correlations between EPU indices and the exchange rate are not time-invariant. The sign of the connection changes in the sample period, especially for the level of exchange rate. The study also reveals that policy uncertainty in the US and exchange rate are negatively connected, suggesting that if policy uncertainty in the US increases, the value of the US dollar vis-à-vis the Japanese yen will decrease. Furthermore, Olanipekun, (2019) investigated the Impact of Economic Policy Uncertainty on Exchange Market Pressure. His finding shows that exchange market pressure responds positively to financial and trade openness. It also demonstrates that the foreign exchange market is influenced by strong capital mobility and unfettered portfolio flows. The study goes on to show that each of the four categories of Exchange Market Pressure (EMP) and Economic Policy Uncertainty, as well as GDP growth, the Consumer Price Index, domestic credit, trade openness, financial openness, and Foreign Direct Investment (FDI) inflow have a long-run link.

From our review, although there have been studies on the relationship between economic uncertainty and macroeconomic variables such as exchange rate, exchange rate volatility, exchange rate variability, and exchange market pressure, among others (see e.g. Mehmet, Rangan, Clement & Wohar 2016, Dai, et al., 2017, Wensheng, Ronald, Joaquin, 2017, Olanipekun et al., 2019), none of these studies alluded to the topics under consideration. To this end, we contribute to a recent but growing literature that has originated in the wake of the global uncertainty by investigating the effects of global economic uncertainty and exchange rate management in Africa.

3. Methodology and Data

Traditional econometric models of the effect of exchange rate management mostly offer the conditional mean of the variability in exchange rate but do not provide complete information about the conditional distribution. Nevertheless, owing to different economic uncertainty and heterogeneous market activities globally, it is probable that exchange rate dynamics and EPU's interactions may produce discriminate outcomes at different quantiles. Due to this fact, the coefficients in the quantile regression (QR) model have the capacity to differ at different quantiles. The QR also provides better estimates by identifying the fluctuation in the impact of economic uncertainty on the variation in exchange rate distribution, and it thereby informs the adoption of the QR method.

Therefore, our current study will employ the quantile regression (QR) model in evaluating the dependence between exchange rate management and economic uncertainty in Africa. The QR model as a modification of the ordinary regression provides a detailed representation of the conditional distribution. Given the nature

of our work, this consists of the complex impact of global policy uncertainty, which served as a proxy for economic uncertainty all through the conditional distribution. The QR technique has the following relevant benefits: it accounts for changes in parameters across diverse quantiles that enable us to detect what happens in the extreme values of our samples; the QR is robust; there exists outlier and heavy tails in data distribution and when the dependent variables are heterogeneous (Koenker and Hallock, 2001). Thus, the QR model is more suitable in our analysis since it captures the conditional mean distribution when the foreign exchange market is bearish, intermediate, or bullish, which also determines policy responses. The seminal work of Koenker and Bassett (1978) introduced the QR framework, with the assumption that the significance of the disturbance term conditional on the explanatory variables is zero in the τ^{th} percentile.

In general, given any (τ) level across the response variable g and given a number of exogenous variables w, the conditional quantile indicates:

$$Q_g(\tau \mid w) = \inf\{k : F(k \mid w) \geq \tau\},$$

where $F(\bullet \mid w)$ is the conditional distribution function. Hence, we present the conditional quantile in the model as follows:

$$Q_t(EMP \mid EPU_i) = \delta_0^{\tau} + \rho^{\tau} EPU_i + \varphi^{\tau} \mathbf{W} + \xi^{\tau} \tag{1}$$

From (1), $Q_{\tau}(EMP \mid \bullet)$ represents the estimated exchange market pressure (EMP), that proxy exchange rate management, conditional quantile function at the τ^{th} quantile, given $\tau \in (0,1)$. EMP denotes the periodic exchange market pressure. EPU_i stands for both the global and individual market economic uncertainty in our sample. These include Algeria, Congo DR, Cote d'Ivoire, Ghana, Kenya, Mauritius, Morocco, Nigeria, South Africa, and Zambia. ρ^{τ} stands for the coefficients measuring the magnitude of dependence of the exchange market pressure at the τ^{th} quantile to EPU_i. $\mathbf{W}$ denotes a group of covariate control variables, while φ^{τ} varies according to the specific estimated quantile. Equation (1) evaluates the impact of the variations in economic uncertainty on exchange rate management. This model is implemented using eight quantiles (5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 80^{th}, 90^{th}, 95^{th}), which are divided into three market conditions – lower quantiles (5^{th}, 10^{th}, 25^{th}), or bearish market, a currency pair where there is decline in the exchange rate value. The second market condition is the high or upper quantiles (75^{th}, 80^{th}, 90^{th}, 95^{th}), or bullish market, which is a market where market actors expect the value of exchange rate to rise. Lastly, the intermediate or medium quantile (50^{th}), or "neutral" market condition is when the currency pair (exchange rate) is between the bullish and bearish markets. The value of exchange rate is sideways with insignificant vertical fluctuations to the foreign exchange market. Intermediate market situations are generally referred to as sideways drift or lateral trends.

To determine the impact of both global and domestic uncertainty on exchange rate management for the African economies, monthly data was obtained for the period from 1997 to 2019. We employ data for EPU index that Baker et al. (2016) developed (available on: http://www.policyuncertainty.com/), and world uncertainty data is provided by Ahir, Bloom, and Furceri (2018): World Uncertainty Index, Stanford mimeo. Exchange rate data was sourced from IMF, International Financial Statistics, and www.investing.com. The construction of each country's EPU index follows the searching for related terms on historical daily newspaper documentations, including "economy", "policy", and "uncertain". Global EPU index is made up of the EPU indices of 20 economies, based on the comparative portions of their weighted nominal gross domestic product (GDP). These indices have been used by prior studies (see, for example, Olanipekun et al., 2020). Our measure of exchange rate management is captured by the EMP, which is constructed as foreign exchange rate and international reserves minus gold.

Following Olanipekun et al. (2020) and Aizenman and Pasricha (2012), we constructed the EMP using the formula: $EMP_t = 100 \times (\Delta exr_t - \Delta fer_t)$, where exr_t and fer_t represent a country's currency exchange rate to the US dollar and foreign reserves excluding gold in US dollar respectively. Δ signifies change, and t is time. This data was obtained from IMF, International Financial Statistics database.

The concept of EMP was primarily documented in Girton and Roper's (1977) pioneering paper. They argued that fluctuations in foreign exchange can be described by the movements in the official exchange rate and the intervention in foreign reserves. This concept was further applied by Weymark (1995), who states that the fluctuations in exchange rate produced by the surplus of demand over supply for foreign currency can be eliminated without interference in the foreign exchange market. Furthermore, Eichengreen et al. (1996) weighted and standardized the EMP model by adding the interest rate variations to foreign reserves and exchange rate. Therefore, the EMP denotes how the additional demand or supply of the home currency give rise to money gap, thereby drawing the intervention of central banks in moderating the unfavourable depreciation or appreciation of the exchange rate. Lastly, the components required in computing the EMP are relevant in the sense that for economies with fixed exchange rate systems, exchange rate market pressures adjust over the movements in foreign reserves, whereas for economies of flexible exchange rate systems, the pressures in the exchange rate market are through volatilities in exchange rate.

Further, the discussion on how exchange rate management interrelates with economic uncertainty must control for certain relevant macroeconomic factors, such as terms of trade (TOT) that reveals the rise in export prices and decreases foreign export demand (Chen, Zu, and Hu, 2020; Raza and Afshan, 2017) or foreign reserves minus gold (FER) that may have negative effect on exchange rate dynamics (Abid, 2020; Leming et al., 2020; Eichler and Littke, 2018). Other

control variables include the interest rate (IR), the money supply (MS) – it reflects the concern of central bank with regard to money market dynamics (Abid, 2020) –, and the consumer price index (CPI) (see Abid, 2020). *Table 1* presents detailed characteristics of variables, including symbols, measurements, and sources.

Table 1. *Characteristics of data*

S/N	Symbols	Variables	Measurements	Sources
1.	**GEPU**	**Global Economic Policy Uncertainty**	The construction of each country's EPU index follows a search of daily newspaper archives on articles containing related terms, including "economy", "policy", and "uncertain"	http://www.policyuncertainty.com/
2.	**DEPU**	**Domestic Economic Policy Uncertainty**	The 3-quarter weighted moving average is computed as follows: 1996Q4 = (1996Q4*0.6) + (1996Q3*0.3) + (1996Q2*0.1)/3	http://www.policyuncertainty.com/
3.	**EMP**	**Exchange Market Pressure**	The change in a country's currency exchange rate to the US dollar MINUS foreign reserves excluding gold in US dollar	Authors' computation with underlying data from IMF, International Financial Statistics, and www.investing.com.
4.	**TOT**	**Terms of Trade**	This is computed as the percentage of price of Exports to price of Imports; export prices divided by Import prices multiplied by 100	Authors' computation with underlying data from IMF International Financial Statistics
5.	**FER**	**International Reserves**	Foreign Reserves excluding Gold, US Dollars	IMF, International Financial Statistics
6.	**IR**	**Interest Rates**	Interest Rates, Central Bank Policy Rate, Percent per Annum	IMF, International Financial Statistics
7.	**MS**	**Money Supply**	Broad Money, National Currency	IMF, International Financial Statistics
8.	**CPI**	**Consumer Price Index**	Consumer Price Index, All Items, Index	IMF, International Financial Statistics

Source: authors' compilation

Note: We take the natural logarithms of international reserves and money supply, while other variables are in their level form.

4. Results and Discussion

Some Stylized Facts

Summary statistics and tests for the order of integration for the global economic uncertainty, each country's domestic uncertainty and exchange market pressure are displayed in *Table 2*. Starting with the domestic economic policy uncertainty (DEPU), *Table 2* reveals that South Africa has the largest market uncertainty with an average value of about 0.1380, followed by Zambia with a mean value of around 0.1028, whereas Algeria and Morocco have the least policy uncertainty in this group of countries, with averages of 0.0475 and 0.0251 respectively. The standard deviation measured the unconditional market variation. This value reveals that again South Africa has the maximum amount of variation in policy uncertainty with an average value of 0.1248, followed by Zambia with an average of 0.0903, while Morocco has the lowest variability in policy uncertainty with 0.0274 as standard deviation. Considering the skewness and kurtosis, *Table 2* shows that market uncertainty for all countries is skewed to the right with high peak and heavy tail recorded for Algeria, Congo DR, Kenya, Morocco, South Africa, and Zambia. Further, considering exchange market pressure, *Table 2* shows that all markets have negative average values with the exception of Cote d'Ivoire and Ghana. Cote d'Ivoire has the largest positive mean value of 68.2244, while Ghana has an average value of 1.0713. On the other side, Congo DR has the highest negative EMP mean value of -2.0163, while Mauritius displayed the lowest EMP mean value of -0.2946. Further, Cote d'Ivoire presents the highest variation in exchange market pressure with a standard deviation of 1,127.807 followed by Congo DR with a variation of about 28.3971, whereas Mauritius has the lowest variability in EMP with 4.6215 as standard deviation. The outcomes for the EMP further show that the markets for Algeria, Congo DR, Morocco, and Zambia are negatively skewed to the left, while the other market are right-skewed, with very high peakedness in Cote d'Ivoire. Further, the EMP revealed heavy tails and outliers, where all the series for each market have large kurtosis. Furthermore, we have tested for the normality, autocorrelation, and heteroskedasticity of our variables. The results indicate rejection of H0 at 1% level of significance for each of the tests. Therefore, conventional regressions with the assumption of disturbance terms being *i.i.d.* no longer suit our study – this may produce spurious results. Hence, the QR approach presents a superior argument in solving such regression challenges and provides all information with analytical flexibility.

Table 2. *Summary statistics*

	Mean	Median	Std.	Skew.	Kurt.	ADF	PP	Bai–Perron multiple breaks
Global Economic Policy Uncertainty								
	126.562	107.643	66.915	1.650	5.908	-13.409***f	-27.230***f	
Domestic Economic Policy Uncertainty								
Algeria	0.048	0.028	0.065	2.807	11.868	-4.918***l	-5.556***f	2000M11
Congo DR	0.0838	0.0458	0.090	1.190	3.199	-5.197***f	-6.247***f	2001M07; 2005M02; 2009M02
Cote d'Ivoire	0.072	0.061	0.054	0.720	2.777	-5.152***l	-2.610*l	2002M01
Ghana	0.072	0.059	0.045	0.894	3.083	-3.451***l	-3.148**l	2000M09; 2004M04; 2009M03
Kenya	0.097	0.094	0.064	0.672	3.278	-3.067***l	-2.847*l	2008M11
Mauritius	-	-	-	-	-	-	-	2000M12; 2007M02; 2010M11
Morocco	0.025	0.018	0.027	1.774	6.306	-3.381**l	-3.484***l	2001M03
Nigeria	0.098	0.089	0.062	0.653	2.605	-3.064**/	-5.858***f	2002M08; M10; 2006M05; 2016M06
South Africa	0.138	0.095	0.125	1.009	3.142	-3.717***f	-6.089***f	1999M12
Zambia	0.103	0.071	0.090	1.431	4.222	-3.010**l	-6.599***f	2000M03; M10; 2004M04
Exchange Market Pressure								
Algeria	-1.653	-0.803	9.348	-8.347	89.528	-7.259***l	-22.95***l	
Congo DR	-2.016	-0.142	28.397	-0.830	23.912	-14.920***l	-14.866***l	
Cote d'Ivoire	68.224	0.010	1127.807	16.871	285.765	-16.958***l	-16.958***l	
Ghana	1.071	0.739	11.606	1.672	11.688	-8.126***l	-17.077***l	
Kenya	-0.798	-0.629	5.877	0.590	10.029	-13.729***l	-13.723***l	
Mauritius	-0.295	-0.260	4.622	0.021	8.387	-14.163***l	-14.528***l	
Morocco	-0.590	-0.427	5.326	-0.316	7.281	-16.006***l	-16.006***l	
Nigeria	-0.406	-0.375	6.727	0.584	6.460	-13.993***l	-14.969***l	
South Africa	-0.360	-0.133	9.266	2.259	27.365	-14.067***/	-14.709***l	
Zambia	-1.469	-1.390E-05	17.260	-1.951	19.367	-20.721***l	-20.767***l	

Notes: Preliminary summary statistics for global and domestic uncertainties for ten African economies are presented in this table. Std., Skew. Kurt., ADF, and PP denote standard deviation, skewness, kurtosis, Augmented Dickey–Fuller test, and Phillips–Perron respectively. To ascertain the timing and number of breaks, we also provide Bai–Perron multiple test results, implemented following L + 1

vs. L sequential, with a trimming option of 0.15, five maximum breaks, and 5% level of significance. l and f represent stationarity stages at level and first difference respectively. ***, **, and * denote 1%, 5%, and 10% level of significance respectively.

Next, we present the results of unit root tests for the Augmented Dickey–Fuller (ADF) and Phillip–Perron (PP). In *Table 2*, both tests of unit roots showed the rejection of the presence of unit root at the 1%, 5%, and 10% significance levels. Therefore, the variables for EMP in each country are stationary at 1% level, i.e. integrated of order I(0), while in the case of policy uncertainty, Congo DR and South Africa are stationary at first difference – integrated of order I(1) while other countries are of order I(0).

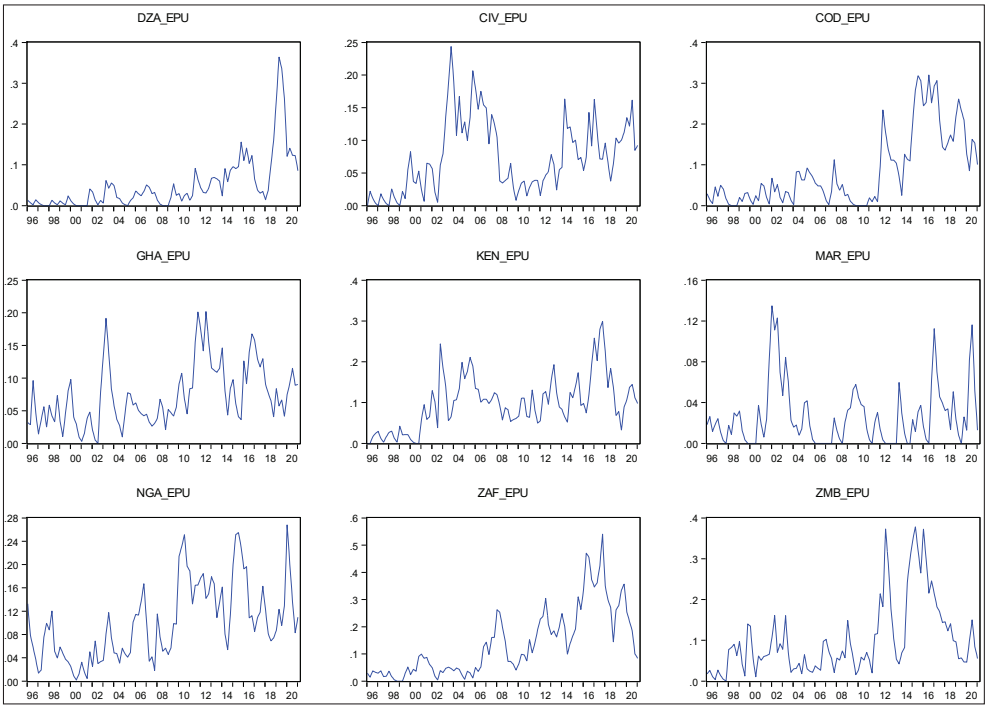

Figure 1. *Domestic Uncertainty Indices for individual countries*

Note: DZA, CIV, COD, GHA, KEN, MAR, NGA, ZAF, and ZMB represent Algeria, Cote d'Ivoire, Congo DR, Ghana, Kenya, Morocco, Nigeria, South Africa, and Zambia respectively. Vertical axes display the values for uncertainty, while horizontal axes denote the time periods.

Moreover, given the duration of our study, there may be structural adjustments in the relationship between EPU and EMP over the years. It is therefore recommended to evaluate the existence of structural breaks in the link between exchange market pressures and economic policy uncertainty. In this study, we followed Bai and Perron's (1998, 2003) test approach for multiple structural breaks. The outcomes

are displayed in *Table 2*, and it can be observed that the economies have at least between one and four breaks. Algeria, Cote d'Ivoire, Kenya, Morocco, and South Africa experienced one break each in 2000M11, 2002M01, 2008M11, 2001M03, and 1999M12 respectively. Congo DR (2001M07, 2005M02, 2009M02), Ghana (2000M09, 2004M04, 2009M03), Mauritius (2000M12, 2007M02, 2010M11), and Zambia have three breaks each (2000M03, M10, 2004M04), and Nigeria has four breaks (2002M08, M10, 2006M05, 2016M06). The outcomes from the structural break tests showed evidence of the spillover effects of major global events to developing markets economies; these include the dot-com bubble of 2001, the global financial crisis of 2007–2009, and the 2010 debt crisis in Europe.

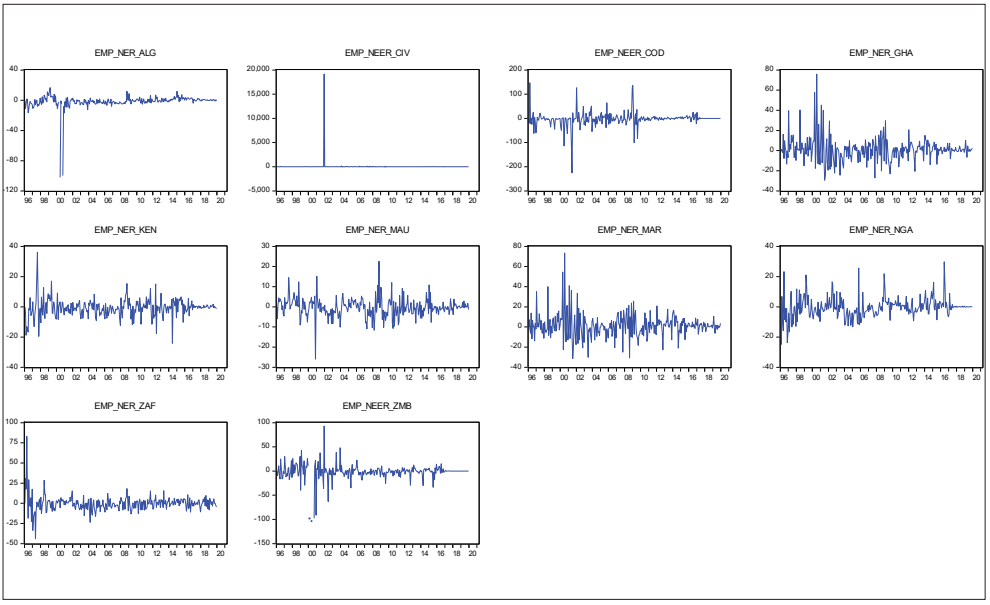

Figure 2. *Exchange market pressures for individual countries*

Note: EMP denotes exchange market pressure. The graphs are for Algeria, Cote d'Ivoire, Congo DR, Ghana, Kenya, Mauritius, Morocco, Nigeria, South Africa, and Zambia. Vertical axes display the values for EMP, while horizontal axes denote the time periods.

In addition, we present a graphical analysis of the key variables in *figures 1–2* (i.e. economic uncertainties and exchange market pressures). *Figure 1* reveals that each country experiences different levels of uncertainty at different periods. For instance, Algeria had high spikes between 2015 and 2017 and in 2019; Cote d'Ivoire experienced high uncertainties between 2003 and 2008 and from 2014 to 2019; Congo DR had high spikes in 2012–2013 and from 2015 to 2019; Ghana showed uncertainties in the periods of 2003, 2011–2014, and 2015–2018; in the case of Kenya, irregular spikes could be observed in 2003, 2004–2008, 2013, and 2016–

2018. Furthermore, Morocco had high uncertainties in the periods of 2001–2003, 2008–2010, 2013, and 2016–2019; Nigeria displays various levels of uncertainty at different periods such as 1997, 2003, 2006, 2008, 2009–2013, 2015, and 2019; South Africa had spikes between 2007 and 2008, 2011 and 2013, and 2015 and 2019; and, lastly, Zambia had high levels of domestic uncertainties in 2011–2012 and from 2014 to 2018. Moreover, *Figure 2* for exchange market pressure indicates that all the countries experienced significant and intensive pressure in their exchange rate management around the period from 2000 to 2003. However, the intensities appear to be more pronounced in Ghana, Kenya, Mauritius, Morocco, Nigeria, and Zambia.

Empirical Analysis

Structure and Degree of Dependence

The QR framework is employed to evaluate the dependence between EPU (global and domestic) and exchange rate management in Africa. We present and discuss the estimation results for both the OLS and QR models. However, the OLS model computes the average consequences of the explanatory variables of the response variable (Cade and Noon, 2003). It has the disadvantage of generating under- or overestimate impacts in diverse conditional distributions. And the OLS estimations do not provide the whole picture about the impact of EPU on EMP. Our analyses have two parts: first, we present the OLS and QR results for each of the markets in our sample, and, second, we present the panel OLS and QR results. Based on the literature on QR, we present estimated results for eight quantiles running from the 5^{th} to the 95^{th} quantile, considering both global and domestic uncertainty. A pair of bootstrapping standard errors are also included following the procedure proposed by Buchinsky (1995).

Panel Results

To evaluate the influence of both global and domestic economic uncertainty on foreign exchange management in Africa, we employ a panel of ten African countries based on monthly data for the period from 1997M01 to 2019M12. To achieve our objectives in this study, we use the penalized panel quantile regression to examine how African economies manage their foreign exchange markets in the face of global and domestic economic uncertainties. *Table 4* presents the seven selected quantiles (0.05, 0.10, 0.25, 0.50, 0.75, 0.90, 0.95) of the estimated coefficients of the panel quantile regression for the sampled African economies. As a form of robustness to our panel QR results, we also presented the estimates of a pooled ordinary least-square (pooled OLS) regression in *Table 3*.

Table 3: *Exchange Rate Management and Economic Uncertainty*

	(1)	(2)
	Model 1	Model 2
VARIABLES	Pooled OLS	Pooled OLS
GLOBAL_EPU	-0.4335	
	(0.6198)	
TERMS_OF_TRADE	0.0003	0.0028
	(0.0067)	(0.0074)
INTEREST_RATE	0.1552***	0.1573***
	(0.0348)	(0.0382)
COMSUMER_PRICE_INDEX	0.0114*	0.0040
	(0.0065)	(0.0061)
FOREIGN_RESERVE	-0.0299	-0.0655
	(0.2783)	(0.3322)
MONEY_SUPPLY	0.1517	0.1671
	(0.1746)	(0.1926)
DOMESTIC_EPU		5.4989*
		(3.1637)
Constant	-4.3511	-6.2168
	(4.9520)	(5.3522)
Observations	2,878	2,878
R-squared	0.0212	0.0242

Notes: Model 1 captures Global Economic Uncertainty, while Model 2 captures Domestic Uncertainty Index. Standard errors are in parentheses. ***, **, and * represent significance levels at 1%, 5%, and 10% respectively.

Starting from the pooled OLS results in *Table 3*, our analyses are provided in two models – Model 1 captures the global economic uncertainty, while Model 2 contains the individual countries' domestic policy uncertainty. Thus, Model 1 in *Table 3* reveals that global economic uncertainty is negatively related to the foreign exchange market of these African economies, but the impact is statistically insignificant at all conventional levels. On the other hand, in Model 2, contrary to the global uncertainty index, we find that domestic uncertainties have a positive and a 10% significance impact on the African foreign exchange market. From the pooled OLS results, we can conclude that the pressure in exchange rate management in Africa intensifies as the level of domestic uncertainty becomes more prominent. Further, we present results for the other macroeconomic variables, and the results indicate that all the regressors positively influenced exchange rate management in Africa, except for FER, which shows a negative effect. These relationships are significant only at 1% and 10% in the cases of IR and CPI, respectively. However,

it should be noted that the pooled OLS model results, as reported in *Table 3* and *Table A1*, are poorly fit, as the low values for the R-squared indicators suggest.

Results for the panel QR regression are displayed in *Table 4* as panels A & B – Panel A captures the effects of global economic uncertainty, while Panel B captures domestic policy uncertainty. From Panel A, it can be concluded that the effect of global policy uncertainty on the African foreign exchange market is positive and significant for the 0.05, 0.10, 0.50, and 0.95 quantiles but negative and significant for the 0.75 and 0.90 quantiles of this region. It is obvious from the results that the intensity of the co-movement between the African foreign exchange rates and the global uncertainty index declines from the 0.05 quantile to the 0.10 quantile and then improves again in the intermediate quantile. It turns negative in the 0.75 and 0.90 quantiles before returning to positive in the extreme upper quantile (i.e. 0.95). These outcomes suggest that the degree and structure of dependence declines from the bearish to the harshly declining markets, recovers during the tranquillity or transitional market conditions, then dampens in the bullish market (0.75 and 0.90), whereafter it increases in the extreme bullish (0.95) markets. Thus, it can be submitted that the African foreign exchange market and global economic uncertainty exhibit a heterogeneous or asymmetric co-movement as the dependence structure varies across the different quantiles. Intensity rises during the bearish and transitional markets, but dependence declines during the bullish markets.

Further, in Panel B, our results show that the domestic uncertainty effect on exchange rate management in Africa is also highly significant for all the quantiles. Specifically, it is positively significant for all the quantiles except for the harshly declining market (0.10), which is negative and significant. This relationship is positive for the bearish market (0.05), the intermediate market (0.50), and the bullish markets. The correlation between domestic uncertainty and African exchange rate market strengthens from the lower to the upper percentiles, which signifies that the structure of dependence improves around the upper tails but declines during the lower tails. Actually, there is evidence of non-linear co-movement among exchange rate markets when we investigate the different percentiles across time. Thus, the African foreign exchange market and their domestic uncertainties exhibit asymmetric correlation as the magnitude of dependence rises during high markets pressures, but the degree of dependence drops when there is less pressure in the market.

Overall, when considering African economies as a group, in a panel analysis, the results between economic uncertainty and foreign exchange market show that there is a significant co-movement between global economic uncertainty and foreign exchange market in Africa. Also, we have found significant co-movement between these countries' foreign exchange markets and their domestic policy uncertainty. Several inferences can be drawn from these results. First, in general, the exchange rate management of these African markets is collectively susceptible to the spillover

effects occasioned by the global economic uncertainty. Secondly, we also agree that African foreign exchange markets are also influenced by locally induced policy uncertainties. This suggests that there is evidence of detrimental and unfavourable policy summersault, which may lead to chains of reactions, thereby worsening the general economy. Our findings in this study are consistent with extent studies on the relationship between economic uncertainty and exchange rates (see Krol, 2014; Aizenman and Binici, 2016; Kido, 2016; Das and Kumar, 2018; Olanipekun et al., 2019).

Table 4. *QR Exchange Rate Management and Economic Uncertainty*

Panel A:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
VARIABLES/ QUANTILES	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
GLOBAL_EPU	0.20***	0.16***	0.27	0.33***	-0.61***	-0.56***	0.07***
	(0.00)	(0.00)	(0.00)	(0.05)	(0.01)	(0.00)	(0.01)
TERMS_OF_ TRADE	0.01***	0.00***	0.00	-0.00***	-0.01***	-0.02***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
INTEREST_ RATE	0.17***	0.16***	0.08	0.06***	0.13***	0.19***	0.38***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
COMSUMER_ PRICE_INDEX	0.05***	0.04***	0.02	0.00	-0.00***	-0.01***	-0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FOREIGN_ RESERVE	0.73***	0.07***	-0.26	0.25***	0.71***	0.54***	-0.52***
	(0.00)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)
MONEY_ SUPPLY	0.96***	1.03***	0.49	-0.12***	-0.40***	-0.50***	0.06***
	(0.00)	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Observations	2,878	2,878	2,878	2,878	2,878	2,878	2,878
Number of groups	10	10	10	10	10	10	10
Panel B:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
VARIABLES/ QUANTILES	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
DOMESTIC_ EPU	2.01***	-3.94***	1.88***	3.06***	5.25***	4.36***	8.22***
	(0.06)	(0.03)	(0.00)	(0.01)	(0.06)	(0.00)	(0.03)
TERMS_OF_ TRADE	0.00***	-0.01***	-0.01***	-0.01***	-0.01***	-0.01***	0.03***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Panel B:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
VARIABLES/ QUANTILES	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
INTEREST_ RATE	0.21***	0.15***	0.12***	0.09***	0.12***	0.17***	0.37***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
COMSUMER_ PRICE_INDEX	0.02***	0.05***	0.02***	0.01***	-0.01***	-0.02***	-0.07***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FOREIGN_ RESERVE	1.46***	1.66***	0.52***	0.42***	0.55***	-0.18***	-1.79***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
MONEY_ SUPPLY	0.96***	0.37***	0.38***	-0.10***	-0.37***	-0.42***	0.33***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	2,878	2,878	2,878	2,878	2,878	2,878	2,878
Number of groups	10	10	10	10	10	10	10

Notes: The table contains the estimated coefficients for the quantile regression. Panel A captures Global Economic Uncertainty, and Panel B captures Domestic Uncertainty Index. Bootstrapped standard errors are reported in parentheses. ***, **, and * represent significance levels at 1%, 5%, and 10% respectively.

5. Conclusions

The main objective of this paper was to investigate the effects of global economic uncertainties on exchange rate management in Africa from 1996 to 2019 employing the quantile regression approach. The first specific investigation centred on the effect of global economic uncertainties on exchange rate management in Africa, and the second one looked into the effect of domestic economic uncertainties on exchange rate management in Africa. Results showed that both global and domestic economic uncertainties have significant implications for exchange rate management in Africa.

Based on the findings of this study and the fact that African countries, being highly dependent on developed economies, are vulnerable to external shocks, global economic uncertainties become a major concern. Thus, African countries must do all within their capacities to improve their economic status in order to reduce the level of dependence on global economies, especially on the developed countries of the world. In the meantime, African countries should pay keen attention to what goes on in global economy in order to combat any impending negative effect of the global economic uncertainties. In the same vein, African economies should pay attention to other uncertainties, such as political and social, or other factors that may aggravate domestic economic uncertainties.

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Appendices

Table A1. *Exchange rate management and economic uncertainty*

	(1)	(2)	(3)	(4)
	Model 1	**Model 1**	**Model 2**	**Model 2**
VARIABLES	**OLS with global_ EPU**	**OLS with global_ EPU**	**OLS with domestic EPU**	**OLS with domestic EPU**
global_epu	1.9201	22.0506		
	(14.5123)	(21.4975)		
terms_of_trade		0.2869		0.2640
		(0.1992)		(0.1981)
interest_rate		-0.6138		-0.5325
		(0.8609)		(0.8574)
comsumer_ price_index		0.1419		0.2194
		(0.2540)		(0.2436)
foreign_reserve		-12.6734***		-12.6754***
		(3.4506)		(3.4520)
money_supply		4.9751		5.0463
		(3.5302)		(3.5307)
dummy_GFC		-39.9118*		-29.7896
		(23.5978)		(21.4428)
domestic_epu			3.8767	0.8642

	(1)	(2)	(3)	(4)
	Model 1	Model 1	Model 2	Model 2
VARIABLES	OLS with global_ EPU	OLS with global_ EPU	OLS with domestic EPU	OLS with domestic EPU
			(31.7922)	(32.1717)
Constant	-3.0950	20.9986	5.7102	113.1451
	(68.9411)	(139.4699)	(7.0202)	(106.7164)
Observations	2,880	2,880	2,880	2,880
R-squared	0.0000	0.0061	0.0000	0.0058

Notes: Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. Model 1 captures Global Economic Uncertainty, while Model 2 captures Domestic Uncertainty Index.

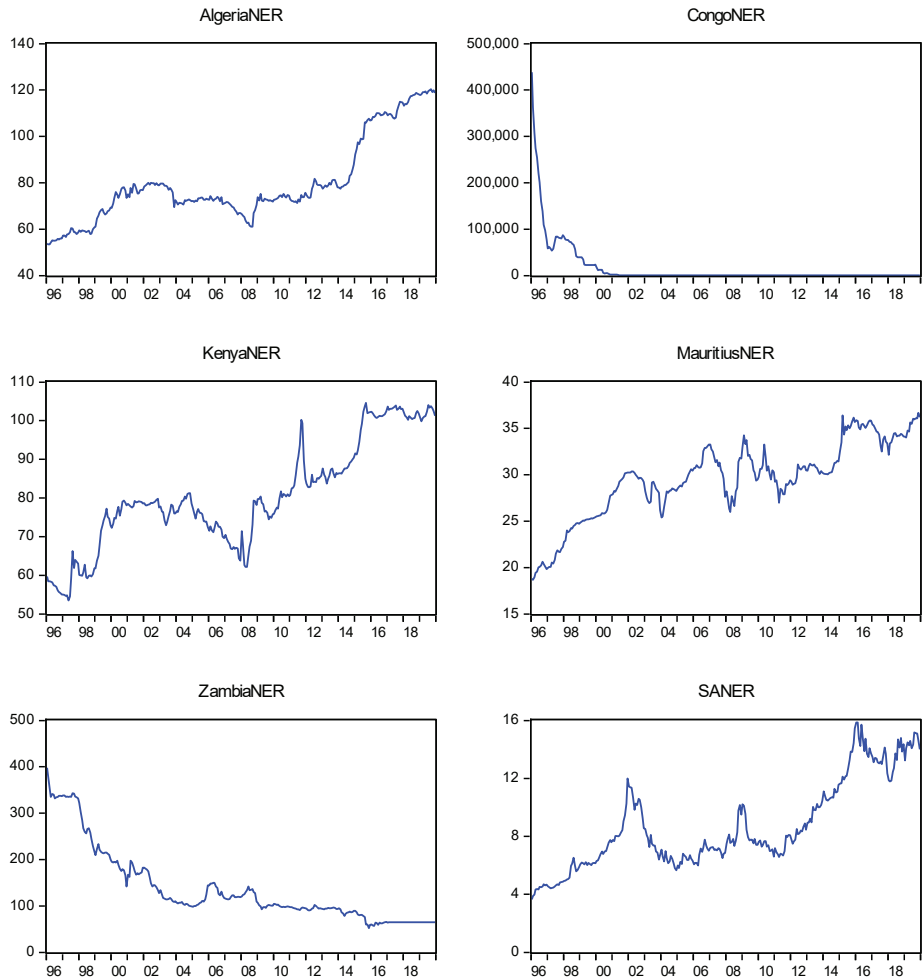

Figure A1-a. *Trend analysis of nominal exchange rates (1996–2019)*

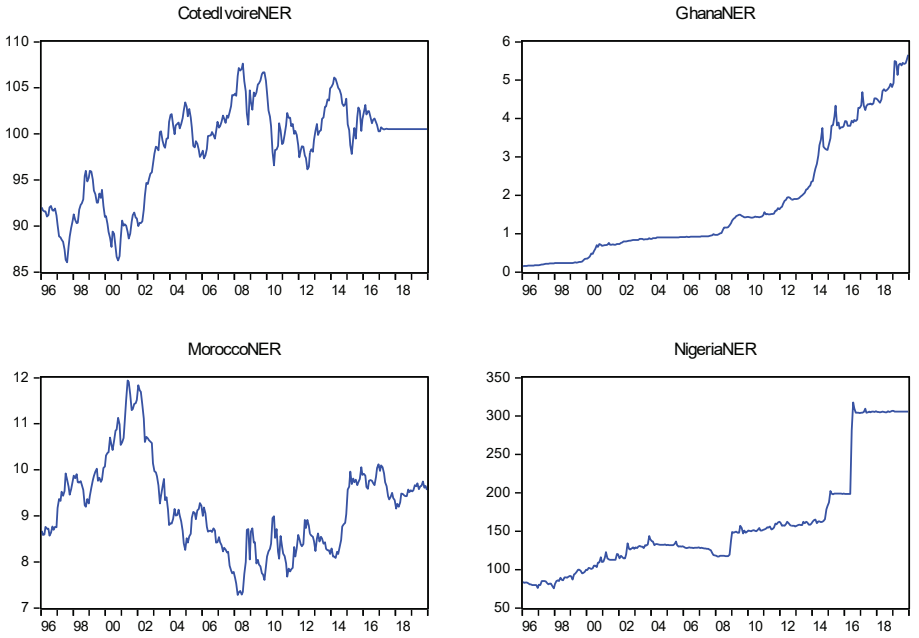

Figure A1-b. *Trend analysis of nominal exchange rates (1996–2019)*

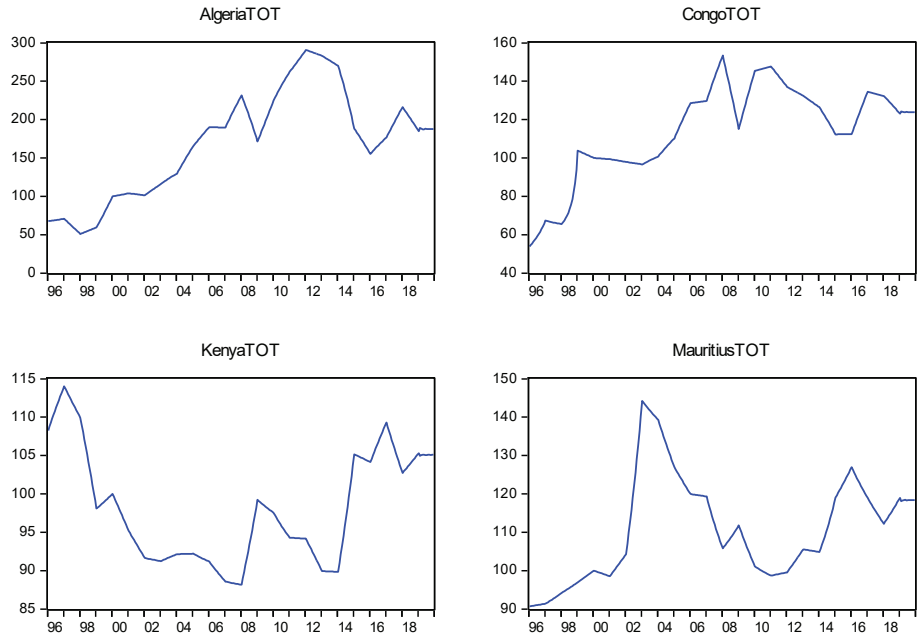

Figure A2-a. *Trend analysis of terms of trade (1996–2019)*

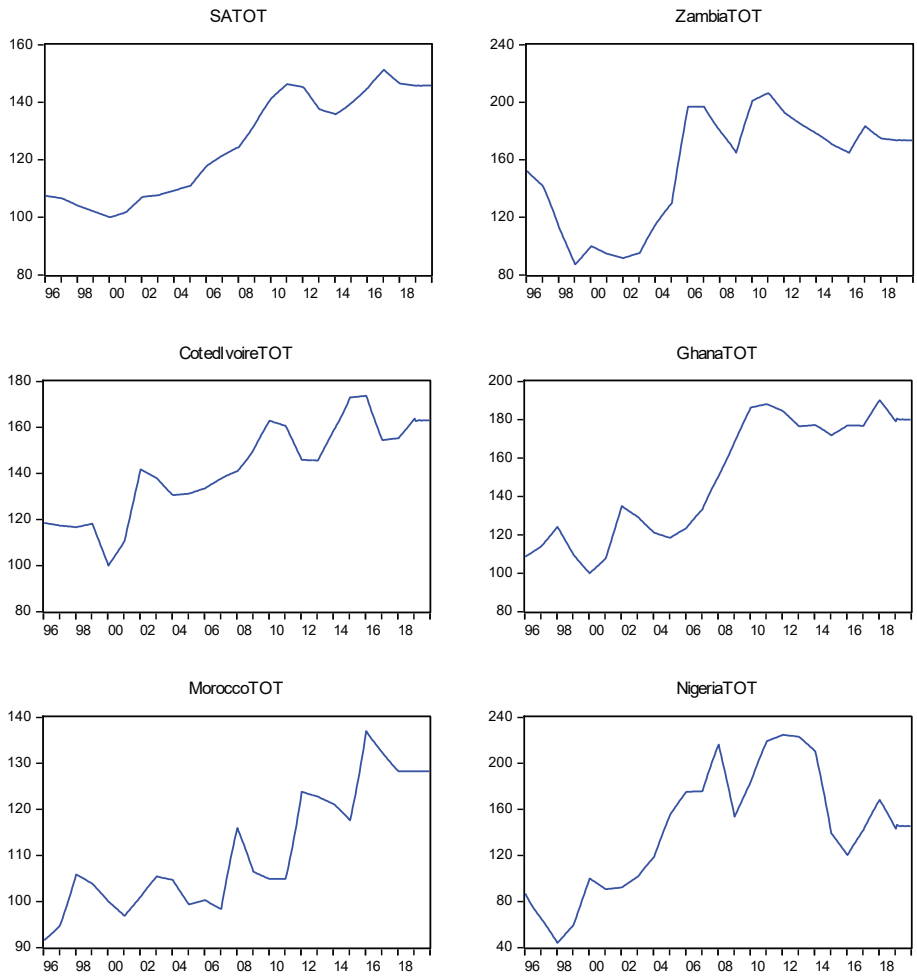

Figure A2-b. *Trend analysis of terms of trade (1996–2019)*

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The Impact of Emotionally Intelligent Academic Leadership on Faculty Members: Evidence from the Education System of India

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Abstract. This study investigates the impact of emotionally intelligent academic leadership on faculty members' organizational commitment and citizenship behaviour in selected colleges in south India. The data for the study is collected from 352 faculty members using a survey study approach and assessed through descriptive and inferential statistics. Statistical results suggest that respondents' perceptions of their academic leaders were more or less similar, and most of them rated self-awareness as the essential characteristic of emotional intelligence of their academic leaders. The findings demonstrate that most faculty members are dedicated to their organization and exhibit relatively high affective commitment compared to other aspects of organizational commitment. The relationship between emotionally intelligent leadership and faculty members' organizational commitment is partially mediated by faculty members' citizenship behaviour. This research contributes to the Indian academic system in developing strategies for academic leaders' emotional growth and increasing the level of commitment and citizenship behaviour of faculty members.

Keywords: academic leadership, organizational commitment, emotional intelligence, Indian higher education, faculty members

JEL Classification: I23

1. Introduction

The term "emotional intelligence" (hereafter EI) is gaining popularity and acceptance in the business sector. Salovey and Mayer (1990) were first to introduce this term. However, it was Goleman (1995) who made it famous when he described EI as a potential factor in comprehending and anticipating representatives' performance in the working environment. He also propounded the four popular dimensions of emotional intelligence: self-awareness, self-management, social awareness, and

relationship management. According to Goleman (1998), "leaders with high levels of emotional intelligence tend to boost performance and get results". Therefore, it is imperative for leaders to maintain control over their moods and feelings towards themselves and others.

The concept of commitment has gained organizational interest since it refers to the level of investment that people make in or the bond they share with their organization (Peretomode and Bello, 2018). Allen and Meyer (1990) define organizational commitment as a psychological condition characterized by a desire to stay and a need to provide services at an organization. Investigations into faculty members' organizational commitment revealed that while all teachers are committed, their level of commitment varies (Zafar, 2019). Academic research has found a link between organizational commitment and citizenship behaviour among the various faculties in educational institutions (Salehi, 2011). Grego-Planer (2019) states that organizational commitment is one of the antecedents of organizational citizenship behaviour.

Our study makes significant contributions to existing literature. First, it adds emotionally intelligent academic leadership to the body of knowledge as a new variable in higher education in the Indian context. Second, if higher education institutions want to succeed, they must focus on training programmes that help to build leaders' emotional intelligence, as it has great impact on organizational commitment and citizenship behaviour among colleagues. Monitoring emotional intelligence among academic leaders would lead to better leadership practices and, as a result, higher decision-making quality. Finally, our empirical research testifies the affective commitment of faculty members towards their organization, which is very different from that of Indian university professors, as studied by Bashir and Gani (2020).

The remainder of the paper is organized as follows. Section 2 describes the literature review, research framework, and hypothesis. Section 3 presents the methodology. Section 4 reports the baseline results and data analysis. Section 5 presents a discussion on the robustness of the tests. Section 6 concludes the paper.

2. Literature Review

Salovey and Mayer (1990) coined the term "emotional intelligence" (EI) and defined it as "an individual's capacity to regulate his or her emotions appropriately and involves the ability to monitor one's own and others' feelings and emotions, to discriminate among them, and to use this information to guide one's own thinking and action". The primary task of this research is to identify the emotional dimensions of academic leaders. The study identifies the emotional and leadership qualities using content analysis of four EQ techniques (Mayer and Salovey, 1997;

Goleman, 2001) and leadership approaches (Posner and Kouzes, 1993). The dimensions identified are self-awareness, emotion regulation, self-motivation, social skills, and leadership skills. According to Goleman's popular book *Working with Emotional Intelligence* (1998), emotional intelligence accounts for 67% of the qualities needed to be a successful leader. It is twice as important as technical proficiency or IQ. Many authors have emphasized the importance of academic leadership in helping higher education institutions prosper and accomplish their goals. However, till date, the term "academic leadership" is not always used consistently (Bikmoradi et al., 2010). Academic leadership is defined as "the part of the administrative functions in educational institutions assigned to top managers, university presidents, vice-chancellors, deans, department heads, and all academic professionals who have both leadership and managerial responsibilities" (Hecht et al., 1999: 634).

Sheldon (1971) describes organizational commitment as "an attitude or orientation toward the organisation that connects or attaches a person's identity to the organisation". Meyer and Allen (1991) establish a multidimensional commitment model, which includes three components: affective, continuance, and normative. The affective commitment is discussed as the employees' psychological bond, and identification with the organization is stated as affective commitment (AC). On the other hand, continuance commitment (CC) is concerned with understanding the financial and psychological implications of quitting one's employer. The third component, normative commitment (NC), is concerned with the employee's ideology or sense or feeling of responsibility to the organization and the individual's moral view that continuing within the organization is right and honourable.

The concept of "organizational citizenship behaviour" was first introduced by Organ and colleagues (Smith et al., 1983). Organizational citizenship behaviour "is employee behaviour above and beyond the call of duty and is therefore discretionary and not rewarded in the context of an organisation's formal reward structure" (Konovsky and Pugh, 1994). A default understanding is that "the behaviour or act should be outside the formal reward structure, not part of the defined job requirements and performed for the organisation's good" (Organ, 1988). Since its inception, the concept has gained significant academic attention. It is seen as intangible; OCB is not often legally recognized or rewarded. Further, terms such as "helpfulness" and "friendliness" are difficult to define. However, OCB has a significant beneficial influence at the organizational level, increasing organizational performance from 18% to 38% across multiple measurement parameters (Podsakoff et al., 2000; Ehrhart, 2004). It replicates "the flexible nature of workers' roles in the modern workplace and acknowledges that employees do get recognised and rewarded for engaging in OCB" (Van, 2000).

Few connected studies have been conducted to assess the relationship between emotional intelligence, academic leadership, and organizational commitment

among faculty members, indicating a research deficit. However, no relevant research has been conducted in the education industry to discover the mediating role of citizenship behaviour between an academic leader's emotional intelligence and the commitment aspects of faculty members in the context of the Indian higher education sector.

Research Framework

The research model used in this study is illustrated in *Figure 1*. We posit that emotionally intelligent academic leadership has a positive impact on faculty members' organizational commitment directly or indirectly through organizational citizenship behaviour. We also propose a positive effect of emotionally intelligent academic leadership on organizational citizenship behaviour. Additionally, there is also a positive impact of organizational citizenship behaviour on the organizational commitment of faculty members. Based on established relationships in the past, a research model is developed for these variables with emotionally intelligent academic leadership as an independent variable, organizational commitment as the dependent variable, and organizational citizenship behaviour as the mediating variable.

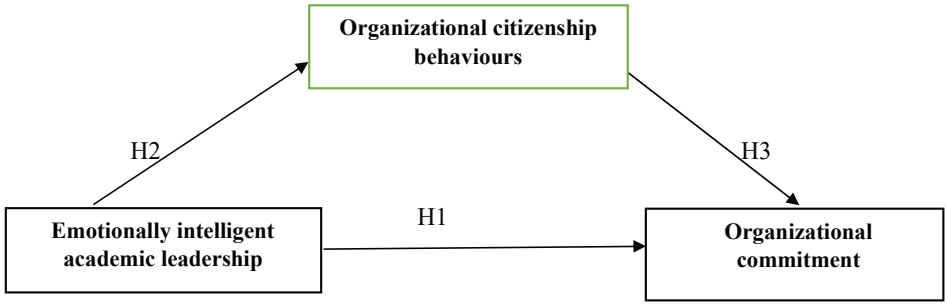

Figure 1. *Research framework*

Hypotheses

Based on the research framework and the relationship between the various variables of the study, we formulate the following hypotheses:

H1 – An emotionally intelligent academic leadership has a positive impact on the organizational commitment of faculty members.

H2 – An emotionally intelligent academic leadership has a positive impact on the organizational citizenship behaviour of faculty members.

H3 – There is a positive influence of organizational citizenship behaviour on the organizational commitment among faculty members.

H4 – Organizational citizenship behaviour partially mediates the influence of emotionally intelligent academic leadership on faculty members' organizational commitment.

3. Methodology

Data was collected from 352 respondents who were academic members working as assistant professors, associate professors, and professors at various colleges in south India. For data collection, a questionnaire survey was used. The respondents had to provide details about their gender, age, educational level, employers, jobs, and period of service. In the next stage, they were asked to answer 16 questions on the emotionally intelligent academic leadership provided by their immediate reporting academic leaders, such as a dean, head of the department, or director. Next, they had to answer 15 questions on whether and how this form of leadership affected their levels of organizational commitment. Finally, they were asked to rate ten questions related to organizational citizenship behaviour as mediating the influence of emotionally intelligent academic leadership on the organizational commitment of faculty members.

The first section of the survey dealt with the respondents' demographic details followed by the 16-item scale of emotionally intelligent academic leadership (Hyde et al., 2002; Posner, 1993), the 15-item scale of organizational commitment by Meyer and Allen (1990), and the organizational citizenship behaviour scale of 10 items by Podsakoff et al. (1997) and Lee and Allen (2002).

4. Results and Analysis

As shown in *Table 1*, the 352 respondents in this study included both females (n = 194, 55.10%) and males (n = 158, 44.90%). The majority of the respondents were 29–35 years old (n = 112, 31.8%) with a post-graduate education (n = 149, 42.3%). Most of them had 6–10 years (n = 134, 38.1%) or more than 10 years (n = 125, 35.5%) of work experience. Regarding the college, most respondents worked in private aided colleges (n = 166, 47.2%). The majority of the respondents were assistant professors (n = 299, 84.9%), followed by associate professors (n = 36, 10.2%) and professors (n = 17, 4.8%).

Table 1. *Respondents' profiles*

	Count (352)	Percentage		Count (352)	Percentage
Gender			**Educational Qualifications**		
Male	158	44.9	PhD	130	36.9
Female	194	55.1	MPhil	72	20.5
			PG	149	42.3
Age			**College**		
22–28	51	14.5	Government	106	30.1
29–35	112	31.8	Private Aided	166	47.2
36–42	106	30.1	Private Un-Aided	80	22.7
43–49	57	16.2			
50–60	26	8.8			
Work Experience			**Academic Designation**		
03-May	93	26.4	Assistant Prof.	299	84.9
06-Oct	134	38.1	Associate Prof.	36	10.2
Above 10	125	35.5	Professor	17	4.8

Descriptive Statistics

Table 2. *Descriptive statistics and correlations (N = 352)*

	EIAL	OC	OCB
EIAL	1		
OC	.442**	1	
OCB	.434**	.359**	1
Mean	3.9886	3.6449	4.2727
SD	0.76041	0.68897	0.55552
Skewness	-1.525	-0.769	-0.435
Kurtosis	4.043	0.713	1.051

Notes: * $p < .05$; ** $p < .01$;
EIAL – emotionally intelligent academic leadership, OC – organizational commitment, OCB – organizational citizenship behaviour.

Table 2 shows the positive relationship between the variables used in the study, i.e. emotionally intelligent academic leadership, organizational commitment, and organizational citizenship behaviour. The data is substantially skewed.

Reliability and Validity of the Measurement Model

The precondition to run the factor analysis (Kaiser–Meyer–Olkin) and Bartlett's test of sphericity analysis were performed. The test results indicate that the sample was appropriate for factor analysis, as given in *Table 3*.

Table 3. *Results of the Kaiser–Meyer–Olkin measure of sampling adequacy*

Test for Emotionally Intelligent Academic Leadership (EIAL)	
Kaiser–Meyer–Olkin Measure of Sampling Adequacy	0.927
Bartlett's Test of Sphericity	
Approx. Chi-Square	2503.061
Sig.	0
Variance Explained	58.92
Test for organizational commitment (OC)	
Kaiser–Meyer–Olkin Measure of Sampling Adequacy	0.7
Bartlett's Test of Sphericity	
Approx. Chi-Square	1038.35
Sig.	0
Variance Explained	66.28
Test for organizational citizenship behaviour (OCB)	
Kaiser–Meyer–Olkin Measure of Sampling Adequacy	0.86
Bartlett's Test of Sphericity	
Approx. Chi-Square	1192.415
Sig.	0
Variance Explained	54.54

The Cronbach alpha value was tested, and it was 0.909 for EIAL, .705 for OC, and .856 for OCB. The AVEs were 0.4569 (EIAL), 0.553 (O.C.), and 0.476 (OCB), indicating convergent validity and, indirectly, content validity, with the exception of organizational commitment. The reliability of all constructs was demonstrated by CR yielding the following values: EIAL (.930), organizational commitment (.948), and OCB (.900), as given in *Table 4*.

Table 4. *Reliability and validity of the scales*

	Indicator	**Factor loading**	**AVE**	**Composite reliability**	**Cronbach alpha**
EIAL (Emotionally Intelligent Academic Leadership)	16	0.758–0.856	0.456	0.930	0.909
OC (Organizational Commitment)	15	0.664–0.795	0.553	0.948	0.705
OCB (Organizational Citizenship Behaviour)	10	0.657–0.841	0.476	0.9	0.856

Testing the Hypotheses with the Structural Equation Model

The structural model was examined using a PLM–SEM technique. *Table 5* and *Figure 2* describe the structural model. The first hypothesis suggests that an emotionally intelligent academic leadership significantly impacts faculty members' organizational commitment. Hypothesis 1 is supported ($\beta = 0.3791$; $t = 8.16$; $p < 0.001$), as seen in *Table 5* and *Figure 2*. This finding corroborates H1 of the study by demonstrating the importance of EIAL for organizational commitment. H2 is accepted since there is an important link between emotionally intelligent academic leadership and the OCB of university professors ($\beta = 0.522$; $t = 11.44$; $p < 0.001$). The next hypothesis (H3) indicates a significant association between OC and OCB among faculty members ($\beta = 0.392$; $t = 8.43$; $p < 0.001$); hence, H3 is accepted. OCB significantly mediates the relationship between EIAL and faculty members' organizational commitment ($\beta = 0.204$; $t = 6.83$; p 0.001), demonstrating that H4 is valid. High t values show that the independent variable EIAL significantly influences the mediating variable OCB and the dependent variable commitment. The moderating variable OCB also has an effect on the dependent variable OC.

Table 5. *Structural model*

Hypothesis	Coefficients	Standard Deviation	t-Statistic	p-Value	Decision
Emotionally intelligent academic leadership → organizational commitment	0.3791	0.046	8.16	***	Supported
Emotionally intelligent academic leadership → organizational citizenship behaviour	0.522	0.046	11.44	***	Supported
Organizational commitment → organizational citizenship behaviour	0.392	0.046	8.43	***	Supported
Emotionally intelligent academic leadership → organizational citizenship behaviour → organizational commitment	0.204	0.03	6.83	***	Supported

Note: * $p < 0.05$; *** $p < 0.001$.

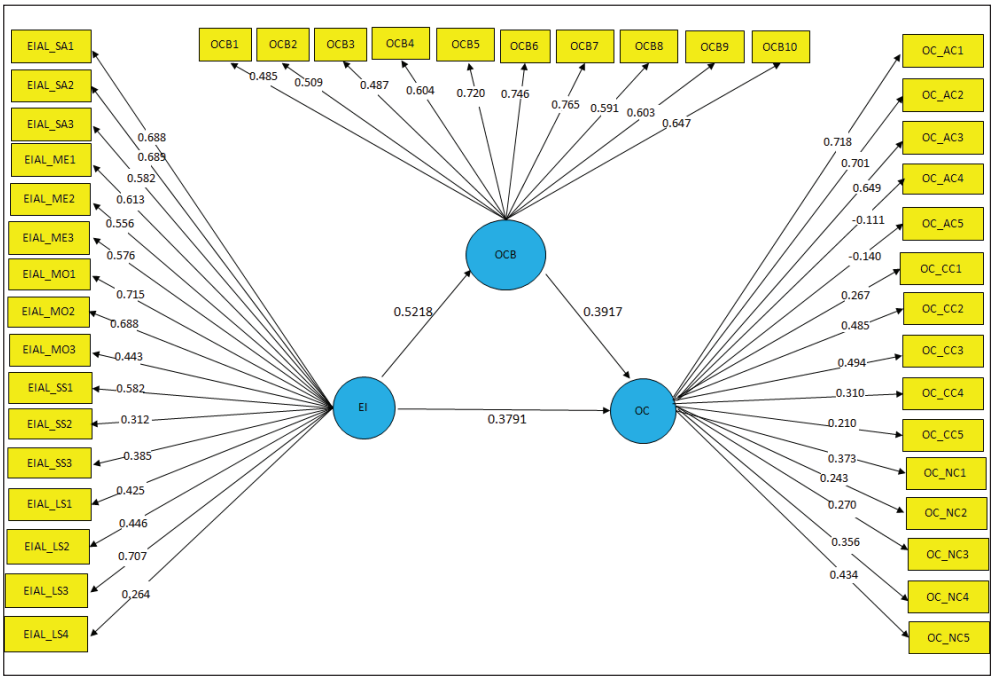

Figure 2. *PLS–SEM model*

5. Discussion

The core interest of this academic research was to explore and identify the leadership skills and the emotional dimensions of academic leaders in the Indian education system. Thus, this study used a survey method to collect data from the faculty members to understand how they perceive their leaders and how their leadership influences their organizational commitment. The study also explored the association between organizational citizenship behaviour and organizational commitment among faculty members. The role of organizational citizenship behaviour as a mediating variable is also explored. The main findings support the first hypothesis, which states that leaders in the academic sector will strongly and significantly impact the commitment level of their co-working professors. This study was closely linked with some of the previous literature (e.g. Qureshi, 2015). These findings show that emotional, academic leadership is absolutely crucial in motivating employees to become more invested in their organizations. Emotionally intelligent leaders positively impact their followers' affective, normative, and continuous commitment (Moin, 2018). In today's competitive climate, dedicated

and professionally committed professionals are vital assets to the success of any organization. Leaders with emotional intelligence can promote employee creativity. Furthermore, leaders with emotional maturity inspire and encourage subordinates to work better (Long and Kowang, 2015).

The second finding of the research confirms hypotheses H2 and H3. Data also revealed that 63% of the respondents strongly agreed that their academic leaders are emotionally mature and intelligent. The findings suggest that, similar to prior studies, self-awareness is the most widely recognized feature of emotional intelligence with 57% of the faculties reporting it (Long and Kowang, 2015). According to the findings, 61% of the respondents stated that they were committed to their organization. Among the commitment dimensions, the highest commitment was the affective commitment, in line with Absar (2010).

Nevertheless, an experiential study considering university professors from across the nation shows that a majority of them have a long-term commitment towards their organization because of the risks and costs of leaving. In summary, we may say that faculty members who work at universities have a long-term commitment since they want to remain with the organization. Teachers in arts and science institutions, on the other hand, have an affective commitment since they are emotionally invested in the organization. The study also analysed faculty members' organizational citizenship behaviour and found that 56% of the respondents accepted their citizenship behaviour towards the organization, in line with the literature (Ehrhart and Desai, 2019).

The final finding is in the context of the fourth hypothesis of this research. The conclusion aligns with Hasani et al. (2013), as affective and continuous commitments are strongly associated with organizational citizenship behaviour. One of the significant findings of this academic research was to establish the hypothesized relation that academic leaders strongly influence the citizenship behaviour of their fellow faculty members. This study demonstrated the association that academic leaders significantly influence co-working professors in the Indian higher education sector. However, this finding was supported by Miao (2018), who testifies to a similar relationship in other industries. This finding must be examined in the context of India's higher education system in general, as leaders in this sector often get influenced by traditional administrative philosophies (Parker 2013). Previous research provides strong evidence that humble leaders will significantly impact their fellow employees' citizenship behaviour (Qian et al., 2020). Furthermore, the Indian academic system emphasizes ranking and achieving world-class educational standing (Banker and Bhal, 2020).

6. Conclusions and Recommendations

This study examines the impact of emotionally intelligent academic leadership on organizational citizenship behaviour and organizational commitment among faculty members in India's arts and science colleges. The research explores the association and effect of citizenship behaviour on faculty members on the commitment aspects. Organizational citizenship behaviour plays a mediator role in the relationship between emotionally intelligent academic leadership and organizational commitment. This research is novel in that it considers this relationship in the context of the higher education sector in India in particular.

Managerial Implications

Academic leaders in the Indian education system need to exhibit emotional intelligence to enhance the level of organizational commitment among their colleagues and faculty members. Human resource capital is always the foundation of any organization, especially in the education sector, and success and reputation among the parents and students cannot be achieved without committed employees. Therefore, academic leaders should not behave as traditional managers. Instead, they should be leaders with motivation, self-respect, empathy, and social skills. They should take the initiative to ensure that the entire teaching staff receives appreciation and encouragement from the top management to be committed. Our findings can be beneficial to top-level management in the education sector in that they should invest in training and soft skills programmes to enhance their academic leaders' emotional intelligence. They will then be able to motivate their faculty members and ensure their commitment to the organization.

Research Limitations and Suggestions for Future Research

This study has its share of limitations that can be investigated in future studies. First, due to the unforeseen COVID-19 pandemic, a large number of teachers and a wider geographic area were eliminated. This omission could have had a negative impact on the research findings. Future studies could revisit the postulated association with broad geographical regions and diverse objectives. Second, the study's sample was limited to the education industry. The leadership style differs from one service industry to another such as hotels, banking, and insurance. Other service industries could be subjected to similar research. Third, university faculties might have been included in a study sample, but they were excluded due to official prohibitions. Finally, additional research is needed to determine the pattern of academic leadership, either as a leader or as a traditional manager, on the intended research.

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Topic Classification of Central Bank Monetary Policy Statements: Evidence from Latent Dirichlet Allocation in Lesotho

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Abstract: This article develops a baseline on how to analyse the statements of monetary policy from Lesotho's Central Bank using a method of topic classification that utilizes a machine learning algorithm known as Latent Dirichlet Allocation. To evaluate the changes in the policy distribution, the classification of topics is performed on a sample of policy statements spanning from February 2017 to January 2021. The three-topic Latent Dirichlet Allocation model extracted topics that remained prominent throughout the sample period and were most closely reflective of the functions of the Central Bank of Lesotho Monetary Policy Committee. The topics identified are: (i) International Monetary and Financial Market Conditions; (ii) Monetary Policy Committee and International Reserves; (iii) Regional and International Economic Policy Conditions. The three-topic Latent Dirichlet Allocation model was determined as the most appropriate model through which a consistent analysis of topic evolution in Central Bank of Lesotho Monetary Policy Statements can be performed.

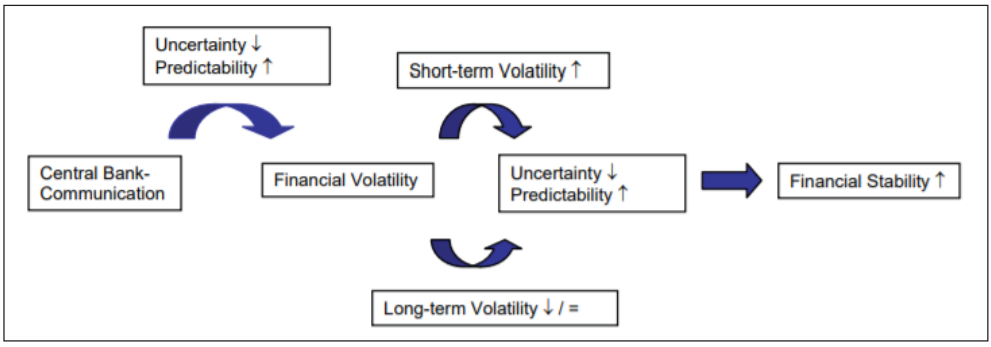
Keywords: monetary policy statement, topic modelling, central bank, Lesotho, Latent Dirichlet Allocation

JEL Classification: E5, E52, E58

1. Introduction

The primary mandate of the Central Bank of Lesotho (CBL) is to achieve and maintain price stability in the country. This is achieved through the one-to-one peg between the South African Rand and Lesotho's currency, the Loti (Damane, 2019). The CBL communicates its policy stance through its Monetary Policy Statement, a policy document released at the end of every meeting of the Monetary Policy Committee (MPC). The advantages of a clear policy communication from institutions such

as central banks cannot be overstated. Central Bank Monetary Policy Statements shape expectations about future policy actions. Although the statements usually carry quantitative measures and indicators, they also include detailed qualitative descriptions of current economic conditions and outlook, which can affect current and future financial market sentiment and conditions (Knütter et al., 2011; Vílchez-Román et al., 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021). *Figure 1* is an illustration of how central bank communication might affect financial stability.[1]



Source: Knütter et al., 2011

Figure 1. *The role of central bank communication in financial stability*

From *Figure 1*, clear and transparent communication of policy by central banks helps to maintain financial stability through the provision of clear, relevant, and credible information. When market participants better understand policies of monetary and financial stabilization, as communicated by the central bank (through its policy statements), this might reduce financial sector uncertainty and volatility and create a conducive environment for safe and stable financial activity. Although short-term volatility is possible, volatility in the long-term is muted, given clear and predictable central bank communication. In this case, asset prices will be aligned with overall monetary policy objectives (Knütter et al., 2011; Vílchez-Román et al., 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021).

There is currently no baseline way of how to analyse CBL MPC statements and concisely characterize the thematic or topical trends of the MPC's discussions over time. This is primarily due to the unstructured[2] nature of the text data.

1 Financial stability exists when there is confidence in the general functioning of key financial institutions and markets in the economy, such that real or financial asset price movements do not undermine the economy's monetary stability and levels of employment (Foot, 2003 – in Knütter et al., 2011).

2 Unstructured data is data often contained in business documents, reports, news articles, etc. It is free-form text data that cannot be immediately obtained or extracted from an electronic file or relational database with well-defined (structured) rows (records) and columns (fields) ("structured data", n. d.).

Recent years have seen marked advances in artificial intelligence (AI),[3] big-data analytics, machine learning,[4] and the digitalization and digitization of global economies and their data. These technological strides have made it possible for economic and financial data analysts to better infer policy guidance from qualitative information contained in policy documents such as Monetary Policy Statements. Using techniques such as natural language processing and topic modelling, analysts can extract "latent" or hidden patterns and relationships between text data, which would otherwise be a challenge to isolate and identify. This enables the assessment of the tone[5] and/or sentiment and discussion trends in Monetary Policy Statements (Edison and Carcel, 2021; Doh et al., 2021). Topic models are Bayesian statistical models that structure large quantities of discrete and unstructured textual data, known as "corpus" (from a document set), in terms of latent themes usually referred to as "topics". They facilitate analysis of how discussions around particular topics evolve and change through time (Blei et al., 2003; Shirota et al., 2015; Zhao et al., 2015; Schwarz, 2018; Dwivedi, 2018; Mahanty et al., 2019; Böök, 2019; Vílchez-Román et al., 2019; Reisenbichler and Reutterer, 2019; Rabindranath, 2020; Buenaño-Fernandez et al., 2020; Edison and Carcel, 2021; Doh et al., 2021).

This paper's objective is to analyse the monetary policy statements of Lesotho's Central Bank from February 2017 to January 2021 and to identify the evolutionary trends of key themes or topics discussed by members of the CBL MPC over the sample period using the Latent Dirichlet Allocation (LDA) topic modelling technique. LDA is an unsupervised machine learning algorithm developed by Blei and Jordan (2003) and Blei et al. (2003). It is the most widely used probabilistic method for modelling large quantities of corpus. The model's main assumption is that a series of topics can be derived from a combination of textual documents using all the documents' words (i.e. document vocabulary). The model's purpose is to use machine learning to uncover the latent/hidden (unobserved) topics in the corpus and how they are exhibited in each document. Topic development leverages a fixed vocabulary distribution of words that co-occur in a recurring pattern. In this way, a probability distribution over a set of topics can represent each document, while the distribution of probability over words in the corpus[6]

3 AI is defined by Merriam-Webster as "a branch of computer science dealing with the simulation of intelligence behaviour in computers [and] the capability of a machine to imitate intelligent human behaviour" ("Artificial Intelligence", n. d.).

4 Machine learning is a component of AI that designs a sequence of actions known as algorithms for purposes of solving a problem or identifying patterns in datasets that are often large and complex. The algorithms automatically optimize through experience and require little to no human intervention to do so – i.e. supervised learning, reinforcement learning, unsupervised learning (Financial Stability Board, 2017).

5 Despite its quantitative attributes, the tone of the monetary policy statement can be assessed to be either pessimistic or optimistic (Doh et al., 2021).

6 A policy statement could exhibit multiple topics and not fit just neatly into one, while all policy statements taken separately could each show varying proportions of the same topics (Reisenbichler and Reutterer, 2019).

can represent each topic. The LDA model is therefore from the family of mixed membership models. However, unlike classical clustering methods with binary variable membership, LDA allows every word to partially occupy all topics with varying probabilities. A vector of continuous non-negative latent variables that adds up to 1 represents the word membership across topics. Similarly, all topics extracted from the corpus are partial members of all documents with different probabilities (Blei et al., 2003; Shirota et al., 2015; Zhao et al., 2015; Schwarz, 2018; Dwivedi, 2018; Mahanty et al., 2019; Böök, 2019; Vílchez-Román et al., 2019; Reisenbichler and Reutterer, 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021).

To our best knowledge, this the first study of its kind in Lesotho. Most studies that employ topic classification to analyse recent discussion trends in central bank policy documents (i.e. Monetary Policy Statements and/or Minutes) are mostly found in developed countries (see: Shirota et al., 2015; Schwarz, 2018; Dwivedi, 2018; Mahanty et al., 2019; Böök, 2019; Vílchez-Román et al., 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021). This study adds to the monetary policy communication literature, especially in the developing world, by offering readers of the CBL Monetary Policy Statements a baseline of how to analyse the statements and to gather key information from their topical trends. Central bank communication that is clear and well understood by all relevant stakeholders can benefit policymakers through the pooling of knowledge and the management of expectations by market participants (Buenaño-Fernandez et al., 2020).

The remainder of the paper is organized such that an overview of the CBL Monetary Policy Committee with a focus on the monetary policy statements is offered in Section 2. Subsequently, Section 3 reviews the literature. An outline of the data and methodology is provided in Section 4. Section 5 presents the results and analysis. Section 6 concludes and gives policy recommendations, and Section 7 provides the areas for further study.

2. CBL Monetary Policy Committee and Statements

The CBL MPC's principal goal is to formulate and monitor the implementation of monetary policy towards price stability as outlined in sections 5, 6(c), and 6(d) of the CBL Act, 2000. According to CBL (2020), the functions of the MPC are four-fold, namely: (i) reviewing and formulating appropriate monetary policy responses to achieve and maintain price stability; (ii) reviewing the likely impact of international and domestic economic developments on the Bank's ability to achieve and maintain price stability (iii); to ensure that the Bank has adequate levels of foreign reserves required to maintain the one-to-one peg of the loti/rand exchange rate, through a decision on the targeted floor of Net International Reserves; (iv) regular review of

the Bank's monetary policy framework to inform the adoption of changes as and when necessary. Communication of MPC decisions is made through a Monetary Policy Statement that is placed on the CBL's website and sent to members of the press through the Corporate Communications Office. The frequency of MPC meetings is bi-monthly. This implies that, ordinarily, a total of six MPC Monetary Policy Statements can be expected in any one year.

3. Review of Literature

An overview of the common assumptions and relative costs associated with the different types of text classification methods is provided in this section. The section also discusses a handful of recent studies that use LDA and other topic modelling techniques to analyse topic trends in economic and financial publications and central bank policy documents (i.e. Monetary Policy Statements and/or Minutes, speeches, etc.).

Overview of Text Classification Methods

There are generally five ways in which discrete text data can be classified. These comprise topic modelling, supervised learning, dictionaries, human coding, and reading. *Table 1* presents the assumptions and costs that are associated with each of these methods. Asmussen and Møller (2019) explain that a comparison of the associated costs and assumptions across methods can add value to the decision of which method to use given the task at hand.

Table 1. *Discrete text categorization methods – common assumptions and relative costs*

	Method				
A. Assumptions	***Reading***	***Human Coding***	***Dictionaries***	***Supervised Learning***	***Topic Model***
Categories known	No	Yes	Yes	Yes	No
Category nesting is known	No	Yes	Yes	Yes	No
Features of relevant text are known	No	No	Yes	Yes	Yes
Mapping known	No	No	Yes	No	No
Ability to automate coding	No	No	Yes	Yes	Yes

B. Costs	*Reading*	*Human Coding*	*Dictionaries*	*Supervised Learning*	*Topic Model*
Pre-analysis Costs					
Conceptualization time – in person hours	Low	High	High	High	Low
Substantive knowledge requirement	Moderate/ High	High	High	High	Low
Costs of Analysis					
Time spent per text – in person hours	High	High	Low	Low	Low
Substantive knowledge requirement	Moderate/ High	Moderate	Low	Low	Low
Post-analysis Costs					
Time spent interpreting – in person hours	High	Low	Low	Low	Moderate
Substantive knowledge requirement	High	High	High	High	High

Source: Quinn et al. (2010)

From *Table 1*, the topic modelling approach is relatively much more convenient compared to the rest of the other methods. It does not require the prior knowledge of categories for classification. It can also be automated (reducing person hours), and it offers low costs across the analytic process.

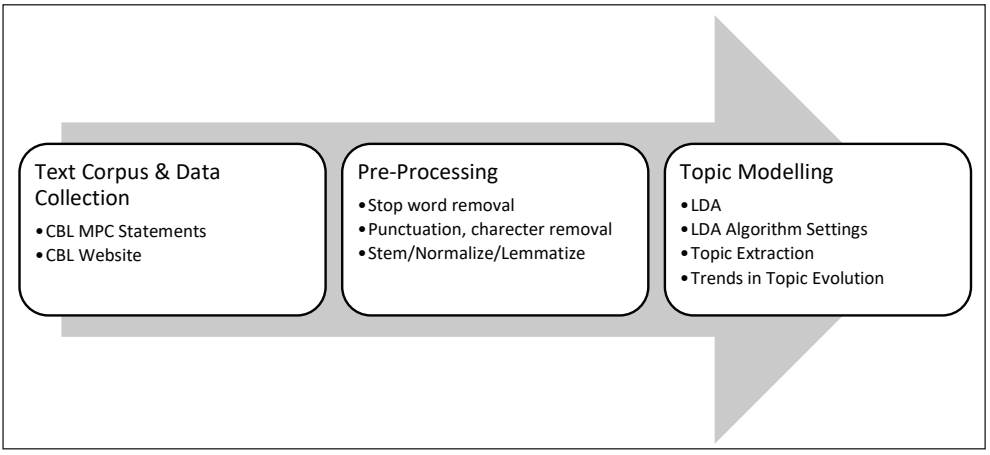
Empirical Literature

A detailed summary of each study is presented in *Appendix A1*. Unsurprisingly, given the dearth of these kinds of studies in the developing world, the empirical evidence reviewed is from developed countries. The studies focus on the topic classification of economic policy documents (i.e. Monetary Policy Statements and/ or Minutes) (see: Edison and Carcel, 2021; Doh et al., 2021; Vílchez-Román et al., 2019; Shirota et al., 2015) as well as customer comments that evaluate products or services the customers consume (see: Sperkova, 2018; Lee et al., 2018). Before the corpus is put through the LDA model, it is pre-processed (i.e. cleared of stop words, normalized, lemmatized, etc.). An assessment of model clustering (topic) output is evaluated at various stages through an iterative process of running the model again but with different Dirichlet priors or a diverse number of topics. In addition, topic selection is critiqued based on authors' discretion and understanding of the subject matter. The choice is also supported by consistency to topic selection with significant co-occurring economic and/or financial developments across the sample period. In all cases, the LDA model can successfully identify evolutionary trends in the topics and thus provide evidence of the importance of the qualitative rationale that usually accompanies the quantitative aspect of policy

communication. For instance, if policy documents include information on how policy institutions intend to interpret incoming data, this can have significant impact on the statement's overall tone (i.e. optimistic vs. pessimistic).

4. Data and Methodology

This section outlines the data and methodology used in the study. *Figure 2* provides an illustrative depiction of the research design and how this section's discussion is structured.



Source: author's own illustration

Figure 2. *Diagram depicting research design*

Text Corpus and Data Collection

The study uses publicly available monetary policy statements of the CBL from February 2017 to January 2021 as the corpus (i.e. text input). The Monetary Policy Statements were obtained from the CBL website[7] on 27 February 2021. The study did not employ any inclusion/exclusion criteria. All the available Monetary Policy Statements available on the CBL website at the time of the study were used. The statements were grouped by the year of publication from 2017 to 2021. The total number of Monetary Policy Statements collected at the time of the study was twenty-six, such that in 2017 (n = 6), 2018 (n = 6), 2019 (n = 6), 2020 (n = 7), and 2021 (n = 1). This makes a total of twenty-six .pdf files. The extent of the text corpus and the study timeline were dictated by the number of publicly available monetary policy statements during the time of the study.

7 https://www.centralbank.org.ls/index.php/monetary-policy/mpc-statements.

Pre-Processing

The pre-processing of textual raw data consists in transforming it and readying it for algorithmic use by removing unnecessary words and characters. There are generally four steps in standard text mining pre-processing. These include: (1) lowercasing the corpus and thus preventing a word with differing capitalization from being misconstrued as two different words; (2) removal of typical stop words, such as "a", "an, "and", "the", etc., since they do not have any value to add to the analysis and could impair result accuracy; (3) stemming/normalizing or lemmatizing the text to remove pluralization or other suffixes that interfere with the uniqueness of the word (e.g. "growing" and "growth" are transformed into "grow"); (4) numbers, punctuation characters, and white noise removal to mitigate against any interference with model efficacy (Blei et al., 2003; Shirota et al., 2015; Zhao et al., 2015; Schwarz, 2018; Dwivedi, 2018; Cedervall and Jansson, 2018; Mahanty et al., 2019; Böök, 2019; Vílchez-Román et al., 2019; Reisenbichler and Reutterer, 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021).

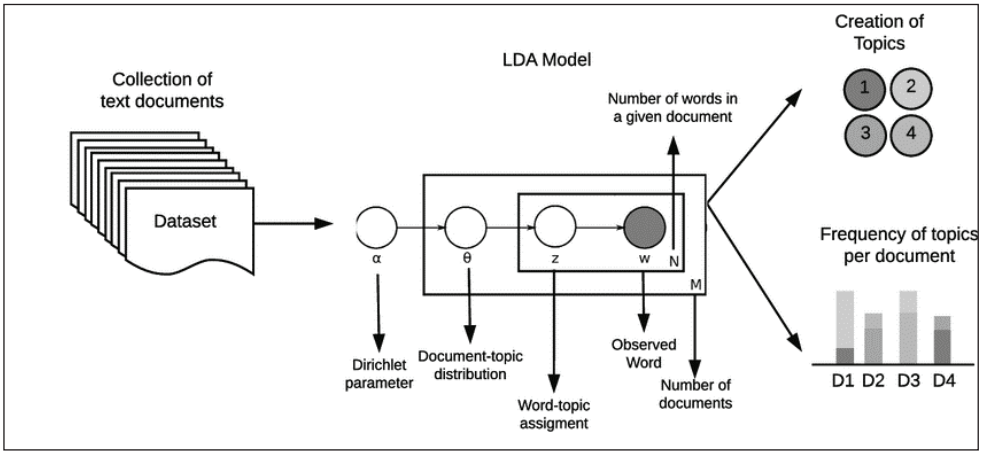
Topic Modelling

The LDA technique can be traced back to the work of Blei and Jordan (2003) and Blei et al. (2003). It is a machine learning algorithm that facilitates the topic modelling of unclassified copious collections of text data. It allows its user to group any number or type of documents into clusters with a similar content, often referred to as "topics", as defined by the user. The algorithm only leverages text data. Thus, the clustering is independent of the language used in the text or the number of documents being considered. The LDA's approach to text clustering is probabilistic. The model bases itself on the fact that same-topic discussions usually use words that are similar and often co-occur. The co-occurrence of such words describes a topic as a distribution of probability over words and each document as a distribution of probability over topics. Through LDA, previously unused text data can be made useful for research. Documents and topics can be compared for similarities, and their previously hidden relationships can be unlocked (Popa and Brandabur, 2020; Sperkova, 2018; Borah et al., 2018; Lee et al., 2018; Bendle and Xin, 2016). A major advantage of LDA over other possible alternatives, such as Latent Semantic Analysis, lies in its flexibility. It can easily compare two or more documents, and it is not restricted in any way by the kind of language (e.g. English, Spanish, etc.) used in the text. LDA consists of two parts, namely: (i) a probability model that describes text as a likelihood function and (ii) an approximate inference algorithm that uses Gibbs sampling to find the optimal topic assignment instead of simply maximizing the likelihood function, since this would be computationally unfeasible (Blei et al., 2003; Shirota et al., 2015; Zhao et al., 2015; Schwarz, 2018;

Dwivedi, 2018; Mahanty et al., 2019; Böök, 2019; Vílchez-Román et al., 2019; Reisenbichler and Reutterer, 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021).

The LDA's Probabilistic Model

Figure 3 provides an illustration of the LDA algorithm schematic. The schematic can be used to explain the model. It considers that each document m out of the total number of documents M is a probabilistic combination of T topics.



Source: Buenaño-Fernandez et al. (2020)

Figure 3. *Schematic of LDA algorithm*

A probability vector θ_m of length T captures the probabilities. The value of T (i.e. the number of topics) is arbitrary and depends on the LDA user and the precision required. The LDA outcome is a M *x* T matrix of θ with probabilities $p(t_t \mid m_m)$, where $\theta_1, ..., \theta_M$ are 1 *x* T vectors. The probability being measured is that of document belonging to topic. It is defined as:

$$\theta = \begin{pmatrix} \theta_1 \\ \vdots \\ \theta_M \end{pmatrix} = \begin{pmatrix} p(t_1|m_1) & \cdots & p(t_T|m_1) \\ \vdots & \ddots & \vdots \\ p(t_1|m_m) & \cdots & p(t_T|m_m) \end{pmatrix} \quad (1)$$

The set of words (of size $t \in T$) in all the documents constitutes the vocabulary used in the LDA. Each topic V is determined as a probabilistic distribution over the text vocabulary. In this case, a topic can be used to determine the likelihood of a word associated with it. In the same way as documents can be clustered

as probabilistic distributions over topics, words can also be represented as probabilistic vectors of each topic in a *V x T* matrix:

$$\varphi = \begin{pmatrix} \varphi_1 \\ \vdots \\ \varphi_M \end{pmatrix} = \begin{pmatrix} p(w_1|t_1) & \cdots & p(w_1|t_T) \\ \vdots & \ddots & \vdots \\ p(w_v|t_1) & \cdots & p(w_v|t_T) \end{pmatrix} \quad (2)$$

In matrix 2, the probabilities $p(w_v \mid t_T)$ reflect the probability that a word v can be detected from the vocabulary conditional on topic t. According to Blei et al. (2003), Lee et al. (2018), Schwarz (2018), Edison and Carcel (2021), and Doh et al. (2021), this means that φ can be used to decide on the content appropriateness of each topic and its ultimate name.[8] Blei et al. (2003) explain that, given the LDA model parameters θ and φ, the model considers the data text in the corpus as being created by a two-part process: (i) a word probability distribution $\varphi \sim Dir(\beta)$ and (ii) topic proportions $\theta_d \sim Dir(\alpha)$, for each document m in the text. For each of the N_m words w_M, the topic assignment is drawn such that $z_{m,n} \sim Multinomial(\theta_m)$, while each word $w_{m,n}$ is drawn from $p(w_{m,n} \mid z_{m,n}, \varphi)$. In the two-part process described above, α and β are known as Dirichlet priors, or hyperparameters, that are both greater than zero and are necessary for the Gibbs sampling process explained later. According to Blei et al. (2003), the corpus likelihood with respect to the model parameters is:

$$\prod_{m=1}^{M} P(\theta_m|\alpha) \left(\prod_{n=1}^{N_M} \sum_{z_{m,n}} P\left(z_{m,n}|\theta_M\right) P\left(w_{m,n}|z_{m,n},\varphi\right)\right), \quad (3)$$

where $P(\theta_m \mid \alpha)$ measures the likelihood of observing the topic distribution θ_m of document m conditional on α. $P(z_{m,n} \mid \theta_M)$ describes how likely the topic assignment $z_{m,n}$ of word n in document m is conditional on the topic distribution of the document. Last, $P(w_{m,n} \mid z_{m,n}, \varphi)$ measures the probability of detecting a specific word conditional on the word's topic assignment and the word possibilities of given topics contained in φ. When the sum-up of all possible topic assignments $\sum_z$ is made, along with the product of all N_m words in a document $\prod_{n=1}^{N_M}$, as well as the product of all documents in the corpus $\prod_{m=1}^{M}$, this gives the likelihood of observing the words in the documents. This means that the LDA is concerned with optimal topic assignment $z_{m,n}$ for each word in each document, coupled with the optimal word probabilities φ for each topic that maximizes this likelihood (Blei et al., 2003; Shirota et al., 2015; Schwarz, 2018; Dwivedi, 2018; Mahanty et al., 2019; Böök, 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021). Summing over all possible topic assignments for all words in all the documents is a computationally unfeasible exercise. The alternative is to

8 LDA does not provide names to the topics but rather allows the user to decide on appropriate names given their knowledge of the subject matter under study (Schwarz, 2018; Edison and Carcel, 2021).

approximate the likelihood function using Gibbs sampling as developed by Griffiths and Steyvers (2004).

Approximate Inference Using Gibbs Sampling

According to Schwarz (2018) and Edison and Carcel (2021), the Gibbs sampler is based on a Markov Chain Monte Carlo (MCMC) algorithm that repeatedly draws new samples conditional on all the available data. In the case of the LDA, the Gibbs sampler updates the topic assignment of words conditional on the topic assignments of all other words in the corpus. The technique is Bayesian. As such, it relies on values being identified for the hyperparameters α and β that were discussed earlier. Both α and β lie in the unit interval. The α prior is chosen based on the number of topics T, while the β prior is dependent on the size of the vocabulary. When the Gibbs sampler is run for a burn-in of several hundred iterations, the Markov chain converges towards a maximum of the likelihood function (Schwarz, 2018). Although the LDA is the most widely used topic modelling technique, it is not free from limitations. According to Reisenbichler and Reutterer (2019), the LDA often requires extensive parameter optimization before running as well as the likelihood that topics are arranged more to fit the needs of the researcher (self-selection) than capturing what is in the corpus.

LDA Implementation

In the same way as Edison and Carcel (2021) as well as Vílchez-Román et al. (2019) proceeded, we implement the LDA algorithm using "ldagibbs", a community-contributed command for STATA developed by Schwarz (2018). The ldagibbs package implements LDA through a two-part process. First, the document is divided into single word tokens. Each word is then randomly assigned with equal probability to one of the T topics. Second, new topic assignments for each of the word tokens are sampled on the basis of the following probability model of word token to topic t assignment:

$$P\left(z_{m,n} = t \middle| w_{m,n}, \varphi\right) \propto P\left(w_{m,n} \middle| z_{m,n} = t, \varphi\right) \cdot P(z_{m,n} = t) \tag{4}$$

Schwarz (2018) explains that the topic assignment of all other word tokens is used by the Gibbs sampler to acquire approximate values for $P(z_{m,n} = t \mid w_{m,n}, \varphi)$ and $P(z_{m,n} = t)$ in equation 4. The $P(w_{m,n} \mid z_{m,n} = t, \varphi)$ is given by the number of words identical to $w_{m,n}$ that are assigned to topic t divided by the total number of words assigned to that topic.

LDA Algorithmic Settings

In our study, three topic models with five, four, and three respective topics were ran. The most ideal topic choice was based on the speed of convergence of each topic model as indicated by the likelihood ratio. In a similar way to Schwarz (2018), Edison and Carcel (2021), and Vílchez-Román et al. (2019), the following settings are applied to each topic model: $\alpha = 0.25$, $\beta = 0.1$, with a burn-in period of 1,000 (i.e. the number of iterations the Gibbs sampler should run). An assessment of model clustering (topic) output can be evaluated at various stages and could be done by running the same model either with varying Dirichlet priors or with a different number of topics (Blei et al., 2003; Shirota et al., 2015; Zhao et al., 2015; Schwarz, 2018; Dwivedi, 2018; Mahanty et al., 2019; Böök, 2019; Vílchez-Román et al., 2019; Rabindranath, 2020; Edison and Carcel, 2021; Doh et al., 2021).

5. Results and Analysis

The results and analysis of the topic modelling exercise are presented in this section. The discussion that follows is divided into two parts, namely: (i) topic extraction and formulation and (ii) topic distribution over time.

5.1 Topic Extraction and Average Topic Trends

To extract topics from CBL Monetary Policy Statements, the study ran three versions of the LDA model: a three-topic, a four-topic, and a five-topic LDA model. The study also performed robustness iterations, where the Dirichlet priors were systematically altered in each model. This was done to allow for an assessment of model validity in the process of topic extraction. The choice of topic number in each model was guided by the four functions of the CBL MPC, as stated in the CBL MPC Charter 2020. The sections that follow discuss the topic extraction (and formulation) as well as the average topic trends under each version of the LDA model.

Results of Three-Topic LDA

Appendix A2 presents the word probability matrix generated from the Three-Topic LDA. Each topic's word probability vectors are a description of the likelihood of seeing a word conditional on a topic. For this reason, the word probability sum in a single word probability vector is 1. The most frequent words in each topic are sorted in increasing order of word probability to reveal the top five words in each topic. This allows for the adding of topic labels. *Table 2* shows the top five words per topic from the Three-Topic LDA.

Table 2: *Top five words per topic in the Three-Topic LDA*

Topic 1	Topic 2	Topic 3
intern	committe	intern
condit	monetari	econom
monetary	intern	polici
financi	reserv	condit
market	polici	region

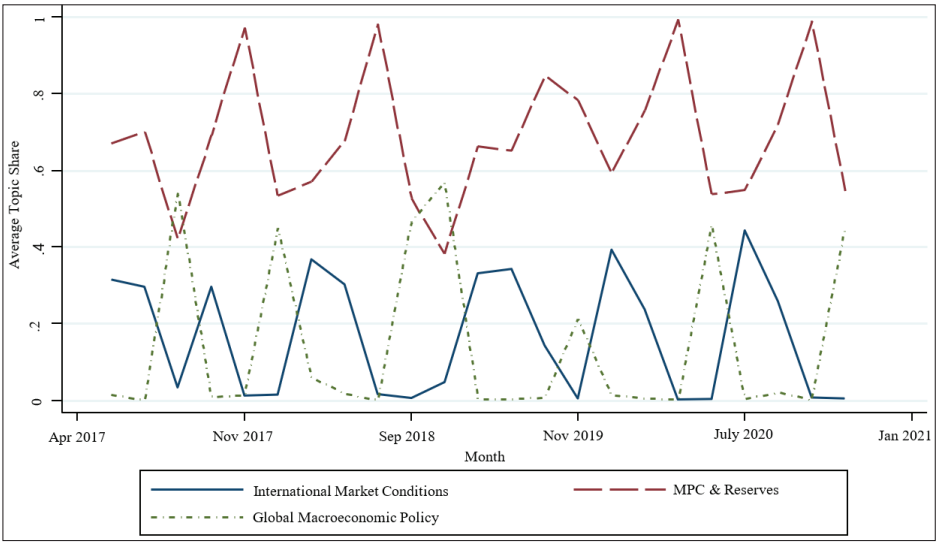
Source: author's classification

Table 3 shows the Three-Topic LDA topic labels. *Figure 4* illustrates the average topic trends over the sample period. Upon close observation, the extracted topics are closely reflective of the functions of the CBL Monetary Policy Committee, as discussed in Section 2.

Table 3. *Three-Topic LDA topic labels*

Topic No.	Topic Label	Shorter Variant
Topic One	International Monetary and Financial Market Conditions	International Market Conditions
Topic Two	Monetary Policy Committee and International Reserves	Monetary Policy and Reserves
Topic Three	Regional and International Economic Policy Conditions	Global Macroeconomic Policy

Source: author's classification



Source: author's classification

Figure 4. *CBL Monetary Policy Statement average topic trends – Three-Topic LDA*

From *Figure 4*, the Monetary Policy Committee (MPC) and Reserves topic has the highest average topic share of all the three topics plotted. This implies that it is the topic that occupied the most discussion during the review period. This makes intuitive sense, seeing that the ultimate work of the CBL MPC is to ensure that there are enough international reserves to maintain the one-to-one fixed exchange rate between Lesotho's currency and that of South Africa.

Results of Four-Topic LDA

Like the Three-Topic LDA model, the four-topic word probability matrix in the Four-Topic LDA model is presented in *Appendix A3*. Comparing *Appendix A2* to *A3*, the word probabilities relative to the top five words in the Four-Topic LDA model are less than those in the Three-Topic LDA word probability matrix. The top five words in the Four-Topic LDA word probability matrix, with the highest probability of belonging to the topics, are selected and presented in *Table 4*. They are used to develop the respective topic labels.

Table 4. *Top words in Four-Topic LDA*

Topic 1	Topic 2	Topic 3	Topic 4
economic	quarter	global	economic
COVID-19	growth	sector	risks
global	economic	these	global
expected	domestic	likely	policy
measures	quarter	financial	quarter

Source: author's classification

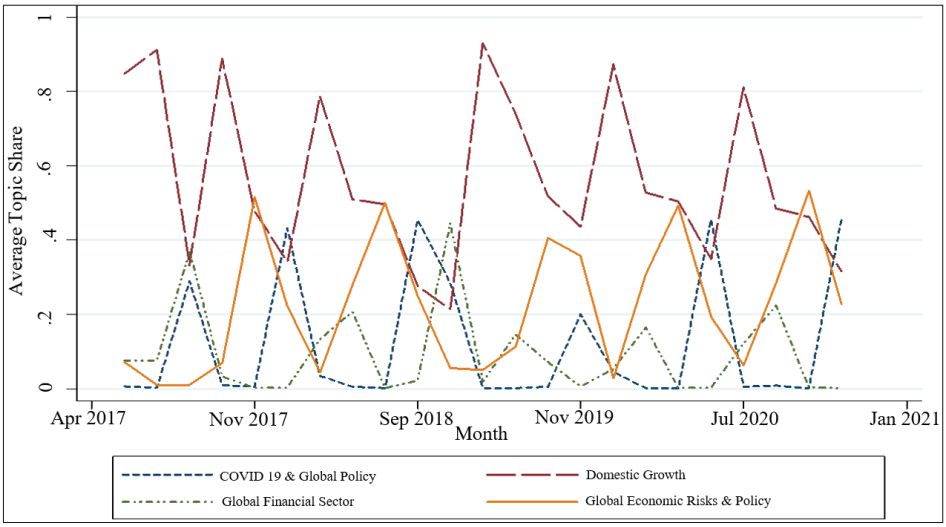
Although there are some similarities in the words per topic in the Four-Topic LDA relative to the Three-Topic LDA, the Four-Topic LDA reveals other aspects of discussion that featured in the CBL Monetary Policy Statements, such as the COVID-19 global pandemic and associated global economic measures. *Table 5* shows the Four-Topic LDA topic labels.

Table 5. *Four-Topic LDA topic labels*

Topic No.	Topic Label	Shorter Variant
Topic One	COVID-19 and Global Economic Measures	COVID-19 and Global Policy
Topic Two	Domestic Economic Growth	Domestic Growth
Topic Three	Global Financial Sector	Financial Sector
Topic Four	Global Economic Risks and Policy	Economic Risks and Policy

Source: author's classification

Figure 5 is an illustration of the average topic trends over the sample period. Like the Three-Topic LDA model, topics that most closely related to the functions of the CBL MPC were the most prominent; that is, the discussions on domestic economic growth as well as global economic risks and policy had the highest average topic shares.



Source: author's classification

Figure 5. *CBL Monetary Policy Statement average topic trends – Four-Topic LDA*

Results of Five-Topic LDA

Appendix A4 presents the world probability matrix from the Five-Topic LDA model. The words with the highest probability of belonging to the topic are used to develop the respective topics, as can be inferred from *tables 6–7*.

Table 6. *Top words in Five-Topic LDA*

Topic 1	Topic 2	Topic 3	Topic 4	Topic 5
risks	quarter	performance	economic	likely
global	economic	estimated	covid-19	global
price	growth	first	pandemic	expected
remained	domestic	credit	measures	these
measured	developments	positive	global	banks

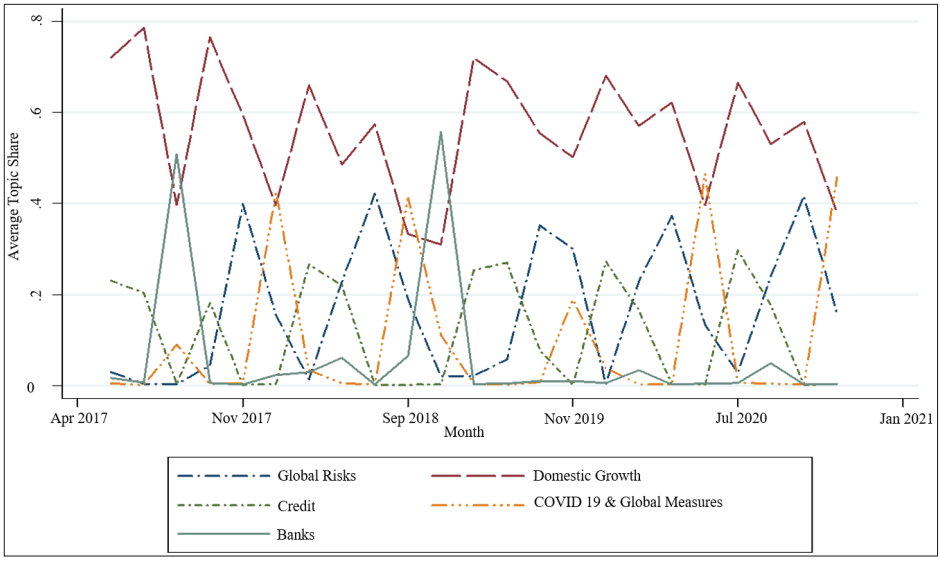
Source: author's classification

Table 7. *Five-Topic LDA topic labels*

Topic No.	Topic Label	Shorter Variant
Topic One	Global Risks and Prices	Global Risks and Prices
Topic Two	Domestic Economic Growth	Domestic Growth
Topic Three	Credit Performance	Credit
Topic Four	COVID-19 and Global Economic Measures	COVID-19 and Global Measures
Topic Five	Global Banks	Banks

Source: author's classification

The average topic share in the Five-Topic LDA model is presented in *Figure 6*. The trend is broadly similar to that observed in the Three- and Four-Topic LDA models, that is, the most prominent topics of discussion involved domestic economic growth and global policy measures.



Source: author's classification

Figure 6. *CBL Monetary Policy Statement average topic trends – Five-Topic LDA*

6. Conclusions and Recommendations

This paper's objective was to use Latent Dirichlet Allocation (LDA) to analyse the monetary policy statements of Lesotho's Central Bank from February 2017 to January 2021 and to identify the evolutionary trend of key themes or topics discussed by members of the CBL Monetary Policy Committee (MPC) over the sample period. In the same way as Edison and Carcel (2021), Doh et al. (2021),

Vílchez-Román et al. (2019), and Shirota et al. (2015), our study shows that the LDA technique can extract topics from corpora without any prior knowledge and determine their importance and appropriateness based on the probability of occurrence. However, according to Sperkova (2018), if the technique used is unsupervised, as is the case in our study, it may contain words that are not immediately interpretable. In this respect, it requires a high substantive knowledge of the subject being analysed and classified.

In the current study, the Three-Topic LDA model extracted topics that remained prominent throughout the sample period and were most closely reflective of the functions of the CBL Monetary Policy Committee. The topics identified were: (i) International Monetary and Financial Market Conditions, (ii) Monetary Policy Committee and International Reserves, and (iii) Regional and International Economic Policy Conditions. Owing to its high word-to-topic probability association, the Three-Topic LDA model was determined as the most appropriate model through which a consistent analysis of topic evolution in CBL Monetary Policy Statements can be performed.

The findings of the current study provide a knowledge base for analysing the monetary policy statements of the CBL. As in Doh et al. (2021), the findings indicate that the evolution of MPC discussions and the tone of the MPC statements over time are influenced by incoming economic data. The results can be used to guide future research. To this end, the study recommends the continued use of LDA, especially the Three-Topic LDA model, in the analysis of topic evolution in CBL Monetary Policy Statements. This can help reveal useful relationships in key policy topic priorities of discussions and their evolution over time.

7. Areas for Further Study

The study has some limitations. First, the study timeline ranges from February 2017 to January 2021, and the corpus comprises texts from twenty-six MPC statements. The choice of timeline and the number of MPC statements was underpinned by the presence of publicly available data during the time of the study. Second, the study is of a single-country perspective, meaning that it fails to leverage on regional monetary policy dynamics to add a layer of robustness in the findings. Future extensions to the study could consider examining a longer timeline and a larger corpus of text from an increased number of MPC statements. Follow-up studies could also consider using topic classification to evaluate the monetary policy stance of the CBL and comparing it to that of other central banks within the same region across the same time period.

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Appendices

A1. Summary of empirical literature

Author(s)	Objective	Data	Methodology	Results
Edison and Carcel (2021)	Use topic classification to explore evolution in topics discussed by Federal Open Market Committee members between 2003 and 2012.	A total of 80 meeting transcripts of the Federal Open Market Committee during 2003–2012.	Identification of source of text corpus – data collection. Pre-processing. Topic classification with Latent Dirichlet Allocation (LDA). Assessment of model clustering (topic) output is evaluated at various stages through an iterative process. Topic selection is critiqued on the basis of authors' discretion and understanding of the subject matter.	The study identified four topics that were as follows: economic modelling, banking, economic activity, and communication. Discussions on economic modelling greatly featured during the Great Financial Crisis, while discussions on the banking system followed in subsequent years. Communication gained prominence as a discussion topic later in the sample.

Author(s)	Objective	Data	Methodology	Results
Doh et al. (2021)	To identify the tone of post-meeting statements of the Federal Open Market Committee.	A total of 87 Federal Open Market Committee statements from March 2004 through December 2014.	Identification of source of text corpus – data collection. Pre-processing. Natural language processing tools.	Information about the Federal Open Market Committee's quantitative decision on the target policy rate is as important as an assessment of risk. If information on how the Federal Open Market Committee interprets incoming data is included into the statement, this has a significant impact on the statement's overall tone.
Vílchez-Román et al. (2019)	Use topic classification to identify primary topics in organization studies between 1970 and 2015.	Academic document abstracts under the business and management subject research during 1970–2015.	Identification of source of text corpus – data collection. Pre-processing. Topic classification with Latent Dirichlet Allocation (LDA).	The study identified that a three-topic-based classification system was more stable instead of a four- or five-topic-based one. The most popular topics were organizational behaviour, organizational management, and service management. Document classification under the three extracted topics showed that the first 10 documents in the dataset were most represented under the topic: organizational management.
Sperkova (2018)	To use topic modelling in voice of customer textual analysis for performing tasks of emotion, personality, and sentiment detection.	Customer reviews in the form of textual comments.	Identification of source of text corpus – data collection. Pre-processing. Topic classification with Latent Dirichlet Allocation (LDA).	LDA allows dynamics to be evaluated at a highly granular temporal level over time.

Author(s)	Objective	Data	Methodology	Results
Lee et al. (2018)	To delineate the thematic landscape of the product-service system research between 2000 and 2016.	1,229 product-service system publications between 2000 and 2016.	Identification of source of text corpus – data collection. Pre-processing. Topic classification with Latent Dirichlet Allocation (LDA).	Ten product-service system topics are selected using LDA. Results reflect changes in focus in product-service system topics over time.
Shirota et al. (2015)	To use topic extraction to analyse the monetary policy minutes of the Bank of Japan, under the second Cabinet term of Prime Minister Abe.	Minutes of the Central Bank of Japan Monetary Policy Meeting from January 2013 to June 2014.	Identification of source of text corpus – data collection. Pre-processing. Topic classification with Latent Dirichlet Allocation (LDA). Topic choice is supported by consistency to topic selection with significant co-occurring economic and/or financial developments across the sample period.	The study identified five topics that ranged from domestic to international matters. Extracted topics showed that the most prominent discussions were around monetary policy easing and consumption tax increase that prevailed during the sample period.

A2. Three-topic word probability matrix

i. Sorted by increasing order in Word_prob1

words	word_prob1	word_prob2	word_prob3
intern	0.10204082	0.07482993	0.09289617
condit	0.08843537	0.04761905	0.07103825
monetari	0.07482993	0.10204082	0.03825137
financi	0.06802721	0.02040816	0.05464481
market	0.06802721	0.03401361	0.04371585
domest	0.06802721	0.04081633	0.03825137
polici	0.05442177	0.06802721	0.08196721
region	0.05442177	0.01360544	0.07103825
develop	0.05442177	0.04081633	0.04918033
reserv	0.05442177	0.07482993	0.02185792
consid	0.04761905	0.03401361	0.06010929
outlook	0.04081633	0.03401361	0.06557377

words	word_prob1	word_prob2	word_prob3
lesotho	0.04081633	0.04761905	0.05464481
stanc	0.04081633	0.02721088	0.01639344
committe	0.03401361	0.17687075	0.06557377
central	0.03401361	0.04761905	0.06010929
april	0.03401361	0.04081633	0.01092896
determin	0.02721088	0.04081633	0.01639344
econom	0.01360544	0.03401361	0.08743169
SUM	**1.00000002**	**1.00000003**	**0.99999999**

ii. Sorted by increasing order in Word_prob2

words	word_prob1	word_prob2	word_prob3
committe	0.03401361	0.17687075	0.06557377
monetari	0.07482993	0.10204082	0.03825137
intern	0.10204082	0.07482993	0.09289617
reserv	0.05442177	0.07482993	0.02185792
polici	0.05442177	0.06802721	0.08196721
condit	0.08843537	0.04761905	0.07103825
lesotho	0.04081633	0.04761905	0.05464481
central	0.03401361	0.04761905	0.06010929
domest	0.06802721	0.04081633	0.03825137
develop	0.05442177	0.04081633	0.04918033
april	0.03401361	0.04081633	0.01092896
determin	0.02721088	0.04081633	0.01639344
market	0.06802721	0.03401361	0.04371585
consid	0.04761905	0.03401361	0.06010929
outlook	0.04081633	0.03401361	0.06557377
econom	0.01360544	0.03401361	0.08743169
stanc	0.04081633	0.02721088	0.01639344
financi	0.06802721	0.02040816	0.05464481
region	0.05442177	0.01360544	0.07103825
SUM	**1.00000002**	**1.00000003**	**0.99999999**

iii. Sorted by increasing order in Word_prob3

words	word_prob1	word_prob2	word_prob3
intern	0.10204082	0.07482993	0.09289617
econom	0.01360544	0.03401361	0.08743169
polici	0.05442177	0.06802721	0.08196721
condit	0.08843537	0.04761905	0.07103825
region	0.05442177	0.01360544	0.07103825
committe	0.03401361	0.17687075	0.06557377
outlook	0.04081633	0.03401361	0.06557377
central	0.03401361	0.04761905	0.06010929
consid	0.04761905	0.03401361	0.06010929
lesotho	0.04081633	0.04761905	0.05464481
financi	0.06802721	0.02040816	0.05464481
develop	0.05442177	0.04081633	0.04918033
market	0.06802721	0.03401361	0.04371585
monetari	0.07482993	0.10204082	0.03825137
domest	0.06802721	0.04081633	0.03825137
reserv	0.05442177	0.07482993	0.02185792
determin	0.02721088	0.04081633	0.01639344
stanc	0.04081633	0.02721088	0.01639344
april	0.03401361	0.04081633	0.01092896
SUM	**1.00000002**	**1.00000003**	**0.99999999**

A3. Four-topic word probability matrix

i. Sorted by increasing order in Word_prob1

words	word_prob1	word_prob2	word_prob3	word_prob4
economic	0.03987342	0.02282416	0.00054007	0.02572554
covid-19	0.02359033	0.00002011	0.00010801	0.00008561
global	0.01962025	0.00478604	0.01717434	0.02508347
expected	0.0164557	0.00673665	0.00723698	0.00025683
measures	0.01639816	0.00012066	0.00010801	0.00008561
pandemic	0.0159954	0.00004022	0.00032404	0.0000428
likely	0.01409666	0.00034186	0.01404191	0.00222584
outlook	0.01352129	0.01132159	0.00032404	0.00226864

words	word_prob1	word_prob2	word_prob3	word_prob4
decline	0.01329114	0.00553008	0.00043206	0.00059926
spread	0.0132336	0.00002011	0.00010801	0.00008561
growth	0.01058688	0.02582046	0.00054007	0.00517935
relative	0.01058688	0.00020109	0.00043206	0.00068487
contract	0.00966628	0.00018098	0.00064809	0.0000428
economy	0.00926352	0.00528877	0.0036725	0.00025683
		(output omitted)		
SUM	**1.00000044**	**1.00000116**	**0.99999793**	**0.99999858**

ii. Sorted by increasing order in Word_prob2

words	word_prob1	word_prob2	word_prob3	word_prob4
quarter	0.00126582	0.02765042	0.00010801	0.01780669
growth	0.01058688	0.02582046	0.00054007	0.00517935
economic	0.03987342	0.02282416	0.00054007	0.02572554
domestic	0.00701956	0.01972732	0.00032404	0.00933139
developments	0.00143843	0.01697233	0.00626485	0.003724
monetary	0.00017261	0.01325209	0.00108015	0.00350997
increase	0.00080552	0.01319176	0.00162022	0.00124133
economies	0.00069045	0.013051	0.00097213	0.0113004
committee	0.00005754	0.01278958	0.00216029	0.00029963
during	0.0004603	0.01264881	0.0044286	0.00068487
inflation	0.00126582	0.01226673	0.00108015	0.01121479
outlook	0.01352129	0.01132159	0.00032404	0.00226864
compared	0.00034522	0.0102759	0.00097213	0.00077048
deficit	0.00005754	0.01003459	0.00010801	0.00012841
		(output omitted)		
SUM	1.00000044	1.00000116	0.99999793	0.99999858

iii. Sorted by increasing order in Word_prob3

words	word_prob1	word_prob2	word_prob3	word_prob4
global	0.01962025	0.00478604	0.01717434	0.02508347
sector	0.00011507	0.00832529	0.01458198	0.0018406
these	0.00017261	0.00006033	0.01436595	0.00021402
likely	0.01409666	0.00034186	0.01404191	0.00222584
financial	0.00040276	0.00368002	0.01263772	0.00415204
africa	0.00086306	0.00012066	0.01231367	0.01108638
negative	0.00241657	0.00006033	0.01036941	0.00012841
number	0.00195627	0.00032175	0.00972132	0.00059926
banks	0.00063291	0.00004022	0.00939728	0.00017122
import	0.00028769	0.00378057	0.00918125	0.00068487
remain	0.00143843	0.00287564	0.00864118	0.00196901
major	0.00069045	0.00237291	0.0081011	0.00295351
expected	0.0164557	0.00673665	0.00723698	0.00025683
result	0.00011507	0.00378057	0.00702095	0.00081329
		(output omitted)		
SUM	**1.00000044**	**1.00000116**	**0.99999793**	**0.99999858**

iv. Sorted by increasing order in Word_prob4

words	word_prob1	word_prob2	word_prob3	word_prob4
economic	0.03987342	0.02282416	0.00054007	0.02572554
risks	0.00005754	0.00004022	0.00021603	0.02521188
global	0.01962025	0.00478604	0.01717434	0.02508347
policy	0.00005754	0.00969273	0.00021603	0.02135947
quarter	0.00126582	0.02765042	0.00010801	0.01780669
activity	0.00420023	0.00892857	0.00129618	0.01605171
price	0.00057537	0.00008044	0.00086412	0.01592329
remained	0.00005754	0.00780245	0.00021603	0.01553805
measured	0.00132336	0.00032175	0.00021603	0.01511001
international	0.00166858	0.00583172	0.00097213	0.01395428
second	0.00011507	0.00154842	0.00054007	0.01369746
declined	0.00040276	0.00010055	0.00054007	0.01271295
rates	0.00069045	0.0008647	0.00043206	0.01262734
other	0.00017261	0.00094514	0.00043206	0.01155723
		(output omitted)		
SUM	**1.00000044**	**1.00000116**	**0.99999793**	**0.99999858**

A4. Five-topic word probability matrix

i. Sorted by increasing order in Word_prob1

words	word_prob1	word_prob2	word_prob3	word_prob4	word_prob5
risks	0.0312308	0.00025517	0.0006152	0.00102459	0.00015004
global	0.02474999	0.00897011	0.00010253	0.0161373	0.02580645
price	0.01972177	0.00051033	0.00051266	0.00064037	0.00015004
remained	0.01927482	0.00700728	0.00512663	0.00006404	0.00030008
measured	0.01854852	0.00058885	0.00041013	0.001729	0.00030008
economic	0.01849265	0.03018823	0.00071773	0.03425973	0.0036009
declined	0.0149729	0.00060848	0.00020507	0.00025615	0.00150038
policy	0.01486117	0.01332758	0.0003076	0.00198514	0.00090023
trade	0.0148053	0.00023554	0.00010253	0.00108863	0.00150038
activity	0.01396726	0.01171806	0.00051266	0.00307377	0.00075019
rates	0.01346444	0.00188431	0.00010253	0.00096055	0.00030008
first	0.01301749	0.00147212	0.01445709	0.00032018	0.00015004
tensions	0.01089446	0.00001963	0.00020507	0.00038422	0.00015004
include	0.01078273	0.00009814	0.0003076	0.00147285	0.00015004
(output omitted)					
SUM	**1.00000114**	**0.9999998**	**0.99999941**	**1.00000127**	**1.0000025**

ii. Sorted by increasing order in Word_prob2

words	word_prob1	word_prob2	word_prob3	word_prob4	word_prob5
quarter	0.00536343	0.03344652	0.00102533	0.00012807	0.00045011
economic	0.01849265	0.03018823	0.00071773	0.03425973	0.0036009
growth	0.00128499	0.02930496	0.00010253	0.00384221	0.00270068
domestic	0.00553104	0.02155181	0.00010253	0.00787654	0.00060015
developments	0.00122912	0.01856832	0.00010253	0.00044826	0.00585146
economies	0.0039667	0.01666438	0.0003076	0.00038422	0.00090023
inflation	0.00363149	0.01578111	0.00010253	0.00198514	0.00060015
monetary	0.0008939	0.0143875	0.00010253	0.00006404	0.00060015
increase	0.00027935	0.0133472	0.00184559	0.00025615	0.0012003
policy	0.01486117	0.01332758	0.0003076	0.00198514	0.00090023
outlook	0.00067043	0.01240505	0.00071773	0.01299949	0.00015004
during	0.00005587	0.01183583	0.00779247	0.0005123	0.00105026
committee	0.00055869	0.01179657	0.00512663	0.00006404	0.00045011
activity	0.01396726	0.01171806	0.00051266	0.00307377	0.00075019
(output omitted)					
SUM	**1.00000114**	**0.9999998**	**0.99999941**	**1.00000127**	**1.0000025**

iii. Sorted by increasing order in Word_prob3

words	**word_prob1**	**word_prob2**	**word_prob3**	**word_prob4**	**word_prob5**
performance	0.0014526	0.00113844	0.01814826	0.00083248	0.00015004
estimated	0.00022348	0.00047108	0.01599508	0.00057633	0.00030008
first	0.01301749	0.00147212	0.01445709	0.00032018	0.00015004
credit	0.00016761	0.00563331	0.01394443	0.00012807	0.00105026
positive	0.00005587	0.00029442	0.01281657	0.00275359	0.00015004
review	0.00050282	0.00117769	0.00984313	0.00006404	0.00135034
which	0.00094977	0.00054959	0.00974059	0.00076844	0.00045011
official	0.00027935	0.00047108	0.00974059	0.00064037	0.00015004
unchanged	0.00335214	0.00157026	0.0085102	0.00006404	0.00015004
registered	0.00011174	0.00449487	0.00830514	0.00064037	0.00045011
during	0.00005587	0.01183583	0.00779247	0.0005123	0.00105026
compared	0.00055869	0.00891122	0.00779247	0.00019211	0.00030008
above	0.00217889	0.00098141	0.00758741	0.00006404	0.00015004
african	0.00033521	0.00084401	0.00748488	0.01018186	0.00060015
(output omitted)					
SUM	**1.00000114**	**0.9999998**	**0.99999941**	**1.00000127**	**1.0000025**

iv. Sorted by increasing order in Word_prob4

words	word_prob1	word_prob2	**word_prob3**	**word_prob4**	**word_prob5**
economic	0.01849265	0.03018823	0.00071773	0.03425973	0.0036009
covid-19	0.00005587	0.00005888	0.00010253	0.02593494	0.00075019
pandemic	0.00005587	0.00001963	0.00010253	0.017354	0.00165041
measures	0.00061456	0.00019628	0.0003076	0.01639344	0.00225056
global	0.02474999	0.00897011	0.00010253	0.0161373	0.02580645
outlook	0.00067043	0.01240505	0.00071773	0.01299949	0.00015004
spread	0.00005587	0.00001963	0.00010253	0.01223105	0.00615154
relative	0.00094977	0.00007851	0.0006152	0.01191086	0.00030008
recovery	0.00055869	0.00054959	0.00645955	0.01043801	0.00015004
african	0.00033521	0.00084401	0.00748488	0.01018186	0.00060015
expected	0.00044695	0.00702691	0.00020507	0.00998975	0.02565641
likely	0.00167607	0.00123658	0.00010253	0.00998975	0.02925731
remains	0.00005587	0.00049071	0.0047165	0.00966957	0.00030008
contract	0.00011174	0.00017665	0.0003076	0.00851691	0.00570143
(output omitted)					
SUM	**1.00000114**	**0.9999998**	**0.99999941**	**1.00000127**	**1.0000025**

iv. Sorted by increasing order in Word_prob5

words	word_prob1	word_prob2	word_prob3	word_prob4	word_prob5
likely	0.00167607	0.00123658	0.00010253	0.00998975	0.02925731
global	0.02474999	0.00897011	0.00010253	0.0161373	0.02580645
expected	0.00044695	0.00702691	0.00020507	0.00998975	0.02565641
these	0.00005587	0.00005888	0.00143546	0.00012807	0.01875469
banks	0.00016761	0.0001374	0.00082026	0.00012807	0.01275319
given	0.00005587	0.00009814	0.00051266	0.00268955	0.01230308
affected	0.00022348	0.00007851	0.00020507	0.00019211	0.01230308
major	0.00134086	0.00339569	0.00010253	0.00012807	0.01125281
decline	0.00033521	0.00632029	0.0003076	0.00806865	0.01020255
especially	0.00810101	0.00015703	0.00010253	0.00230533	0.00975244
result	0.00022348	0.0039649	0.00051266	0.00006404	0.00945236
negative	0.0007263	0.0007655	0.00123039	0.0012167	0.00930233
short	0.00050282	0.00007851	0.0006152	0.00435451	0.00870218
under	0.00134086	0.0006281	0.00133292	0.00147285	0.00795199
(output omitted)					
SUM	**1.00000114**	**0.9999998**	**0.99999941**	**1.00000127**	**1.0000025**

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