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Marinko Škare, *University of Pula, Croatia, mskare@unipu.hr*
Nada Trunk Širca, *ISBSS, Slovenia, trunk.nada@gmail.com*
Boris Urban, *University of Witwatersrand, South Africa, Boris.urban@wits.ac.za*
Šárka Velčovská, *Technical University of Ostrava, Czechia, sarka.velcovska@vsb.cz*
Manfred Weiss, *Johann Wolfgang Goethe University, Germany, m.weiss@jur.uni-frankfurt.de*

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Managing Global Transitions (MGT) is a quarterly, scholarly journal that covers diverse aspects of transitions and welcomes research on change and innovation in increasingly digitalized and networked economic environments, from a societal, organizational, and technological perspective. MGT fosters the exchange of ideas, experience, and knowledge among developed and developing countries with different cultural, organizational, and technological traditions. MGT invites original scientific, research, and review papers advancing the field of transitions in societies, organizations, and technologies.

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EDITORIAL OFFICE

University of Primorska, Faculty of Management
Izolska vrata 2, 6000 Koper, Slovenia
mgt@fm-kp.si · www.mgt.fm-kp.si

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Productive Capacities and the SDGs: Critical But Nuanced Relationships

David Tennant
University of the West Indies, Jamaica
david.tennant@uwimona.edu.jm

Sandria N. Tennant
University of the West Indies, Jamaica
sandria.tennant@uwimona.edu.jm

Stuart Davies
United Nations Resident Coordinators Office, Jamaica
stuart.davies@un.org

Patrice Whitely
University of the West Indies, Jamaica
patrice.whitely02@uwimona.edu.jm

It is widely accepted that productive capacities are an enabler for the UN sustainable development goals (SDGs), but there is a dearth of literature empirically testing this view. This paper examines the relationships between productive capacities and the SDGs and reveals nuances that need to be accounted for in integrated development approaches. Using panel data time series models, with Driscoll-Kraay adjusted standard errors, we examine how enhancing the eight elements of the Productive Capacity Index (PCI) impacts the SDGs. We find that each of the SDGs has statistically significant relationships with multiple elements of the PCI, and the results highlight areas in which productive capacity enhancements accelerate progress on one or more SDGs but can also be inimical to others, particularly to goals related to the environment and income inequality. Our approach provides development practitioners with a new framework to better target SDG interventions.

Keywords: sustainable development, productive capacity, economic resilience, structural transformation, Sustainable Development Goals
JEL Classification: Q56, O11, O44, O40

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Introduction

More frequent global economic crises and heightened climate risks have led vulnerable economies, such as the Least Developed Countries (LDCs) and Small Island Developing States (SIDS), to prioritize economic resilience in their development planning processes. Greater resilience, de-

fined as the ability of an economy to mitigate, adapt to, and recover from shocks, is derived, inter alia, through a robust and more diversified fabric of productive capacities (UNCTAD 2006a; Briguglio et al. 2009). Such capacities include the 'productive resources, entrepreneurial capabilities and production linkages that together determine a country's ability to produce goods and services' (UNCTAD 2021a, p. 8).

Although enhancing countries' productive capacities is important to achieving the UN Sustainable Development Goals (SDGs), this simplistic view does not serve policymakers in resource-constrained economies well. This is because both the SDGs and a country's productive capacities are multifaceted and multidimensional concepts, with complex, nuanced interrelationships. The achievement of some sustainable development goals can impede progress in others, and the enhancement of some productive capacities can adversely affect achievement of some of the SDGs (Morton, Pencheon, and Squires 2017; Lawrence, Ihebuzor, and Lawrence 2020a). A regularly used example highlights the tension between the SDGs related to socio-economic development and those focused on environmental degradation, which could be exacerbated through the enhancement of productive capacities such as energy, natural capital and certain types of structural transformation.

A high degree of interconnectedness among and between the SDGs and a country's productive capacities complicates the process for achieving the SDGs. An approach that seeks to maximize synergies and mutually reinforcing objectives, while minimizing conflicting and perverse outcomes is needed (Griggs et al. 2014). Systems approaches to analyse and plan for the SDGs, which can manage these complexities, uncertainties, and interconnectedness of economic and socioeconomic issues, are therefore called for (Sachs et al. 2019; Freeman et al. 2014).

Systems approaches are particularly important when one considers how efforts that enhance each of the eight productive capacities[1] which make up the United Nations Conference on Trade and Development (UNCTAD) Productive Capacities Index impact each of the seventeen SDGs. While some efforts may be mutually reinforcing, positively and directly impacting multiple SDGs, others may have conflicting impacts on different goals, and through their impact on one SDG, have spill-over, indirect effects (whether positive or negative) on other SDGs. The systems approach to the SDGs that has been advocated seeks to analyse the various components, interactions, and dynamics in an integrated manner

that targets the realization of the desired outcomes (Lawrence, Ihebuzor, and Lawrence 2020b).

This paper utilizes a systems approach to explore the nuances of the relationships between the different aspects of productive capacity and each of the SDGs. UNCTAD's categorization and measurement of productive capacities is used to determine countries' capacities in human capital, natural capital, energy, transport, information and communications technology (ICT), institutions, the private sector, and structural change. Countries' performances in each of these are regressed first against countries' overall SDG scores, and then against each of the individual SDGs, to ascertain what the nuanced relationships are between the multifaceted components of sustainable development and productive capacity.

In so doing, the paper adds to the literature by assessing the impact of economic complexity and structural transformation on sustainable development. The UNCTAD (2021a) report asserts that enhanced productive capacities enable countries to be more resilient and better able to respond to shocks, such as the COVID-19 pandemic and other natural hazards. Examining the relationships between productive capacities and the SDGs are critical to that discourse, as it is only through enhanced productive capacities that countries can structurally transform and achieve greater economic complexity. This paper therefore strikes at the root of the issue, with sustainable development and economic resilience being the end goals.

The next section of this paper summarizes the extant literature on the relationship between productive capacity and sustainable development, highlighting the complexities and need for further research. This is followed by a description of the methodology and data used as well as the regression results, sensitivity analysis, and conclusions derived.

Sustainable Development and Productive Capacity: A Brief Summary of the Literature

Sustainable development has been defined as 'the process of improving the quality of human life while living within the carrying capacity of supporting ecosystems' (Ozili 2022, p. 262). Productive capacities have been broadly defined by UNCTAD (2006b, p. 61) as focusing on 'both structural and supply-side constraints, and encompassing physical infrastructure, technology, enterprise development and energy, as well as specific sectoral challenges in relation to agriculture and agro-industries, manufacturing and mining, rural development and food security,

and sustainable tourism'. Sustainable development in any country is dependent on its productive base. This is well established in economic theory. In classical development theories, such as by Prebisch (1950), and Lewis (1954), development was predicated on the need for high capital accumulation and the transformation of the productive structure (Andreoni and Chang 2017).

Although neoclassical economics de-emphasized production in favour of exchange, the underlying importance of productive capacities is fundamental to the well-used Cobb-Douglas production function. In the simplest form of the Solow growth model, aggregate output is determined by labour, capital, and technology, with diminishing returns to labour and capital separately and constant returns to both factors jointly. Improvement in an economy's long-term rate of growth is thus dependent on productivity improvements, which the model assumes are caused by technological change (Todaro 2000). Endogenous growth theorists explained such technological change by broadening the definition of capital to include, inter alia, human capital, and intangible capital such as knowledge. Achieving enhanced innovation through learning by doing and research and development was thus shown to be critical to long-term economic growth (Becsi and Wang 1997).

Aschauer (1989) also improved on the simple Cobb-Douglas production function framework by adding public capital to private capital, labour and technology as explanatory variables for output. He found the output elasticity of infrastructure to have a high and significant impact on output and growth, and argued that core infrastructure, which consists of highways, mass transit, airports, electrical and gas facilities, water, and sewers contributes highly to productivity growth.

New institutional economics further theorized that economic success is achieved with the formulation of institutional innovations that lower the costs of transactions, permit the capturing of more gains from trade, and foster the expansion of markets (North 1990, p. 3). Theoretical justification for the critical elements of productive capacity included in our model (human capital, natural capital, infrastructure – including transport, ICT and energy, and institutions and the private sector) is thus provided in the foundational classical and neoclassical theories of growth and development.

Several empirical studies have examined countries' productive capacities, with results indicating that cross-country differences in resource endowment and productive capacity lead to uneven levels of sustaina-

ble development (Dasgupta, Managi, and Kumar 2022; Ozili 2022). Xin et al. (2023, p. 2) note that 'a country's productive capacity is interconnected with basic factors that allow equitable and sustainable growth and development'. There is consensus in the literature that inadequate productive capacities limit countries' economic outputs, leaving them reliant on a narrow range of exports (Isaksson 2007). This has been the fate of many LDCs, precipitating advocacy for clear policy guidance for fostering economy-wide productive capacity in such countries (Castell 2021). The challenge, however, is that while many of the theoretical and empirical studies have focused on one or a few productive capacities, far fewer attempt to holistically measure and examine countries' productive capacities generally and assess the impact of such capacities on achieving sustainable development.[2]

Andreoni and Chang (2017) suggest that this may be due to the proclivity of neoclassical theory to ignore the dynamics of production by underestimating the heterogeneity of production activities within and across production sectors and neglecting the critical role of productive transformation. They introduce a theoretical framework in which development is reconceptualized as a process of production transformations, led by the expansion of collective capacities that results in the creation of good employment and sustainable structural change.

Andreoni and Scazzieri (2014) developed a theoretical model in which they similarly emphasized the importance of production arrangements and the dynamics of production structures. Their model utilized the classical laws of increasing and decreasing returns and adopted a dual representation of production structures. They showed that different increasing and/or decreasing returns trajectories may be identified depending on which production units and levels of aggregation are under consideration. They show that any given economic system may follow a plurality of structural trajectories and conclude that analysis of the relationships between production structure and economic dynamics can help to identify triggers of change and how they work, to design targeted measures for setting economic systems on different transformation paths. It was therefore important to include structural transformation in our model to test its potential impact on sustainable development.

This is in line with the approach adopted by UNCTAD (2006b), who by citing the eclectic contributions of early development economists such as Lewis (1954), Kalecki (1969), and Kaldor (1967, 1981), assert that the dynamics of production structure matters for economic growth, with struc-

tural transformation, productivity growth and international competitiveness being driven by the processes of technological learning, along with capital accumulation. In the context of the SDGs, UNCTAD (2020) noted that the underlying factors driving performances in the SDGs were not being adequately analysed. UNCTAD thus developed the Productive Capacities Index (PCI) as a policy tool to aid in measuring national performance in productive capacities and their potential to reach the targets under the SDGs.[3] The PCI is designed to be used to identify and evaluate the strengths and weaknesses of a country's productive capacities and to inform policy for the effective building of such capacities for sustained growth.

The PCI is a relatively new measure, and has sparked renewed empirical interest in testing the relationship between productive capacities and sustainable development. The results of several regression analyses show that productive capacities can play a crucial role in meeting the SDGs. Specifically, countries with higher levels of productive capacities have been shown to perform better in SDGs 1 to 4, 8, 9, and 11. UNCTAD (2021b) thus emphasizes the importance of productive capacities in enabling structural transformation, which can lead to poverty reduction and help make inroads in bringing about food security, education, and urbanization-related indicators under the Global Goals.

As to the effect of the PCI on environmental degradation, Oluc et al. (2023) examined the relationship between carbon dioxide emissions, economic growth, and the PCI for a panel of 38 Organisation of Economic Cooperation and Development (OECD) countries between 2000 and 2018. They found that increasing productive capacity can play an important role in reducing CO_2 emissions. Xin et al. (2023, p. 2) note that 'successive waves of technical development boost productivity and lead to reduced resource use and emissions'.

It is, however, important to acknowledge that sustainable development and productive capacities are both multi-dimensional concepts, involving interactions between economic, social, environmental and governance dimensions. A simplistic view of the relationship between them can lead to important nuances being overlooked. The Sustainable Development Goals (SDGs) adopted by the United Nations in 2015 incorporate 17 goals, 169 targets and 231 indicators (Cling and Delecourt 2022; Breuer et al. 2023). The existence of trade-offs, synergies and co-benefits between these goals and targets have been highlighted by many authors (e.g. Cling and Delecourt 2022; Bali Swain and Yang-Wallentin 2020). Although some studies

have confirmed positive, mutually reinforcing relationships between most of the goals, others find inherent conflicts between some goals, particularly those relating to socio-economic development and environmental sustainability (Dawes, Zhou, and Moinuddin 2022; Lawrence, Ihebuzor, and Lawrence 2020a). Ravallion (2020), for example, noted that achievement of SDG-1 (Zero Poverty) post-COVID-19 will almost certainly require economic growth in poor countries, which will come with environmental costs, including global warming. Empirically, studies such as those by Sharmin and Tareque (2018, 2020), Linh and Lin (2014), Griggs et al. (2014), Delabre, Alexander, and Rodrigues (2020), and Nilsson, Griggs, and Visbeck (2016) highlighted examples of how approaches to economic development can negatively impact the environment.[4]

Many of the studies that have sought to shed light on the interrelationship between socio-economic development and environmental sustainability have tested the Environmental Kuznets Curve (EKC) theory. This theory suggests an inverted U-shaped relationship between environmental degradation and economic growth (Linh and Lin 2014). 'At early stages of development, it is hypothesized that the environment deteriorates with economic growth, until a certain level of per capita income is reached, beyond which further increases in income result in environmental improvements' (Panayotou, Peterson, and Sachs 2000, p. 5). Leal and Marques (2022), however, reviewed more than 200 articles from 1998 to 2022 on the EKC and did not find any consensus in the literature on the existence of the EKC. Panayotou, Peterson, and Sachs (2000, p. 15) concluded that 'further research is needed to untangle the diverse and shifting forces underlying the environment-growth relationship'.

A similar type of conflict has been observed between economic growth and the SDGs' social sustainability targets, particularly SDG-10 (reduced inequalities). Empirical evidence in some regions has been found supporting Kuznets' (1955) theorized inverse U-shaped pattern of inequality, wherein as countries developed, income inequality first increased, peaked, then decreased. In other regions, notably East Asian countries, including South Korea, Japan and Taiwan, monotonically falling inequality was experienced (Acemoglu and Robinson 2002). Andreoni and Chang (2017) assert that understanding the importance of structural transformation and productive capacities helps to explain the divergence of experiences. They also note that social sustainability requires an increase in the number and quality of jobs and not simply the satisfaction

of basic needs, which is dependent on economic growth that is driven by production transformation.

The lack of clarity on, and likely conflicting relationship between the three pillars of sustainable development 'makes it challenging to determine the most effective strategy to create sustainable development' (Bali Swain and Yang-Wallentin 2020, p. 105). Bervar and Trnavčevič (2019, p. 196) contend that 'in practice, sustainable development means searching for, debating and seeking compromise among different concepts'. Sachs et al. (2019) suggest systems-based approaches to deal with trade-offs between SDG interventions and have sought to provide guidelines on how to organize the implementation of these interventions in a manner designed to maximize impact and minimize trade-offs. Such systems-based approaches are critical, as 'increased policy coherence and integrated implementation are necessary to address pressing development problems that cut across different sectors' (Breuer et al. 2023, p. 1). This necessitates nuanced analyses and rigorous research to guide policymakers as they seek to establish codes, standards, and legislation to allocate resources in pursuit of sustainable development (Ozili 2022; Bervar and Trnavčevič 2019).

This is particularly so as countries seek to achieve the SDGs through enhancement of their productive capacities. Like the SDGs, countries' productive capacities have multiple components that are interconnected, reinforcing, and sometimes conflicting, giving rise to a need for nuanced development interventions. Strong policy guidance is needed if developing countries are to target the SDGs effectively through enhanced productive capacities. However, very little such guidance currently exists and the guidelines provided by Sachs et al. (2019) on implementing SDG interventions do not consider developing countries' need to simultaneously enhance their productive capacities or assess empirically the measures proposed. A holistic approach, which considers the complex relationships and interrelated character of the SDGs and productive capacities is required. Furthermore, as very few developing country governments will have access to the financial and human resources to tackle all of the required policy initiatives at once, a phased and properly sequenced approach built on a thorough and nuanced understanding of the relationship between the SDGs and productive capacities will be crucial. It is this gap in the literature that this paper seeks to fill.

Methodology

This paper estimates the relationship between a country's performance on the SDGS and its productive capacities, utilizing a panel time series model. Both fixed effects and random effects models were initially estimated, and a Hausman Test for fixed or random effects was conducted. Test P-values confirmed that the fixed effect model was the appropriate model to use. The estimation pools together the models for all countries into a single regression model by adding country-specific dummy variables γ1, γ2, ..., γn corresponding to the *n* countries included in the dataset.

The following model is therefore estimated:

$$\begin{aligned} SDG\ Score_{i,t} = {} & \alpha_0 + \beta_1 PCI\ components_{i,t-1} \\ & + \beta_2 [PCI\ components_{i,t-1}]^2 \\ & + \beta_3 controls_{i,t-1} + \beta_4 Trend_i + \gamma_i + \delta_t + u_{i,t} \end{aligned} \tag{1}$$

where the SDG Score represents each country's SDG score measured annually, and PCI components denotes individual variables for human capital, natural capital, energy, transport, information and communications technology, institutions, the private sector, and structural change. A set of control variables are also included as well as a constant term, time trend, time effects dummies and individual country fixed effects.

The fixed effects model shown by equation (1) therefore involves estimating the coefficients for each of the independent variables, time trend, time effects and the country-specific effects for country (i). $SDG\ Score_{i,t}$ is a scalar containing the sustainable development goal score of country i, at time t; the main independent variables of interest are listed above; $controls_{i,t-1}$ is a row vector of size $[1 \times k]$ containing the values of k control variables, for country i at time t-1; β_3 is a column vector of $[k \times 1]$ containing the regression coefficients for the k control variables; and $u_{i,\,t-1}$ is a scalar containing the error term of the regression for country, i at time $t-1$.

Before estimating (1), several pre-regression diagnostic tests were conducted. The errors were tested for heteroscedasticity and autocorrelation using the Breusch-Pagan test and the Wooldridge test for autocorrelation in panel data, respectively. Both heteroscedasticity and autocorrelation were found to be present, suggesting that the standard errors of the regression model must be appropriately adjusted. The results for the

Hausman, Breusch-Pagan, and Wooldridge tests are presented with the regression results in table 3.

When using panel data, the possibility of cross-sectional or spatial dependence is also a cause for concern. In the presence of cross-sectional dependence, if the unobserved common cross-country factors are independent of the explanatory variables, the fixed effects estimator will still be consistent, but it will be inefficient. Therefore, both the Pesaran and the Frees test for cross-sectional dependence were conducted. These tests were selected because they can handle both balanced and unbalanced panels and are suitable for a finite T. The results for the Frees tests are also reported in table 3.[5] The values in the table indicate that the null hypothesis of cross-sectional independence is rejected at all conventional significance levels. To correct for this, we ran the regression analysis using the Driscoll-Kraay standard errors. As highlighted in Hoechle (2007), in the presence of cross-sectional dependence, the Driscoll-Kraay standard errors are more robust than the Newey-West standard errors. Hoechle (2007) also uses simulations to show that, even though the Driscoll-Kraay standard errors are intended for panels with a large time dimension, they still perform well even when T is as low as 5.

The presence of cross-sectional dependence in the model implies that when testing for stationarity, second-generation unit root tests should be used. However, as noted in Blackburne and Frank (2007), issues such as slope heterogeneity and non-stationarity are typically a cause for concern when T is large. Despite our T being relatively small, unit root tests were conducted. The second-generation Pesaran test was attempted. However, results could only be obtained for the SDG score due to gaps in the data for the other variables. The Dickey-Fuller version of the Fisher test was conducted on all the variables since it allows for unbalanced panels. For all the variables, the null hypothesis that all panels contain unit roots was rejected at the 1% level.[6] The result of the Pesaran test on SDG score was consistent with the result of the Fisher test.

Even though neither the Dickey-Fuller version of the Fisher test nor the Pesaran test gave us reason to be concerned that the SDG variable may be unstable, because the SDG goals were established in 2015 and the values of the SDG index before that year were extrapolated, we conducted further tests to ascertain whether there was a structural break in the data at or near 2015. The panel data unit root test presented in Karavias and Tzavalis (2014) was conducted, as it allows for the existence of one or two structural breaks in the time series. The results did not indicate

a structural break at or near 2015, and rejected the null hypothesis that all the time series are unit root processes. This suggests that there was no change in the distribution of the variable over the review period. The results for the Fisher unit root tests are presented in tables 1 and 2.[7,8]

Data

The data utilized in this study are compiled from the World Bank, International Monetary Fund, and the United Nations – United Nations Sustainable Development Solutions Network (UNSDSN) and UNCTAD.

TABLE 1 Descriptive Summary Statistics for the Dependent Variables

Variables	Description	Obs.	Mean	Median	Std. dev.	Min	Max	Fisher P-value
SDG Overall	Overall	3,749	64.1	65.2	10.5	38.4	86.5	0.000
SDG 1	No Poverty	3,738	71.8	88.2	32.4	0	100	0.000
SDG 2	No Hunger	3,749	57.9	59.0	11.2	11.5	83.6	0.000
SDG 3	Good Health and Well-Being	3,749	64.5	71.3	22.5	11.5	97.2	0.000
SDG 4	Quality Education	3,748	70.9	79.6	27.2	0.0	99.9	0.000
SDG 5	Gender Equality	3,749	55.6	57.6	17.8	3.4	91.9	0.000
SDG 6	Clean Water and Sanitation	3,749	65.4	66.5	15.5	23.3	95.1	0.000
SDG 7	Affordable and Clean Energy	3,749	62.6	67.4	19.0	0.1	99.6	0.000
SDG 8	Decent Work and Economic Growth	3,749	65.7	65.5	11.1	33.2	91.8	0.000
SDG 9	Industry, Innovation, and Infrastructure	3,749	31.2	20.9	27.3	0	99.1	0.000
SDG 10	Reduced Inequalities	3,733	60.2	65.7	26.6	0	100	0.000
SDG 11	Sustainable Cities and Communities	3,749	68.8	74.6	18.8	13.8	99.8	0.000
SDG 12	Responsible Consumption and Production	3,749	84.6	88.4	13.0	46.7	98.8	0.000
SDG 13	Climate Action	3,749	80.0	89.4	22.5	0.0	99.9	0.000
SDG 14	Life Below Water	3,709	63.0	62.6	9.5	29.0	89.7	0.000
SDG 15	Life on Land	3,749	64.2	64.1	13.2	27.1	97.9	0.000
SDG 16	Peace, Justice, and Strong Institutions	3,749	65.6	65.6	14.0	27.5	95.8	0.000
SDG 17	Partnerships for the Goals	3,749	57.0	57.0	12.7	19.4	100	0.000

The dependent variables in each respective model are the countries' overall SDG scores and their performances in each of the 17 SDGs. This data is taken from the database which accompanied the 2022 Sustainable Development Report. Data is provided on 163 countries' performances on the sustainable development goals tracked over the period from 2000 to 2022. Both an overall score, which is the simple average of the individual SDG scores for the 17 Goals, and the individual SDG scores are reported. Each of the 17 Goals are scored over the range 0 to 100 (best). Descriptive statistics are provided in table 1.

The focal explanatory variables are the countries' scores on each of UNCTAD's PCI components, representing their performance in enhancing each of the eight productive capacities. The PCI covers 193 economies over the period 2000-2018, with the set of productive capacities and their specific combinations mapped across 46 indicators. Countries with lower productive capacities possess an index score closer to zero, while those with high productive capacities have index scores closer to 100[9]. The components of the PCI are as follows:

- Human Capital, which captures the education, skills and health conditions possessed by the population, and the overall research and development integration in society through the number of researchers and expenditure on research activities. Gender is reflected by the fertility rate.
- Natural Capital, which reflects the availability of extractive and agricultural resources, including rents generated from the extraction of the natural resource, less the cost of extracting the resource.
- Energy, which measures the availability, sustainability, and efficiency of power sources.
- Transport, which measures the capability of a system to take people or goods from one place to another. It is defined as the capillarity of roads, railway networks, and air connectivity.
- Information and Communication Technology, which reflects the accessibility and integration of communication systems within the population and includes fixed lines, mobile phones users, internet accessibility, and server security.
- Institutions, which reflect political stability and efficiency through regulatory quality, effectiveness, criminality, corruption, and terrorism, and the safeguard of freedom of expression and association.

TABLE 2 Descriptive Summary Statistics for the Independent Variables

Variables	Obs.	Mean	Median	Std. dev.	Min.	Max.	Fisher P-value
Productive Capacity Index (PCI) Components							
Human Capital	3,676	47.47	46.10	13.30	18.66	89.13	0.000
Natural Capital	3,676	52.70	51.98	8.62	14.61	96.69	0.000
Energy	3,676	26.73	27.39	7.09	5.61	59.21	0.000
Transport	3,676	16.99	15.51	7.32	4.00	60.59	0.000
ICT	3,676	9.99	7.85	7.41	2.76	86.39	0.000
Institutions	3,676	54.07	51.28	20.07	1.64	99.73	0.000
Private Sector	3,676	76.93	78.22	9.15	37.97	96.87	0.000
Structural Change	3,676	19.10	18.53	6.08	0.96	64.74	0.000
Control Variables							
Age-Dependency	4,997	60.75	55.03	18.19	16.17	111.48	0.000
Inflation Vol.	3,465	1.78	0.88	5.45	0.03	170.55	0.000
Nat. Res. Rents	3,848	6.75	1.57	11.30	0.00	87.46	0.000
Trade Openness	4,286	85.19	71.64	55.21	1.20	863.20	0.000

- Private Sector, which is defined by the ease – time and monetary costs – of cross-border trade, and the support to business through domestic credit, velocity of contract enforcement and time required to start a business.
- Structural Change, which refers to the movement of labour and other productive resources from low-productivity to high-productivity economic activities. This is captured by the sophistication and variety of exports, the intensity of fixed capital and the weight of industry and services on total Gross Domestic Product (GDP).

All eight productive capacities are included in the regressions in both linear and quadratic forms to investigate the possibility of different relationships between the key variables of interest. table 2 summarises the descriptive statistics of the independent variables.[10] All the independent variables are lagged by one year in the regression analysis.

In addition to the focal variables, four control variables are also included in the regressions. These control variables attempt to capture variation in macroeconomic stability, external resilience, and domestic resource availability and capabilities across countries, that could influence countries' progress towards sustainable development.

The influence of macroeconomic instability is captured by price volatility, measured as the standard deviation in countries' quarterly CPI

inflation, sourced from the International Monetary Fund (IMF)'s International Financial Statistics. The higher the volatility in this measure, the greater the macroeconomic instability and the slower the development, as the decision-making process of economic agents becomes myopic as economic uncertainty increases.

External resilience is represented by trade openness. Countries with more open trade regimes can export and import goods more freely and have access to resources that lie beyond their national borders. While trade openness can be good for sustainable development, it is also noted that it can be a source of external vulnerability, exposing countries to changing currents in trade flows. It is possible for this variable to have either a positive or negative impact in the regression analysis. Trade openness is measured at the aggregate level and is the sum of exports plus imports of goods and services as a percentage of GDP. It is sourced from the World Bank's World Development Indicators Database and is lagged by one year in the regression analysis.

Domestic resource availability is included in the regressions through two control variables, natural resource rents and the age-dependency ratio. Natural resource rents are measured by the sum of oil rents, natural gas rents, coal rents, mineral rents, and forest rents as a percentage of GDP. This data is sourced from the World Bank's World Development Indicators (WDI). The age-dependency ratio is the non-working age population – the sum of the young population (under the age of 15) and the elderly population (age 65 and over) – as a percentage of the working age population (ages 15 to 64). Countries with high age-dependency ratios are more likely to require proportionately more of the income produced by their working age populations to support both the young and elderly in society and will make less resources available to advance sustainable development goals. This data is sourced from the World Bank's World Development Indicators (WDI).

Results

The regression results in the second column of table 3 show which of the eight productive capacities are key correlates with countries' overall SDG scores. The results indicate that while transport and the private sector did not have statistically significant relationships with the dependent variable, five of the eight indicators which comprise the PCI have an inverted-U relationship with SDG scores. Table 3 shows that Human Capital, Natural Capital, Energy, ICT, and Structural Change all have

TABLE 3 Regression Results

	Overall SDG Score	Individual SDG Goals																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		No Poverty	Zero hunger	Good Health & Well-Being	Quality Education	Gender Equality	Clean Water & Sanitation	Affordable & Clean Energy	Decent Work & Economic Growth	Industry, Innovation & infrastructure	Reduced Inequalities	Sustainable Cities & Communities	Responsible Consumption & Production	Climate Action	Life Below Water	Life on Land	Peace, Justice & Strong Institutions	Partnerships for the Goals
Human Capital$_{t-1}$	0.276**	+ve**	+ve**	+ve**	+ve**	+ve**	+ve**	+ve**		-ve**	-ve**	+ve**	+ve**	-ve**	-ve**	-ve**		+ve**
Sq. Human Capital$_{t-1}$	−0.002**		-ve**	-ve**	-ve**	-ve**	-ve**	-ve**		+ve**	+ve**	-ve**	o**	+ve**	+ve**	+ve**		-ve**
Natural Capital$_{t-1}$	0.156**	+ve**	+ve**	+ve*	+ve**	+ve**	+ve**		+ve*	-ve**	-ve**					-ve**		+ve**
Sq. Natural Capital$_{t-1}$	−0.001**	-ve**	-ve**	-ve*	-ve**	-ve**	-ve*			+ve**	+ve**					+ve*		-ve**
Energy$_{t-1}$	0.098**		+ve**	+ve**	+ve**		+ve**	+ve**		-ve**	-ve**	+ve**	+ve**					-ve**
Sq. Energy$_{t-1}$	−0.001**		-ve**	-ve**	-ve**		-ve**	-ve**		+ve**	+ve**	-ve*	-ve**					+ve**
Transport$_{t-1}$	0.004	+ve**		-ve**	-ve**		+ve**		+ve*	-ve**	+ve**		-ve**	-ve**			+ve**	
Sq. Transport$_{t-1}$	0.000	-ve**			+ve**		-ve**			+ve**	-ve**		+ve**	+ve**	+ve**		-ve**	+ve**
ICTt-1	0.461**	+ve**	+ve**		+ve**	+ve**	+ve**		+ve**	+ve**	+ve**	-ve**		-ve**	+ve**	+ve**	+ve**	
Sq. ICT$_{t-1}$	−0.011**	-ve**	-ve**	-ve*	-ve**	-ve**	-ve**		-ve**	-ve**	-ve**	+ve**		+ve**	-ve**	-ve**	-ve**	+ve**
Institutionst-1	0.065**	+ve**	+ve*	+ve**			+ve**	+ve**	-ve**			+ve**	+ve**	+ve**				
Sq. Institutionst-1	0.000**				-ve**		-ve**	-ve**	+ve**			-ve**	o**	-ve**		+ve**	+ve**	+ve*
Private Sectort-1	0.044		+ve**		-ve**	+ve**	+ve**	+ve**	+ve**		+ve**					-ve**		-ve**
Sq. Private Sectort-1	0.000		-ve**			-ve**	-ve**	-ve**	-ve**		-ve**	+ve**				+ve**		+ve**
Structural Changet-1	0.126**		-ve**	+ve**	+ve**	+ve**		+ve**	+ve**		-ve**				+ve**	+ve**		

Continued on the next page

TABLE 3 *Continued from the previous page*

	Overall SDG Score	Individual SDG Goals																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
		No Poverty	Zero hunger	Good Health & Well-Being	Quality Education	Gender Equality	Clean Water & Sanitation	Affordable & Clean Energy	Decent Work & Economic Growth	Industry, Innovation & infrastructure	Reduced Inequalities	Sustainable Cities & Communities	Responsible Consumption & Production	Climate Action	Life Below Water	Life on Land	Peace, Justice & Strong Institutions	Partnerships for the Goals
Sq. Structural Changet-1	−0.002*		+ve**	-ve**	-ve**	-ve**	+ve*	-ve**	-ve**		+ve**				-ve**	-ve**		
Dep_lag	−0.029**	-ve**		-ve**	-ve**	-ve**	-ve**	-ve**				+ve**	-ve**	+ve**	+ve**	+ve**	+ve**	-ve**
Inf_Std_Q_lag	0.000		-ve**			+ve**						-ve**			+ve**			
Ln_NRR_lag	−0.074*		+ve**			-ve**			+ve**	-ve**							-ve**	
Trade_lag	0.009**			+ve**	+ve**	+ve**		-ve**		+ve**					+ve**	+ve**		+ve**
Trend	0.181**																	
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−324.78**			-ve**	-ve**	-ve**	-ve**	-ve**	-ve**	-ve**		-ve**	+ve**	-ve**	-ve**	-ve**		

NOTE ** if significant at 5% level; * if significant at 10% level

Hausman	0.000
Breusch-Pagan	0.000
Wooldridge	0.000
Frees	25.120

a positive impact on SDG scores for countries with low levels of productive capacity in these areas. However, for countries with high levels of capacity in these areas, further increases in capacity could lead to lower SDG scores[11]. In contrast, Institutions has a positive quadratic relationship with SDG Score. This indicates that there is a positive relationship between institutions and SDG Score for countries with low institutional capacity, as well as for countries with high institutional capacity. This suggests that irrespective of a country's current level of institutional capacity, there is potential for its overall SDG performance to be enhanced with improved institutional capacity.

To further elucidate these relationships, the remaining columns of table 3 present the summarized results of the regression models in which each of the individual SDGs was iteratively included as the dependent variable, and the unpacked components of the PCI were included, along with the control variables, as the independent variables. The statistically significant relationships between the SDGs and the respective productive capacities are highlighted[12]. It should first be noted that each of the 17 SDGs had multiple statistically significant relationships with multiple components of the PCI. This underscores the importance of considering different aspects of countries' productive capacity in any discussion on the SDGs. However, nuanced analyses are critical, particularly for SIDS and LDCs, which are resource-constrained developing countries. They must be very strategic and highly prioritized in their policy efforts towards sustainable development. Analyses of this nature enable such countries to focus on the policy interventions that allow them to have the greatest impact in multiple areas. Table 4 is quite instructive in this regard, as it visually illustrates how the panel regression results produced in this paper can be useful to developing country policymakers and their international development partners.

In this table, for each productive capacity, the statistically significant relationships that are more likely to produce enhancements in SDG performance are colour-coded green and listed first. These include positive linear and quadratic relationships between the SDG and productive capacity being considered. Inverted-U relationships with the PCI components are also coded green, based on the reasonable assumption that SIDS and other vulnerable groups of countries are likely to have low levels of productive capacity. The relationships that are coded red are the ones for which negative linear and quadratic relationships were derived. U-shaped relationships are coded pink, and are placed towards the bot-

TABLE 4 Significant Relationships between Components of PCI and Individual SDGs*

Human Capital	Natural Capital	Energy	Transport	ICT	Institutions	Private Sector	Structural Change
1	8	2	8	1	1	2	3
12	1	3	1	2	2	5	4
2	2	4	6	4	3	6	5
3	3	6	10	5	12	7	7
4	4	7	16	6	6	8	8
5	5	11	2	8	7	10	14
6	6	12	14	9	11	11	15
7	17	9	4	10	13	15	6
11	9	10	9	14	15	17	2
17	10	17	12	15	16	4	10
9	15		13	16	17		
10			3	17	8		
13				11	4		
14				13			
15				3			

Key

- +ve Linear
- Inverted-U
- +ve squared term only
- U-shaped
- -ve squared term only
- -ve Linear

NOTE *Corresponding SDGs are shown in each cell of the table.

tom of the table, based on the previously mentioned assumption regarding SIDS and other vulnerable groups of countries.

Most of table 4 is green-coded, highlighting the important role that improving productive capacities can play in precipitating enhanced SDG performance. Private Sector, Structural Change, Transport, Energy and Natural Capital were shown to have green-coded relationships with over a third of the 17 SDGs. Three productive capacities had green-coded relationships with more than half the SDGs. ICT, Institutions and Human Capital had green-coded relationships with 12, 11 and 10 of the SDGs, respectively.

The results suggest that improvements in institutional capacity provide the greatest opportunity for widespread, unmitigated improvement in SDG performance. This is because four of the 11 green-coded relation-

ships between institutional capacity and the SDGs are positive linear or quadratic (implying that irrespective of a country's level of institutional capacity, performance in SDGs 1, 2, 3 and 12 will improve with enhanced institutional capacity). Human capital has a similar relationship with SDG-1 (No Poverty) and SDG-12 (Responsible Consumption and Production), and Natural Capital and Transport both have a similar relationship with SDG-8 (Decent Work and Economic Growth).

Most of the green-coded relationships, however, have an inverted-U shape. Eleven of the 12 green-coded relationships with ICT capacity have this shape, indicating that for countries with low levels of such capacity, enhanced ICT capacities can yield positive outcomes in 11 SDGs. Human Capital has inverted U shaped relationships with eight SDGs, similarly, indicating that countries with low human capital are likely to have improved SDG performance as such capacity is enhanced. Natural Capital, Energy and Structural Change each have seven such relationships, Private Sector has six, and Transport and Institutions both have four such relationships. These inverted U-shaped relationships dominate the results, with all SDGs exhibiting such a relationship with at least one of the components of the PCI. The dominance of these results highlights the dynamic nature of the relationship between productive capacities and the SDGs, as consideration must be taken of the countries' extant level of each productive capacity when seeking to ascertain its likely relationship with SDG performance. In this respect, our results support and elucidate the findings derived in UNCTAD (2021b), Oluc et al. (2023), and Xin et al. (2023).

The results also highlight the SDGs which are likely to be adversely impacted by countries' efforts to enhance the respective productive capacities, as reflected in the pink- and red-coded relationships. As an example, Human Capital had pink-coded relationships with five of the goals. The results indicate that SDGs 9, 10, 13, 14 and 15 had U-shaped relationships with human capital, so, as countries with low levels of human capital sought to improve capacity in this area, worsened performance in these SDGs could be exhibited. Similar, pink-coded relationships with one or more SDGs are evident for each of the components of the PCI. This suggests that for varied SDGs, even though improvements in productive capacities can yield enhanced SDG performance, this will only occur when the countries are well-endowed with such capacities. When countries have low levels of such capacities, efforts to increase them are likely to be associated with worsened performance

in some SDGs. This reflects the nuanced relationship between productive capacities and SDG performance and highlights the trade-offs that must be considered as countries seek to grow and develop. This is in line with studies such as those by Ravallion (2020), Sharmin and Tareque (2018), and Delabre, Alexander, and Rodrigues (2020), which highlight the social and environmental trade-offs faced by poor countries seeking economic growth.

Of the 27 relationships that were pink- and red-coded, ten are with SDGs related to the environment, nine are with social sustainability SDGs, and six are with SDGs related to economic development. Of the ten pink- and red-coded relationships between productive capacities and the SDGs related to the environment, nine were pink. These U-shaped relationships strongly suggest that countries seeking to build productive capacities from very low levels often have to do so at the expense of worsened environmental performance in specific areas, at least temporarily. The upshot of these types of relationships is that once productive capacities increase beyond a certain threshold, further improvements will yield enhanced environmental performance. These results lend support to the Environmental Kuznets Curve (EKC) theory, with the early stages of development associated with environmental deterioration being characterized by low levels of productive capacity, and the level of development beyond which further increases in development result in environmental improvement being characterized by high levels of productive capacity.

It is also noteworthy that improvement in institutional and energy capacities are the only two components of the PCI for which the results do not highlight any downside risks for environmental performance for countries with low levels of capacity in both areas. This is particularly instructive for the energy sector, as it suggests that recent efforts in such countries to improve energy capacity are largely being conducted in an environmentally responsible manner. This may be due to the rapid advances in variable renewable energy technologies that Arndt et al. (2019) assert developing countries are well positioned to take advantage of.

Of the nine pink- or red-coded relationships between productive capacities and the SDGs related to social sustainability, four were red. SDG-3 (Good Health and Well-being) had a statistically significant negative relationship with Transport, as well as with squared-ICT (albeit at only the 10% level of significance). SDG-4 (Quality Education) had statistically significant negative relationships with Private Sector capacity,

as well as with squared-Institutions. These relationships, particularly between transport and SDG-3 and the private sector and SDG-4, merit further investigation to identify the factors which are driving the association between the variables.

Also noteworthy is the fact that four of the five pink-coded relationships between productive capacities and the social sustainability indicators involved SDG-10 (Reduced Inequality). Human Capital, Natural Capital, Energy and Structural Change all had U-shaped relationships with Reduced Inequalities. These results suggest that as countries with low capacities in these areas seek to increase their capacities, careful attention must be placed on the issue of income inequality. Advancement in human and natural capital, energy capacity and structural change can worsen inequality in a society. Similar results were derived by Lee and Lee (2018), who found that, inter alia, higher per capita income and faster technological progress (typically associated with higher levels of human capital and structural change) tend to make income distribution more unequal.

The results also indicate that four of the six pink-coded relationships between productive capacities and the SDGs targeting economic development involve SDG-9 (Industry, Innovation, and Infrastructure). U-shaped relationships were exhibited between this goal and Human Capital, Natural Capital, Energy and Transport. The upward-sloping part of this relationship is easily understood, as high levels of these productive capacities are needed to foster resilient infrastructure, sustainable industrialization, and innovative activities. Note, however, that the results indicate that improving such capacities when the levels of human and natural capital, energy and transport are low can be inimical to this goal. This is because while improving productive capacities from low levels typically results in increases in the quantity of production, SDG-9 requires resources to be dedicated to clean, innovative, and sophisticated production techniques. This is unlikely to be the primary focus in countries with low levels of human and natural capital, and energy, and weak transportation capacity. The basic improvements yielded at low levels of capacity are likely to be in industries and infrastructure that are not highly resilient and innovative, again highlighting the prevalent trade-offs when countries seek to grow and develop.

There is thus adequate evidence from the results to reasonably caution that as countries pursue enhancement of their productive capacities, attention must be placed on measures to mitigate adverse environmental

consequences and worsened income inequality, and to catalyse clean, innovative production even when seeking to develop from low capacities. The results also indicate that a focus on enhancing institutional and ICT capacities, along with human capital, will yield the most widespread improvement in SDGs, particularly for countries with low capacities in ICT and human capital. For countries seeking to target improvement in particular SDGs through productive capacity enhancement, the results further highlight the alternate paths that could be pursued. For some of the goals, for example SDG-6 (Clean Sanitation and Water), SDG-5 (Gender Equality), SDG-4 (Quality Education) and SDG-2 (Zero Hunger), between five and six paths are available for countries with low levels of productive capacity. For other goals, such as SDG-9 (Industry, Innovation and Infrastructure) and SDG-13 (Climate Action) the results only revealed one relationship that yielded improved performance for countries with low capacities (enhanced institutional capacity for SDG-13 and enhanced ICT capacity for SDG-9.)

This is very instructive, as it suggests that countries which are performing generally poorly in meeting many of the SDG targets could focus policy attention on enhancing capacity in one or a few key areas to maximize broad-based impact. Alternatively, countries with a need to focus intensively on one or a few specific SDGs could focus on the productive capacities that have been shown to be positively associated with that/those goals.

Sensitivity Analysis – Exploring the Impact of the Global Financial Crisis on the Stability of the PCI-SDG Relationships

Since the period for this study extends to 2018, we test whether global crisis events, notably the global financial crisis (GFC), had an impact on the relationship between productive capacities and sustainable development. Beginning on the 9th of August 2007, global financial markets were in a state of distress, with contagion spreading rapidly across advanced economies and having pervasive impacts globally over the following years. Markets and economies displayed the remnants of the global economic crisis for many years after the initial years of the shock, affecting economic growth and thus narrowing the space for advancing sustainable development.

We ran the model on periods before and after 2007 to examine the impact that the GFC had on the stability of the relationships between each of the productive capacity elements and sustainable development.

TABLE 5 Sensitivity Analysis – Overall SDG Score

	Full model Coeff.	Pre GFC Coeff.	Post GFC Coeff.
HCap_lag	0.276**	0.205**	0.166**
HCap_sq_lag	−0.002**	−0.002**	−0.001**
NCap_lag	0.156**	−0.169*	0.173**
NCap_sq_lag	−0.001**	0.001	−0.001**
Energy_lag	0.098**	0.093	0.105**
Energy_sq_lag	−0.001**	−0.002	−0.001**
Trans_lag	0.004	0.047**	0.02
Trans_sq_lag	0.000	0.000	0.000
ict_lag	0.461**	0.276**	0.633**
ict_sq_lag	−0.011**	−0.007**	−0.014**
Inst_lag	0.065**	−0.030**	0.047**
Inst_sq_lag	0.000**	0.000**	0.000
PS_lag	0.044	−0.068	0.109**
PS_sq_lag	0.000	0.000	−0.001**
StCh_lag	0.126**	0.094**	0.121*
StCh_sq_lag	−0.002*	−0.002*	−0.001
Dep_lag	−0.029**	0.001	−0.063**
Inf_Std_Q_lag	0.000	0.004**	−0.039**
Ln_NRR_lag	−0.074*	0.006	−0.152**
Trade_lag	0.009**	0.002	0.008**
Trend	Yes	Yes	Yes
Time Effects	Yes	Yes	Yes
Constant	Yes	Yes	Yes

NOTE ** if significant at 5% level; * if significant at 10% level

The results are shown in table 5 in which the full model is compared to pre-crisis and post-crisis variants of the model, where countries' overall SDG score is utilized as the dependent variable. Time trend, time and country fixed effects, and a constant term, are included in the models.

The results indicate that of the six productive capacities that had statistically significant relationships with SDG score in the full model:

- one, institutions, had a different type of relationship in the pre- and post-crisis periods, which also differed from the relationship exhibited in the full model;

TABLE 6 Significant Relationships between Components of PCI and Individual SDGs Pre- and Post-Crisis*

Human Capital		Natural Capital		Energy		Transport		ICT		Institutions		Private Sector		Structural Change	
Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
2	12	11	11	7	5	14	1	5	17	5	3	3	9	3	1
3	2	2	1	2	4	3	8	8	1	10	4	6	1	6	3
4	3	6	2	4	6	6	15	9	2	8	2	16	2	16	4
5	4	9	4	6	7	7	16	10	3	2	7	8	6	2	6
6	5	10	5	13	11	9	2	15	4	7	11	9	8	4	8
7	6	15	15	9	12	8	9	16	6	15	12	2	10	5	12
11	7	16	17	16	14	15	16	17	7	16	13	15	14	7	13
14	8		9	3	15	11	4	3	8	6	16		16	13	16
16	1		13	14	1		12	7	9		5		13	17	10
9	9			17	17		5	11	10		6		15	14	
8	16						6	13	12		8		17	15	
10	15							4	13		14				
	10							6	5		17				
	13								11						
	14								14						

Key

- +ve Linear
- Inverted-U
- +ve squared term only
- U-shaped
- -ve squared term only
- -ve Linear

NOTE *Corresponding SDGs are shown in each cell of the table.

- one, structural change, exhibited a similar relationship in the pre-crisis period as in the full model, but a changed relationship for the squared term in the post-crisis period;
- two, natural capital and energy, retained the relationship exhibited in the full model in the post-crisis period, but did not exhibit a similar relationship in the pre-crisis period; and
- two, human capital and ICT, had stable inverted U-shaped relationships with SDG score in the pre- and post-crisis periods.

We next ran the regressions for the pre- and post-crisis periods in which the scores on each of the 17 SDGs are iteratively included as the dependent variable. The summarized, colour-coded results are presented in table 6[13]. The light-green-coded inverted U-shaped relationships between the respective productive capacities and the individual SDGs again dom-

inate the results, irrespective of whether the pre- or post-crisis period is being considered. Notwithstanding this, as would be expected, the nature of the individual relationships between specific capacities and SDGs has been impacted by the GFC. Some capacities, such as natural capital, energy, institutions, and the private sector, had considerably more inverted U-shaped relationships with SDGs in the post-crisis period than in the pre-crisis period. Others, such as transport and structural change, had more pink- and red-coded relationships with SDGs in the post-crisis period than in the pre-crisis period. And others, notably human capital and ICT, exhibited remarkable stability in their relationships with the SDGs, in spite of the GFC's deep and far-reaching impacts.

The stability of the relationships between human capital and ICT with countries' overall SDG score and with several of the individual SDGs, in the face of a major, disruptive global event, is noteworthy, and highlights the potential stable impact that enhancing such productive capacities can have on countries with low levels of human capital and ICT. The dominance of inverted U-shaped relationships between productive capacities and SDGs in spite of the GFC further supports the importance to sustainable development of the role of enhancing such capacities in countries where they are low. The divergence between the results in the pre- and post-crisis periods for several of the relationships highlights the disruptive nature of the GFC, and points to the need for further research to elucidate the specific channels through which crisis impacts are felt and can be alleviated. The recent COVID-19 global pandemic provides another opportunity for future research to focus on the nuances of the relationship between productive capacities and SDGs, as enhanced economic resilience and economic transformation increasingly become crucial elements of countries' development strategies.

Conclusions

The investigation of the relationships between each of the eight component indicators of the Productive Capacity Index (PCI) with the individual Sustainable Development Goals (SDGs) yields nuanced conclusions that ought not be ignored. The fact that each of the 17 SDGs had statistically significant relationships with multiple components of the PCI underscores the importance of considering the different aspects of countries' productive capacity in any discussions on the SDGs. Such nuanced analyses enable the Least Developed Countries (LDCs), Small Island Developing States (SIDS) and other vulnerable economies to fo-

cus on the policy interventions which allow them to have the greatest impact in multiple areas, or to target critical areas with specifically designed interventions that are most likely to create the desired outcomes. As an example, for countries with low capacities in ICT, Institutions and Human Capital, targeted improvements in those areas can yield positive outcomes in between 10 and 12 of the SDGs.

The analyses presented in this paper also allow such countries to better prepare for the likely adverse effects of policy interventions on vulnerable areas. Over a third of the statistically significant relationships that were categorized as having potentially adverse effects on the affected SDGs were related to the environment, with SDG-13 (Climate Action) and SDG-15 (Life on Land) being particularly vulnerable to adverse relationships with multiple productive capacities. The results also suggest that as countries pursue enhancement of their productive capacities, careful attention must be placed on issues of income inequality and the need to encourage resilient, innovative production. The model and results presented herein thus provide a useful template for use in policy settings, both in developing country governments and their international devel-

Notes

1 The productive capacities included in the PCI are: Natural Capital, Human Capital, Energy, Transport, ICT, Institutions, Private Sector, and Structural Transformation.
2 The challenge, however, is that while many of the theoretical and empirical studies have focused on one or a few productive capacities, far fewer attempt to holistically measure and examine countries' productive capacities generally and assess the impact of such capacities on achieving sustainable development.
3 First released in 2021.
4 Foye (2022), however, highlighted the nuanced nature of this relationship, as her results indicated that climate change negatively influenced food prices in Nigeria. She concluded that only concerted and consistent climate change mitigation strategies can precipitate lower food prices through a green economy.
5 The Pesaran test results confirmed the findings of the Frees test and are available upon request.
6 It should also be noted that the Newey-West and Driscoll-Kraay results are similar. As highlighted in Hoeschle (2007), this may indicate that the level of cross-sectional dependence is low. Therefore, the results of the first-generation unit root tests appear to be trustworthy. These results can be provided by the authors upon request.
7 The results for the other unit root tests are available upon request.

8 The Pesaran and Yagamata slope heterogeneity test was conducted. However, it did not perform well due to the finite time dimension of the panel. Both Pesaran and Yagamata (2008) and Bersvendsen and Ditzen (2021) argue that the test lacks power when T is small.
9 See https://unctad.org/topic/least-developed-countries/productive-capacities-index
10 Pair-wise correlations between the SDGs and PCI components can be provided by the authors upon request.
11 All but one of those relationships were significant at the 5% level. While Structural Change had a positive relationship with SDG Score that was significant at the 5% level, the negative relationship between squared Structural Change and SDG Score was only significant at the 10% level.
12 The full regression results can be provided by the authors upon request.
13 The full regression results can be provided by the authors upon request.

opment partners, as more effective targeting of resources and policy interventions for achieving the SDGs is pursued.

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A Bibliometric Analysis of the Literature on Optimum Currency Areas and Monetary Integration

Ntombiyesibini Matonana
Nelson Mandela University, South Africa
s215336348@mandela.ac.za

Andrew Phiri
Nelson Mandela University, South Africa
phiricandrew@gmail.com

Our study presents a pioneering bibliometric analysis of optimum currency areas literature and monetary integration, utilising 9,228 research outputs published between 1960 and 2022. We employ the biblioshiny function in R-studio to comprehensively analyse this data. Our findings reveal a growing body of literature on optimum currency areas, with increased author productivity. Remarkably, influential authors, despite their lower research volume, receive extensive citations and publish in prestigious journals such as *The Quarterly Journal of Economics* and *The American Economic Review*. Additionally, our analysis exposes a lack of representation from non-European/American institutions, as well as an underrepresentation of female and non-White researchers. We propose future research directions to address these gaps. Notably, our study is the first to conduct a bibliometric analysis on optimum currency areas and monetary integration, highlighting its originality.

Keywords: optimum currency areas, monetary integration, bibliometric analysis, biblioshiny package
JEL Classification: F31, F45, G15

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Introduction

Monetary unions are considered the ultimate form of regional integration for a group of neighbouring countries with strong cultural, geopolitical and trade ties. This, in many cases, was a result of cooperation, revolution, and violent force as in the case of monetary boards during colonial times in Africa (Perker Willis 1901; Sylla 2021). Although there has been increased attention on monetary unions in the modern era,

history shows that both scholarship and debates on unions are of historic record, although the area was less specialised as it rested within the broader political economy debates. In the twentieth century, several unions faced dissolution whilst others arose, particularly post-World War II era, when several states which were previously under colonial rule achieved their independence. The debate in this era mostly emerged because of the discourse over the relative merits of fixed versus flexible exchange rates and evolved to include the conditions under which nations should peg their exchange rate regimes and follow a common monetary policy, and the costs and benefits of partaking in such an arrangement (Friedman 1953; Meade 1957).

Robert Mundell's (1961) renowned contribution gave birth to the term 'optimum currency area', introducing a theory that identifies the criterion by which countries can optimise efficiency whilst benefiting from an internal and external balance within a monetary union. This further enticed scholarship on the question of currency areas, with prominent papers by McKinnon (1963), Kenen (1969), Giavazzi and Pagano (1988), Tavlas (1993), Broz (2005), Kunroo, Sofi, and Azad (2016) and many more. Since its inception, the framework of optimum currency areas (OCA) has been utilised to evaluate the costs and benefits of relinquishing monetary autonomy for participation in a currency union and extensively examined and debated within the literature of economics and finance. Notably, the OCA has been applied to various regional common currency arrangements such as the Eurozone, East Caribbean Currency Union, CFA Franc Zone, and SACU Common Monetary area and is currently being considered for adoption by other blocs such as the Cooperation Council for the Arab States of the Gulf (GCC), the Bolivarian Alliance for the Americas (ALBA) and the African Economic Community (AEC).

Over the past six decades, a considerable body of literature has emerged examining the qualifications necessary for countries to share a common currency. Whilst some of these studies have reviewed developments in the OCA literature (Ishiyama 1975; Lafrance and St-Amant 1999; Kunroo 2015; Asongu, Nwachukwu, and Tchamyou 2017), no previous studies have performed formal bibliometric analysis on the subject. This is surprising since bibliometric analysis is a more robust method of probing into the intellectual structure of a topic compared to traditional methods of reviewing the literature (Donthu et al. 2021). By relying on quantitative techniques, bibliometric analysis not only documents the trends

and progress in research performance on a particular subject, but also highlights potential biases in publication records among researchers of different races, genders, and institutions (Dehdarirad, Villarroya, and Barrios 2015; Deem, Case, and Nokkala 2022). Moreover, bibliometric studies have been found to encourage international collaborative research efforts, which has implications for knowledge spillover effects (Bernal, Carree, and Lokshin 2022; Nie et al. 2022).

This study contributes to the existing literature by conducting a bibliometric analysis of scientific research on OCA and monetary integration. We provide a comprehensive overview of research produced by the academic community on these themes to trace the development of the research area over time. Our analysis aims to provide insights into the current research landscape on the topic. Specifically, we seek to identify the leading authors, their contributions to the literature, the most frequently cited papers, the keywords used in the publications, the temporal distribution of research output, the leading journals publishing on this topic, and the dominant institutions in terms of research activity. The findings of this study are used to discern lacunae in the existing literature and thereby pave the way for the formulation of future research agendas on the topic.

The rest of our study is organised as follows. The next section describes the bibliometric methods. The third section presents the search results and the data overview. The fourth section presents our results and we conclude the study in the fifth section.

Methodology

Bibliometric analysis is a research method that employs bibliographic data to evaluate research performance and provide insights beyond those obtained from traditional literature review methods. This approach involves analysing large volumes of scientific metadata to identify emerging areas and trends in a given research field. By analysing bibliographic data, bibliometric analysis offers a means of identifying, analysing, and organising key elements of research topics, thereby revealing patterns within the subject area.

The process of bibliometric analysis entails mining textual data from past publications to identify potential correlations and connections between publications, resulting in a deeper understanding of the structure and dynamics of research fields (Pritchard 1969; Wittig 1978). By examining the relative impact of different publications, authors, and institu-

tions within a field of study, this method facilitates the identification of research gaps and areas for future exploration.

To analyse textual data, we use the biblioshiny function of the bibliometrix package in R-studio software, which provides a robust platform for conducting bibliometric analysis and is increasingly becoming a standard tool in the field of scientometrics (Aria and Cuccurullo 2017).

Search Results and Data Overview

In order to conduct a thorough bibliometric analysis, a broad range of bibliometric techniques and extensive data from 1960 to 2022 were utilised. The bibliographic search was narrowed to include titles, keywords, and abstracts of publications related to optimum currency areas, using both Scopus and Web of Science (WoS). The research outputs that were retrieved were constrained to selected fields of study, such as economics, econometrics, business, international relations, business finance, and social science, in order to exclude irrelevant literature while still capturing papers with relevant keywords. As Scopus and WoS have different data formats, the bibliometric dataset was first processed through R Studio software to eliminate duplicate documents from the two databases. The data obtained from the two databases were then transformed into bibliometric data through the software, merged, standardised, and cleaned to identify duplicate documents, leaving 9,228 documents using 3,335 keywords plus and 11,250 author keywords.

Table 1 displays the primary information regarding the collection of data used for bibliometric analysis from the years 1960 to 2022. Of the total 9,228 documents utilised, 7,086 comprise articles, 970 are book chapters, 381 are reviews, 273 are books, 178 are conference papers and the remaining 341 comprise other document types. Based on the results presented in table 1, it is evident that journal articles are the most frequently cited documents, accounting for 76.8% of the total corpus. On the other hand, the least cited documents include retracted and corrected submissions, art exhibit reviews, and news items which together constitute less than one percent of the total corpus. These findings highlight the reliability and validity of the analysis since the majority of references used come from documents published in scientific journals. Before 1960, the average annual growth rate was 2.42%, which increased to 9.78% after 1960, indicating a surge in publications. The average age of the documents provides insights into the temporal distribution of schol-

TABLE 1 Main information about the dataset

Category	Description	Results
General	Timespan	1960–2022
	Sources (Journals, Books, etc.)	2,288
	Documents	9,228
	Annual Growth Rate %	9.78
	Document Average Age	13.4
	Average citations per doc.	11.37
	References	313,063
Document contents	Keywords Plus (ID)	3,335
	Author Keywords (DE)	11,250
Authors	Authors	10,418
	Authors of single-authored docs	3,226
	AUTHOR COLLABORATION	
Author collaboration	Single-authored docs	4,606
	Co-Authors per doc.	1.77
	International co-authorships %	1.05
Document types	Article	7,086
	Article; proceedings paper	50
	Book	273
	Book chapter	970
	Book review	148
	Conference paper	178
	Correction	3
	Editorial	42
	Editorial material	37
	Erratum	2
	Meeting abstract	4
	News item	3
	Note	40
	Review	380
	Short survey	7

NOTE Biblioshiny based on WOS and Scopus dataset

arly works. The average age of 13.4 indicates that the dataset contains relatively recent documents.

Furthermore, a more in-depth examination of the data reveals that the majority of the publications are authored by a single researcher, and international co-authorship is extremely low, accounting for only 1.05% of the total corpus, indicating that the topic is mostly studied within national boundaries. The dataset has a high proportion of single-authored documents of 49.91%. Despite the existence of 10,419 authors who have written on this topic, the results confirm the assumption that the im-

pact of international collaboration is dependent, in part, on the leading country or institution in the collaboration. Moed (2005) notes that when a high research output and high citation country collaborates with a low research output and low citation country and the former provides the primary author or leading research group, 67% of collaboration pairs produced bi-lateral international collaboration (BIC) papers with an average citation impact above the mean citation impact of NIC papers. However, this percentage drops to 43% when a low-impact country leads.

Empirical Analysis by Output Publications

ANNUAL SCIENTIFIC PRODUCTION

Figure 1 presents the annual publication growth during the analysed period and indicates an increase in research activity from the late 1970s. This was the period when the debate on the advantages and disadvantages of exchange rate pegs leading to currency unions began, giving rise to the theoretical foundations of the optimum currency areas (OCA) theory. According to Crane (1970), the introduction of a new paradigm into literature initially lacks social organisation until it becomes widely adopted, knowledge on the topic progresses, new collaborators emerge, and eventually, anomalies arise. Our analysis provides evidence of this phenomenon, as we observed a marked increase in publications until the early 1990s when the European Economic and Monetary Union (EMU) gained momentum, leading up to its establishment in 1999. This trend was observed again in the late 2010s due to the sovereign debt crisis in the Eurozone. Some papers analysed the establishment process of the EMU, while others assessed the benefits and constraints of the currency union on individual member states. Additionally, a growing number of papers questioned the OCA theory's underpinnings and the EMU's efficiency, focusing on Greece's economic issues. This foreshadowed a period of several adjustments which lessened the severity of the crisis in 2018. This explains the decline in research output on this topic from 2018 onwards, as this is the period when the crisis stabilised.

TOP PRODUCTIVE COUNTRIES AND INSTITUTIONS

Figure 2 illustrates the geographical distribution of countries that have contributed to the research on OCA. The majority of scholarly output is concentrated in North America and Europe, whereas Africa has the

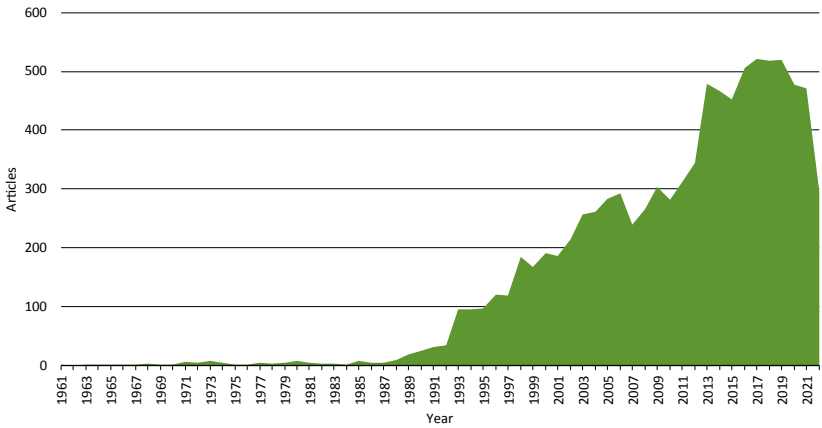

FIGURE 1 Annual Scientific Publication (created with Biblioshiny, based on WOS and Scopus Dataset)

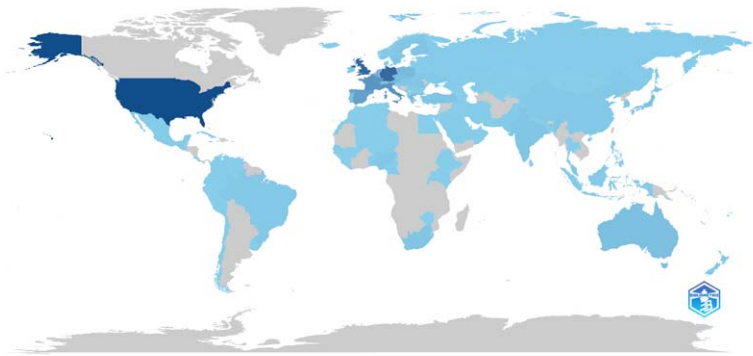

FIGURE 2 ountry-Specific Production (created with Biblioshiny, based on WOS and Scopus Dataset)

lowest number of scholarly contributions.

Figure 3 provides a summary of the top 14 countries with the highest number of research papers. As observed, European and North American countries dominate the top spots. However, the ratio of single-country publications to multi-country publications indicates that cross-country collaborative efforts among researchers are infrequent.

Additionally, table 2 presents the research output of the top 15 institutions. Notably, American (University of California, Harvard University, Indiana University) and British (University of Cambridge, University of London, University of Oxford) institutions occupy top positions in the list, including prestigious institutions such as the University

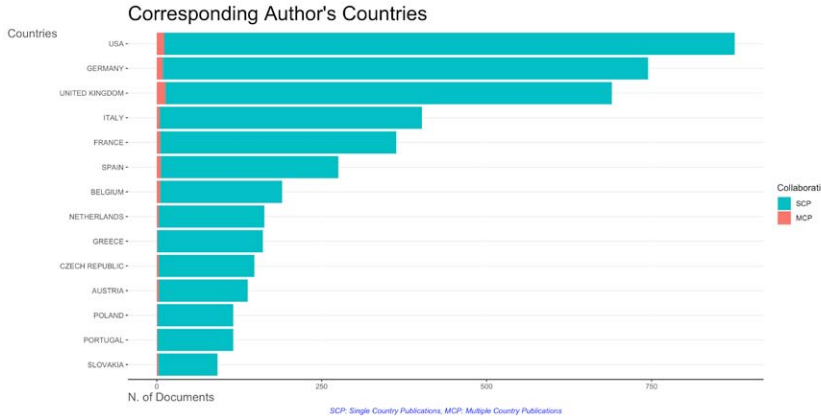

FIGURE 3 Top 14 Productive Countries (created with Biblioshiny, based on WOS and Scopus Dataset)

of Oxford, Harvard University, and the University of Cambridge, which are ranked in the top 3 institutions according to the Times Higher Education rankings (https://www.timeshighereducation.com/world-university-rankings/2023/world-ranking#!/page/0/length/100/sort_by/rank/sort_order/asc/cols/stats). Overall, these findings indicate that advanced economies and institutions are the primary contributors to research on OCA, highlighting the substantial production gap between industrialised and developing nations.

TABLE 2 Most Relevant Affiliations

Affiliations	Country	No. of Articles
University of California	USA	104
European University Institute	Italy	63
Research Institute	USA	59
University of Cambridge	UK	58
Harvard University	USA	53
University of London	UK	48
University of Amsterdam	Netherlands	47
Indiana University	USA	46
Tilburg University	Netherlands	42
Athens University of Economics and Business	Greece	41
University of Oxford	UK	40
University of Bonn	Germany	39
University of Duisburg-Essen	Germany	39

NOTE Author's own compilation from biblioshiny analysis

TOP PRODUCTIVE AUTHORS

In table 3, we present a summary of the most prolific authors who have researched OCA and monetary integration. Our analysis reveals that the majority of authors on the list are European males affiliated with either European or North American institutions. Notably, Amy Verdun is the sole female representative on the list.

Figure 4 depicts the productivity of the top authors over time, indicating a minimal number of publications before 1990. The blue dots

TABLE 3 Top Productive Authors (created with Biblioshiny, based on WOS and Scopus Dataset)

Author/ Nationality	Institution	Ethnicity and gender	No. of documents
Paul De Grauwe/ Belgian	London School of Economics (UK)	WM	44
Ansgar Belke †/ German	University of Duisburg-Essen (Germany)	WM	40
Barry Eichengreen/ American	University of California (US)	WM	40
Daniel Gros/ German	University of Chicago (US)	WM	31
Amy Verdun/ Dutch	University of Victoria (Canada)	WF	30
Luis Gil-Alana/ Spanish	University of Navarra (Spain)	WM	28
Bas van Aarle/ Dutch	University of Leuven (Belgium)	WM	26
Guglielmo Caporale/ Italian	Brunel University (UK)	WM	24
Andrew Hallett †/ British	George Mason University (US)	WM	23
Carsten Hefeker/ German	University of Siegen (Germany)	WM	23
Paul Masson/ Canadian	University of Toronto (Canada)	WM	22
Simon Sosvilla-Rivero/ Spanish	Complutense University of Madrid (Spain)	WM	22
Jürgen von Hagen/ German	University of Bonn (Germany)	WM	22
Philip Arestis/ Cypriot	University of Cambridge (UK)	WM	21
Tamim Bayoumi/ American	Peterson Institute for International Economics (US)	WM	21

NOTE Author's own compilation. '†' indicates that the author is deceased. WM – White Male, WF – White Female.

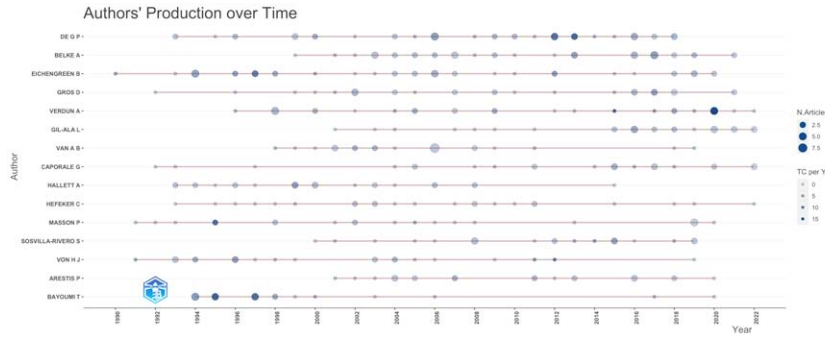

FIGURE 4 Authors' Production over Time (created with Biblioshiny, based on WOS and Scopus Dataset)

represent the number of documents published by these authors. The bigger the circle, the more articles published by the author in that year; the darker the intensity of the dot, the more citations an author has received in that respective year. Robert Mundell's 1961 single publication is the most cited, with an average citation of 181.42 for 1961, Amy Verdun is second with an average of 15.2 citations for 2020 and 11.9 for 2015, Paul De Grauwe has 11.5 citations for 2013 and 10.5 for 2012, and David Howarth has 10.5 citations for 2013 and 10.2 for 2020. Overall, we observe an improvement in research productivity among the top authors over time. A further exploration into authors' publications in relation to citation is provided in table 3. Nevertheless, our findings also highlight a severe underrepresentation of female authors, researchers of different ethnicities, and those affiliated with non-European institutions. These disparities suggest that there is still much work to be done to promote diversity and inclusivity in academic research.

TOP PRODUCTIVE JOURNALS

Figure 5 illustrates the top productive journals that have published research outputs on OCA and monetary unions. Notably, only two of the top 15 publishing outlets for research on the subject, namely the *Journal of International Economics* and the *European Economic Review*, are listed among the top 100 ranked economic journals listed under IDEAS/RePEC aggregated rankings of economic-related journals (https://ideas.repec.org/top/top.journals.all.html), as well as in the extended rankings of economic journals, presented in Mixon and Upadhyaya (2022). This indicates that the majority of the top journals that publish research on OCA and monetary unions are not among the most widely recognised economic journals.

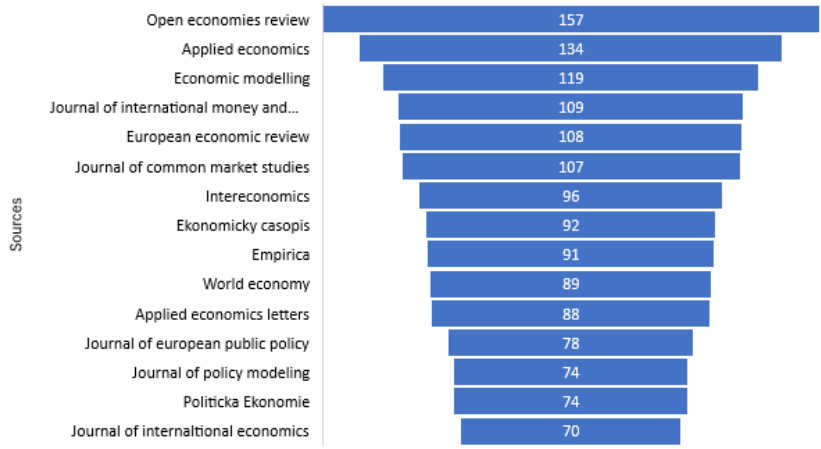

FIGURE 5 Most Productive Sources (created with Biblioshiny, based on WOS and Scopus Dataset)

However, it is interesting to note that most of these journals, such as the *Journal of International Economics*, *Journal of Policy Modeling*, *Journal of European Public Policy*, *World Economy*, *European Economic Review*, *Journal of International Money and Finance*, *Economic Modelling* and *Applied Economics* are listed as A-ranked according to the Australian Business Dean Council (ABDC) ranking list of journals (https://abdc.edu.au/abdc-journal-quality-list/). In contrast, only a few journals on this list are either C-ranked journals, such as *Intereconomics* and *Empirica* or do not feature on the ABDC ranking list, such as the *Journal of International Economics* and *Ekonomicky časopis*.

Therefore, this suggests that while the top journals publishing research on OCA and monetary unions may not be among the most prestigious economic journals, they are highly regarded within their own field, as demonstrated by their A-ranked status according to the ABDC ranking list of journals.

TOP CITED ARTICLES

Citations are a widely accepted measure of academic achievement, defined as '*…discrete units of publication acknowledgement…*' (Cranford 2020). In this regard, citations imply a greater influence of research compared to the number of outputs produced.

Table 4 identifies the top 15 publications with the highest number of citations on the topic. Interestingly, only three of the most productive

TABLE 4 Top cited articles

Author(s)	Year	Article name	*Journal name*	No. of citations
Robert Mundell	1961	A theory of Optimum Currency Areas	*The American Economic Review*	11,002
Ronald McKinnon	1963	Optimum currency areas	*The American Economic Review*	5,266
Jeffrey Frankel and Andrew Rose	1998	The endogeneity of the optimum currency criteria	*The Economic Journal*	4,942
Andrew Rose, Ben Lockwood and Danny Quah	2000	One money, one market: The effect of common currencies on trade	*Economic Policy*	3,686
Tamim Bayoumi and Barry Eichengreen	1992	Shocking aspects of the European Monetary Unification	*NBER Working Paper Series*	2,152
Jeffrey Frankel and Andrew Rose	2002	An estimate of the effect of common currencies on trade and income	*The Quarterly Journal of Economics*	1,873
Francesco Giavazzi and Marco Pagano	1988	The advantage of tying one's hands: EMS discipline and central bank credibility	*European Economic Review*	1,311
Jeffrey Frankeland Katharine Rockett	1988	International macroeconomic policy coordination when policymakers do not agree on the true model	*The American Economic Review*	1,290
Maurice Obstfeld and Alan Taylor	2002	Globalization and capital markets	*NBER Working Paper Series*	915
Alberto Alesina and Robert Barro	2002	Currency Unions	*The Quarterly Journal of Economics*	914
George Tavlas	1993	The 'New' Theory of Optimum Currency Areas	*The World Economy*	882
Barry Eichengreen	1991	Is Europe an optimum currency area?	*NBER Working Paper Series*	881
Tamim Bayoumi and Barry Eichengreen	1997	Even closer to heaven? An optimum-currency-area index for European countries	*European Economic Review*	866
Andrew Rose and Charles Engel	2002	Currency Unions and international integration	*Journal of Money, Credit and Banking*	757
Francesco Paolo Mongelli	2002	"New views" on the optimum currency area theory: What is EMU telling us?	*ECB Working Paper Series*	667
Yoshihide Ishiyama	1975	The theory of optimum currency areas: A survey	*IMF Staff Papers*	661
Paul Krugman	2012	Revenge of the Optimum Currency Area	*NBER Macroeconomics Annual 2012*	434

NOTE Author's own compilation

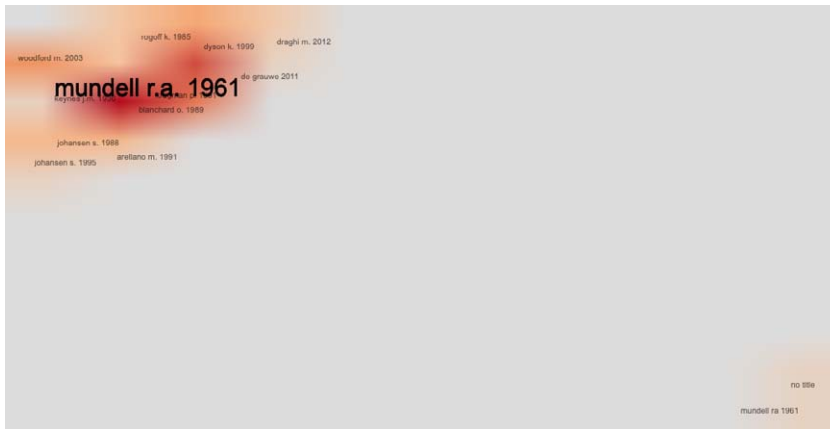

FIGURE 6 Co-Citation Network (created with Biblioshiny, based on WOS and Scopus Dataset)

authors listed in table 2 (Paul De Grauwe, Barry Eichengreen, and Ansgar Belke) have contributed to the most influential articles listed in table 3. This implies that an author's influence is not necessarily related to the number of articles they publish, and the two are often mutually exclusive. However, the demographic makeup of the top influential authors is similar to that of the most productive authors, with a majority being White males from European and North American institutions, resulting in an underrepresentation of women and non-White researchers from other regions. Figure 6 presents the co-citation network, and the intensity of the density shows the strength of the citation of the specific author.

It is worth noting that the top cited articles have been published in high-impact outlets such as *The Quarterly Journal of Economics*, *The American Economic Review*, and NBER *Working Paper Series*, which are ranked among the top 5 economic journals and working papers (Mixon and Upadhyaya 2022). Furthermore, most of these studies offer new 'perspectives' or 'theories' on the debate about OCA theory, supported by empirical evidence. However, these influential papers primarily focus on currency unions in relation to the Euro area, with little attention given to other monetary unions around the world.

KEYWORD ANALYSIS

Selecting appropriate keywords is crucial for researchers to gain readership and citations for their published works, as it enhances the visibility of their research (Nagpal and Petersen 2021). Figure 7a depicts the top 30

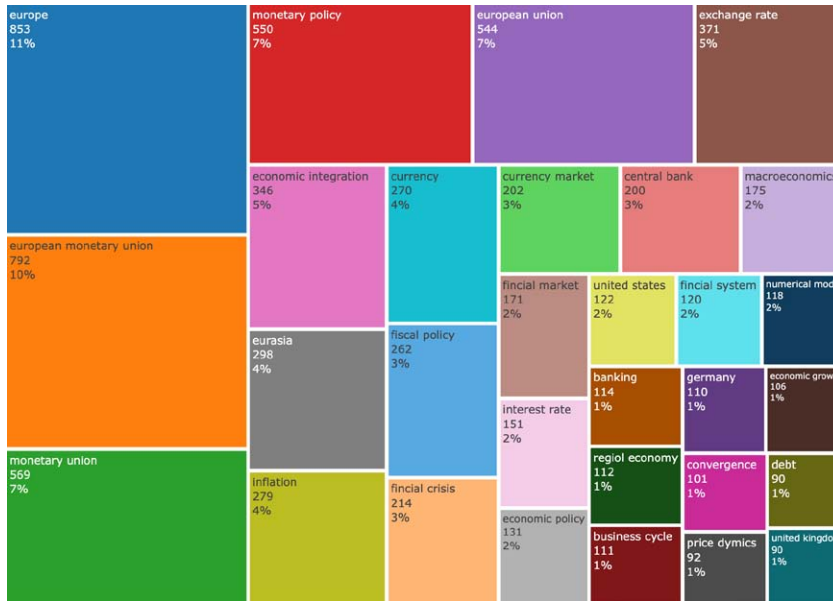

FIGURE 7A Word TreeMap

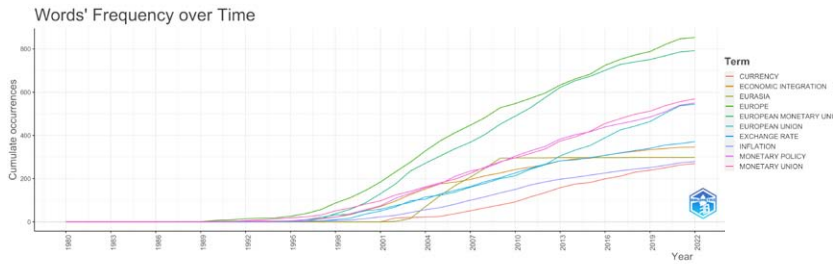

FIGURE 7B Word Frequency over Time (created with Biblioshiny, based on WOS and Scopus Dataset)

keywords used by authors. The size of each block represents the frequency of use of the respective keyword with European monetary union, Europe, monetary union, European union, monetary policy, and economic integration being the most frequently used keywords, as indicated by their larger size and percentages. Figure 7b shows the frequency of use of these words over time from 1980.

Figure 8 presents the three-field plot (i.e. Sankey plot) of the co-relationship between the top keywords, top productive authors and top cited literature. Note that within each of the three elements of the diagram (keywords, authors and cited references), each entity (node) is represent-

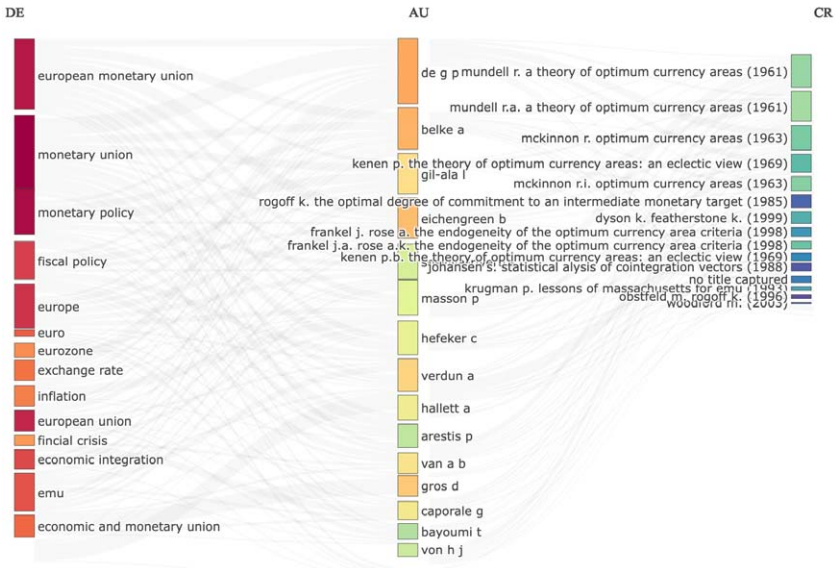

FIGURE 8 Author's Keywords (DE = keywords, AU = authors, CR = references; created with Biblioshiny, based on WOS and Scopus Dataset)

ed by a 'box' and the height of the box measures the strength of influence of the entity against other entities under the same element (i.e. longer (shorter) boxes indicate stronger (weaker) influence) whilst the colour of the boxes measures the influence of an entity against other entities found in different elements (i.e. darker (lighter) shades of colour indicate stronger (weaker) levels of influence). Under the 'keyword element', monetary union and EMU are the most popular keywords used by the most productive authors. Under the 'author' element, Paul De Grauwe, Luis Gil-Alana, Ansgar Belke and Barry Eichengreen are the most influential authors whose research has the strongest influence on the popularity of keywords used in the literature, whilst the pioneering papers by Mundell (1961), McKinnon (1963) and Kenen (1969) are the most influential citations used the most by researchers.

CONCEPTUAL STRUCTURE AND CLUSTERING

A clustering analysis performs a coupling network analysis. Mapping and clustering techniques have a similar objective, which is to provide insight into the structure of a network, and the two types of techniques are often used together in bibliometric and scientometric analyses (Waltman, van Eck, and Noyons 2010). In figure 9 (and figure 10, supplemen-

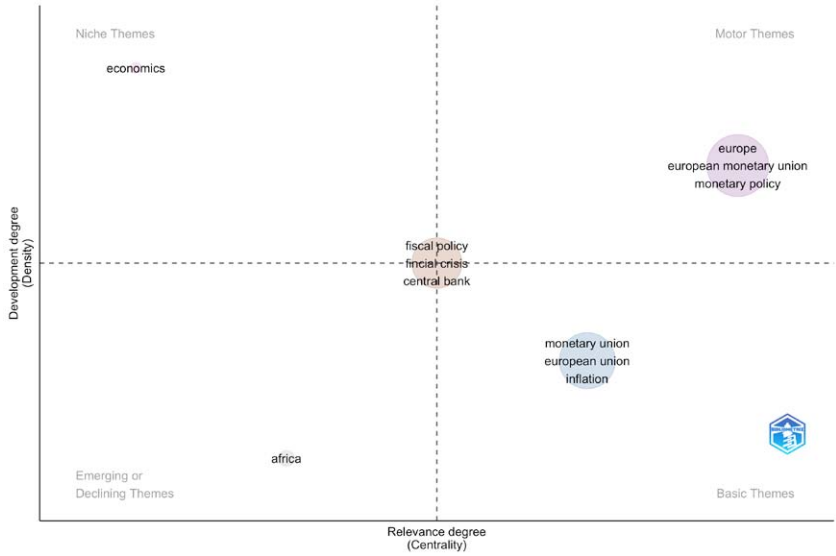

FIGURE 9 Thematic Map (created with Biblioshiny, based on WOS and Scopus Dataset)

tary), the upper left quadrant represents very specialised niche themes, the lower left quadrant represents emerging or declining themes, the upper right quadrant represents driving or motor themes, and the lower right quadrant represents basic themes, all represented according to their rank of centrality and density. Centrality measures the importance of the themes, and density measures the development of the themes. The size of the cluster is dependent on the number of times the theme has occurred. Notably, the themes Europe, European monetary union, and monetary policy appear in the motor themes quadrant, indicating that they are important pillars in the field of study. The themes monetary union, European Union, and inflation in the basic themes quadrant are weakly developed but frequently researched, niche themes are highly developed, and emerging or declining themes are marginal in the research field. These correlate with the keywords presented in figures 7a and 7b. The theme 'Africa' is emerging due to low productivity levels among African authors in this area, and yet have been receiving increasing attention in the research field.

In figure 11, the coupling map formed two clusters of documents with three labels per cluster identified by authors' keywords with the impact measure of global citation score and labelling by Keywords Plus. The

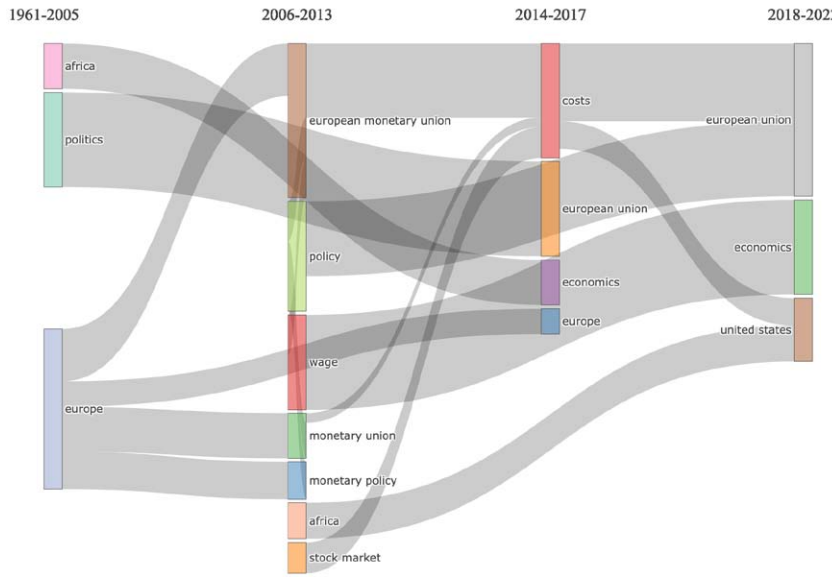

FIGURE 10 Thematic Evolution (created with Biblioshiny, based on WOS and Scopus Dataset)

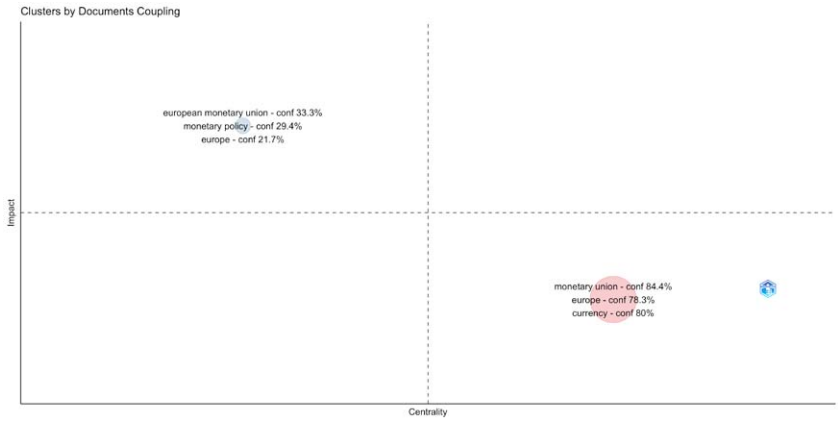

FIGURE 11 Clustering by Coupling (created with Biblioshiny, based on WOS and Scopus Dataset)

monetary union–currency–Europe cluster had the greatest impact and highest centrality. Figure 12 presents the keyword co-occurrence network. The density represents the strength of the co-occurrence of the core concepts, including Europe, European monetary union, and monetary union.

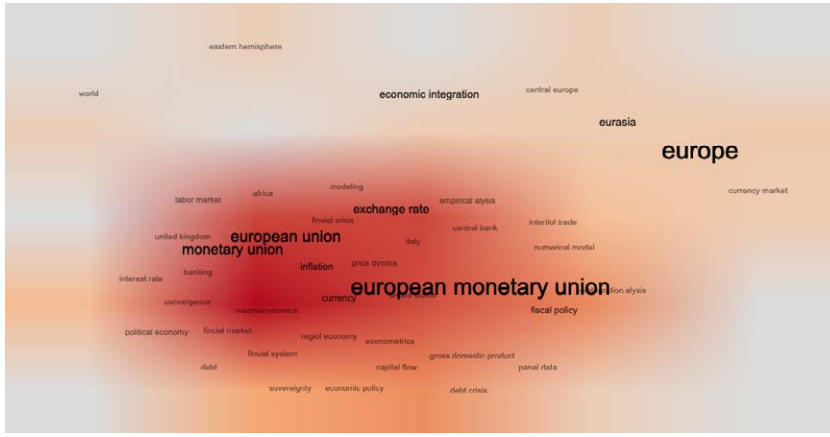

FIGURE 12 Co-Occurrence Network (created with Biblioshiny, based on WOS and Scopus Dataset)

COLLABORATION ANALYSIS

Figure 13 presents a network diagram showing the collaboration efforts among authors. The thickness of the links indicates the number of co-authored documents. The colours indicate different communities of authors. The figure shows the most productive and collaborative authors in the dataset and the patterns and characteristics of the co-authorship among them. Barry Eichengreen, Ansgar Belke, Bas van Aarle, Paul De Grauwe, Daniel Gros, Luis Gil-Alana, and Amy Verdun have the most collaborations. Figure 14 shows the geographical visualisation of the co-authorship of the documents by country. We observe that the USA and the UK lead with 11 collaborative partnerships, followed by the USA and Germany with 7 collaborative partnerships, the UK and Italy, Germany and Belgium with 5 collaborations, the UK and Spain, and Macedonia and North Macedonia with 4 collaborations. Again, we note that most collaborations occur between industrialised economies with no recorded collaborations among African countries featuring in the top-ranking collaborations.

Conclusions and Agendas for Future Research

In this study, we present a bibliometric analysis of literature on Optimal Currency Areas (OCA) and monetary unions from 1960 to 2022, with the aim of identifying the patterns of publications over time, the most productive countries, institutions, and authors, and the most influential articles and keywords used by researchers. Our observations reveal that

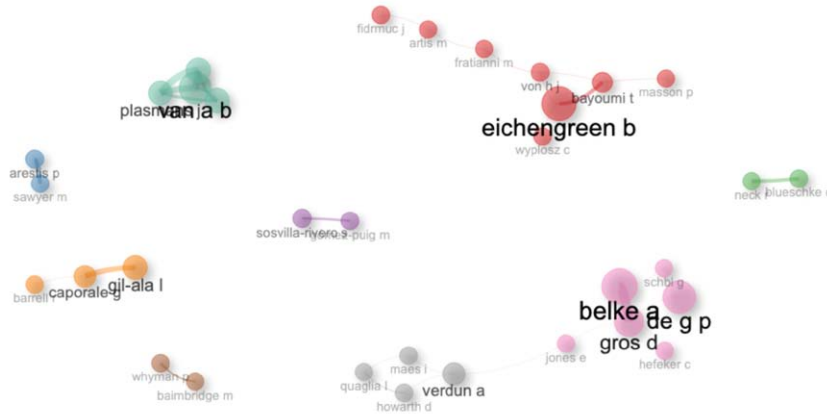

FIGURE 13 Collaboration Network (created with Biblioshiny, based on WOS and Scopus Dataset)

the literature on OCA has experienced steady growth over time, with authors becoming increasingly productive. However, we note that the most influential authors are those who contribute novel perspectives and theories to the OCA debate, supported by empirical evidence. Notably, authors who publish such contributions in high-impact journals such as *The Quarterly Journal of Economics* and *The American Economic Review* receive many citations despite their low productivity.

Moreover, our analysis indicates that most of the theoretical and empirical research on OCA has been concentrated among European and North American institutions/authors, with a focus on the Euro area mon-

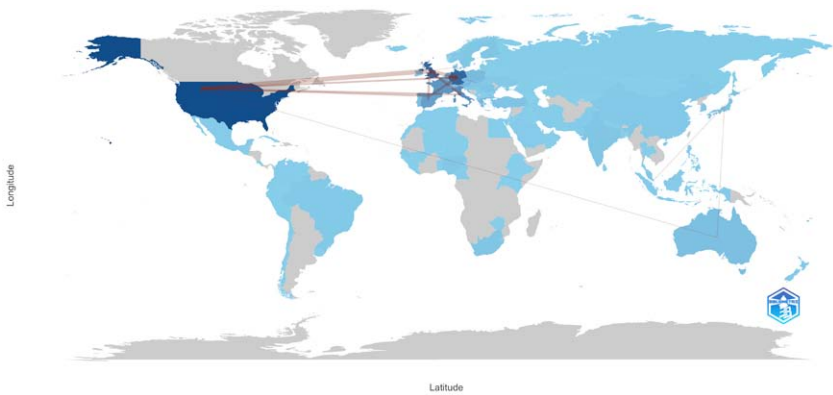

FIGURE 14 Country Collaboration Map (created with Biblioshiny, based on WOS and Scopus Dataset)

etary integration. Furthermore, we highlight an underrepresentation of non-European/American institutions/authors and female researchers in the published material.

Although this study provided several findings in terms of monetary unions, there are clear limitations that further studies can explore. While the bibliometric analysis points out which articles and authors are the most cited, it does not provide the reasons for which these articles or authors are considered as such or whether they are influential in the topic of currency unions and currency integration. Robert Mundell may be a highly cited author due to coining and popularising the concept of optimum currency areas, but his citation by other authors could be for various reasons such as reinforcing criteria for currency areas, discussing the flaws in his methodology, or simple acknowledgement as a contributor in the topic, all reasons that a bibliometric analysis does not delve into. Furthermore, there is a clear gap in research on African monetary unions and African scholar representation in this area. The highlighted lack of collaboration with African scholars on research in this area could result in policy flaws due to the reliance on international research that does not consider Africa-specific challenges when exploring monetary policies in Africa.

In light of these observations, we propose several agendas for future research. Firstly, we emphasise the need for more impactful and inclusive research on currency unions outside the Euro area, with a focus on publishing high-quality work in top-ranked journals. We also suggest that research conducted on currency areas should incorporate novel theoretical perspectives that challenge conventional thinking. For instance, several new debates arose concerning the optimality of monetary unions during the Euro debt crisis of 2010 and similarly, the more recent COVID-19 crisis as well as the introduction of digital currencies by Central Banks may present an opportunity to re-valuate the OCA theory. Finally, we recommend that future research should prioritise collaborations between Western and non-Western institutions to ensure greater inclusion of non-White and female researchers in the publication of articles.

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Supply Chain Management Skills in Business and Humanitarian Contexts

Robert Davtyan
Hanken School of Economics, Finland
robert.davtyan@hanken.fi

Wojciech D. Piotrowicz
Hanken School of Economics, Finland
wojciech.piotrowicz@hanken.fi

Gyöngyi Kovács
Hanken School of Economics, Finland
gyongyi.kovacs@hanken.fi

This study explores the differential skill requirements within supply chain management (SCM) across commercial and humanitarian contexts and career levels. Analysing 116 responses regarding context and 96 concerning career levels, the research confirms the applicability of the T-shaped model, highlighting the distinct skills critical for each sector. Significant discrepancies were found: humanitarian SCM prioritizes functional logistics, while business SCM places a larger emphasis on information technology, customs, transportation, and port/airport management. These findings suggest a dynamic skillset evolution, where functional skills, essential at entry-level positions, give way to general management capabilities as one progresses. This shift is more pronounced by experience rather than job title in the humanitarian sector. The implications for educational institutions and SCM practice are profound, necessitating curriculum updates to meet changing industry demands and support logistics practitioners transitioning between sectors.

Keywords: skills, competencies, supply chain management, humanitarian logistics, survey
JEL Classification: J16, J24, M10

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Introduction

Several reasons stand out why it is important to understand the skill requirements firstly in supply chain management in general, and then specifically in the business and humanitarian contexts. There is a talent

gap in supply chain management (SCM), with the astonishing ratio of six jobs being available for every applicant (Zinn, Goldsby, and Cooper 2018). The logistics skill shortage has been cited as the number one megatrend likely to drive the future of logistics (Arvis et al. 2018). At the same time, it has been shown that the level of logistics and SCM skills of employees contribute positively to firm performance (Kovács and Tatham 2009a; Muogboh 2010). Thus, it is not a trivial matter for any organization in either the commercial or humanitarian sector that they find the right people for supply chain positions.

Talent gaps can occur because of a negative image of a discipline – e.g. SCM jobs being portrayed as dark, dangerous, and male-dominated (Zinn, Goldsby, and Cooper 2018), due to a difference in expected vs offered remuneration, as well as to an education gap. The latter is a question of a large enough population being trained and educated for the skills that are required by industry. This is not only a matter of enough SCM programmes being offered at universities, but also whether those programmes meet the actual skills requirements of industry, not to mention future needs, which is not always the case (Mangan, Gregory, and Lalwani 2010). For example, while current supply management programmes are still largely focused on function-oriented competences, companies continue to lack professionals in sustainable supply management (Schulze, Bals, and Johnsen 2019). As indicated by Fawcett and Rutner (2014), a prevailing obstacle to overcome the talent gap in SCM education is to develop programmes that could assist professionals to get both basic functional logistics skills and soft skills at the same time.

Skills requirements are not static. They can change in times of economic turbulence during which companies need to re-orientate themselves from current operations to seize new opportunities (Tatham et al. 2017), and in times of technological change, i.e. when companies have been seizing such new opportunities. There are many trends in SCM that would indicate such changes, from the impact of 3D printing on production and distribution, to the digitalization, robotization and automation of supply chains, and the possibilities in understanding markets and demand better when applying big data analysis, to name but a few. The new trends will generate needs for different supply chain skills, including those not yet in existence.

Skills requirements are not universal, either. Logistics and supply chain management job advertisements vary across contexts (Kovács, Tatham, and Larson 2012) and surveys have indicated differences between busi-

ness, humanitarian, and military logistics skills (Kovács and Tatham 2009b, 2010). Finally, they vary across the career stages of supply chain managers (Mangan and Christopher 2005). The aim of this research is, therefore, to analyse contextual differences in logistics and supply chain management skills requirements. The study itself has been carried out as a survey of alumni (practitioners) and students from both business and humanitarian logistics and SCM programmes.

The research focuses on the following research questions:

RQ1 *How does the importance of specific SCM skills vary between business and humanitarian contexts?*

RQ2 *Which SCM skills are required from supply chain managers at different career levels?*

Subsequently, the study aims at making several contributions. By addressing the importance of individual skills and comparing their needs in business and humanitarian contexts, the study contributes to educational institutions being able to better gauge their offerings to different groups. At the same time, assessing the importance of specific skill sets throughout the career progression of supply chain managers contributes to a better understanding of the changes in skills needs over time, and across different management positions.

The paper is also structured in accordance with these points. It unfolds with a literature review on SCM skills, dissecting the intricate relationship between SCM proficiency and firm performance. This segment delves into the essential resource configurations for competitive advantage, the pivotal relational dynamics for firm endurance, and stakeholder expectations, setting the academic foundation for the study.

Following this foundation, the Research Design section explicates the methodological framework, detailing the meticulous process of garnering and analysing a broad spectrum of responses from individuals at divergent career junctures within both commercial and humanitarian sectors. It illuminates the statistical techniques utilized to decipher the data, ensuring empirical rigour.

Next, the Analysis and Results section is a deep dive into the empirical findings from the collected data. It examines the practicality of the T-shaped model within SCM and delineates the critical skills that are essential at different career thresholds, emphasizing the unique demands of each sector. Progressing further, the paper elaborates on Contextu-

al Differences in SCM Skills, accentuating the statistical revelations that highlight stark contrasts in skill emphasis between business and humanitarian contexts, thus painting a detailed picture of sector-specific skill exigencies. The narrative then advances to Career Progression and SCM Skills, concentrating on the metamorphosis of SCM skill sets as professionals ascend the career ladder. This part scrutinizes the transition from functional expertise to broader managerial skills, reflecting on how these competencies evolve and become more nuanced over time.

A deliberative discussion ensues, interpreting the broader implications of the findings for SCM practice and pedagogy. This part advocates for educational institutions to dynamically tailor their offerings to the ever-evolving landscape of SCM skills needs. The paper culminates with the conclusion, synthesizing the insights gleaned from the study. It reaffirms the imperative for synchronizing SCM skills with the fluctuating demands of the respective sectors and propels a dialogue on future research trajectories within this field.

SCM SKILLS

Much of SCM research focuses on the holy grail of any discipline: how it adds value to the firm and its stakeholders. Whether looking through the different resource configurations needed for competitive advantage, the relational links and their dynamics for the survival of the firm, or the mere expectations of stakeholders, for the most part, this is a question of establishing the link between SCM and firm performance.

Investigating SCM skills does not come first to mind when it comes to firm performance. Yet skills are unique in that they are non-eroding resources; in fact, quite the opposite, they tend to accumulate, and grow over time (Molloy et al. 2011). At the same time, they fulfil the other requirements of a VRIN resource – they are Valuable, Rare, Inimitable, and Non-substitutable – as well as heterogeneous (Ramsay 2001). Importantly, the individuals possessing certain skills are also the catalysts for developing new capabilities in the firm (Azadegan et al. 2008). From a theoretical perspective, therefore, skills models have been discussed either through the lens of the Resource-Based View (RBV) (Wong and Karia 2010; Kovács, Tatham, and Larson 2012), or, if embracing the role of catalysts and looking at the link between skills and the dynamic environment a firm operates in, through the dynamic capabilities model (Tatham et al. 2017).

Combining (a) the current talent gap in SCM (Arvis et al. 2018; Sinha, Millhiser, and He 2016; Zinn, Goldsby, and Cooper 2018), and (b) the link that has been established not just between skills and firm performance, but between SCM skills and firm performance (Kovács and Tatham 2009a; Muogboh 2010), the question really becomes one of how to ensure the person one hires has the right SCM skills for the specific job – and related to this, which skills should be emphasized in SCM education for the particular SC context. After all, a lack of job market relevance, and a lack of practical and professional skills development are two out of the three main criticisms made towards SCM education (van Hoek 2001; Lutz and Birou 2013).

The issue is not only about current, but also future needs. Different methods in SCM education with respect to emerging topics have also been emphasized in academic literature. Field trips, while being a generally effective teaching method, appear to be specifically fruitful in sustainable transportation education by impacting behavioural intentions (Putz, Treiblmaier, and Pfoser 2018). At the same time, in-class teaching methods are also highlighted, with a focus on ICT. Use of commercial software is extremely helpful in building fundamental SCM knowledge and presenting real challenges of SCM work tasks (Sweeney, Campbell, and Mundy 2010), especially evident when the pandemic hit, as online education frequently became standard. Applying global virtual teams in higher SCM education allows students to obtain experience in conducting work projects internationally via ICT and to become better prepared for the globalized reality of working life by being exposed to high levels of diversity (Trautrims, Defee, and Farris 2016).

Yet what are the "right" SCM skills? Numerous skills and skill sets have been emphasized in SCM, with lists covering both the breadth of general management skills as well as the depth and detail of logistics and SCM. However, there is agreement that logistics professionals need the whole set of the Business-Logistics-Management skills (BLM) (Thai 2012). There is also an entire stream of literature on the intricacies of the 'T-shaped model' (Leonard-Barton 1995) as applied and further developed1 in the SCM context, from Mangan and Christopher (2005) to Heaslip et al. (2019), though exactly which skills are included in which group of skills varies between studies (Lutz and Birou 2013). However, studies on SCM education have embraced and widely applied the T-shaped model (i.e. Naim et al. 2000; Mangan, Lalwani, and Gardner 2001; Allen et al. 2013; Wu et al. 2013; Tatham et al. 2017).

One size does not fit all, however. Different roles in the supply chain, such as whether a company is a manufacturer, wholesaler or retailer, or logistics service provider, may lead to a different emphasis among SCM skills (Wong and Karia 2010; Lorentz et al. 2013). Similarly, different industry sectors such as health care emphasize different SCM skills (Lee, Rammohan, and Sept 2013; Adekola and Adelanwa 2014). Equally, applying SCM skills in different countries or regions may lead to different emphases (Naim et al. 2000; Mangan, Lalwani, and Gardner 2001; Muogboh 2010; Luke and Heyns 2012; Rahman and Yang 2012; Wu et al. 2013; Tatham et al. 2017). Additionally, different contexts, such as the business or the humanitarian, lead to different SCM skills being emphasized for each (see, for example, Kovács and Tatham 2010; Heaslip et al. 2019). Thus, the question arises which SCM skills are the most relevant for each context.

SCM Skills in business and Humanitarian Contexts

Different supply chain settings require different skills. Skills requirements vary geographically, mostly due to different needs between developed and emerging markets (Piotrowicz and Cuthbertson 2015). At the same time, there are differences between skills required for stable environments and skills during turbulent times (Tatham et al. 2017). Many of the emerging areas represent challenges that could, however, be common for different contexts. For example, some of the main challenges to cold supply chain implementation are similar in developing and developed countries and include lack of relevant expertise, inappropriate information systems and scarce operational level training (Gligor, Tan, and Nguyen 2018). Even more to the extreme would be humanitarian supply chains that need to respond to natural disasters and complex emergencies, though even there, there are differences in SCM skill requirements for steadier programmes vs sudden-onset disasters (Kovács, Tatham, and Larson 2012).

A growing stream of literature has focused on SCM skills in the humanitarian context. The context indeed exhibits specific features, from a not-for-profit aim to the urgency of disaster relief operations, struggles with the impact of disasters on transport infrastructure, and restricted access in conflict zones, to name but a few. Yet is it different in terms of the skills required for the job? Recent research indicates that contextually, academic education still focuses on business logistics and commercial supply management, thus neglecting skills for graduates aiming to enter

the humanitarian field (Khan et al. 2020). Kovács and Tatham (2010) singled out the humanitarian cohort from their survey on the T-shaped model and found few significant differences between business and humanitarian contexts. Negotiation skills were more highly emphasized by humanitarians, but none of the other expected differences in other skills, such as marketing, customs clearance, transportation, or even stress management, turned out to be significant. When they then looked at job advertisements, however, there was a reduced overall emphasis on general management skills, as well as on marketing and customer relationship management (Kovács, Tatham, and Larson 2012). In addition, there were differences in SCM skills requirements across levels of emergencies, as well as depending on the size and urgency of a humanitarian programme (Kovács, Tatham, and Larson 2012; Allen et al. 2013). At the same time, Kovács, Tatham, and Larson (2012) discovered hierarchies of skills in their model and found that lower-level skills in the hierarchies (such as fleet management, which is otherwise seen as part of the higher-level skill of transportation) were highly emphasized in humanitarian logistics. In conclusion, this research posits that:

> H1 *The prioritization and emphasis of SCM skills are distinct between business and humanitarian contexts, reflecting the varied strategic and operational demands of each sector.*

In particular, context-specificities are expected as follows:

- A larger emphasis on the groups of general management skills in the business context, vs
- A larger emphasis on the groups of (a) functional skills, as well as (b) problem-solving skills in the humanitarian context;
- A larger emphasis on skills related to (a) marketing, (b) customer relationship management, but also (c) reverse logistics in the business context, vs
- A larger emphasis on negotiation skills in the humanitarian context.

SCM Skills in Career Progression

A closer look at skills hierarchies has also led to their mapping in terms of competence levels across different career stages (Heaslip et al. 2019), along with career progression. This is an important aspect of the professionalization of logistics and SCM overall. Career progression alongside specific elements such as career needs, values and satisfaction become

an important topic academically and practically, with many large companies focusing on nurturing SCM career paths (Goffnett et al. 2012). In the humanitarian space, many different endeavours exist in supporting such a professionalization of the 'humanitarian logistician': new training programmes are constantly being developed and provided not just within but also across humanitarian organizations; certification programmes have been established for humanitarian logistics and humanitarian SCM, as well as medical humanitarian logistics; and numerous courses as well as entire education programmes have been established at institutions around the world. The Humanitarian Logistics Association (HLA) has been an important driving force in such professionalization endeavours, working closely with researchers on their surveys of skills requirements (Allen et al. 2013) or in the effort to map these in such a way as to support the career stages of humanitarian logisticians (Heaslip et al. 2019).

Notwithstanding recent mappings of SCM competence levels across career progressions, at least in the humanitarian context, not much attention has been paid to a segregation of skills data over career progression (Heaslip et al. 2019). At the same time, McKinnon et al. (2017) indicate that not only is there a general and growing shortage of logistics skills but there is a shortage of skilled labour on the more junior level in developed countries, in contrast with a shortage of people being able to fill higher SCM positions in developing countries (Arvis et al. 2018).

As already posited in the business context, there is an expectation of the importance of functional skills diminishing vs general management skills increasing along the career progression in SCM (Mangan and Christopher 2005; Schulze, Bals, and Johnsen 2019). In other words, while functional SCM skills are important for (job) market entry, they are taken for granted at higher management positions that then emphasize other areas such as finance and accounting, human resource management, communication and problem-solving. In the humanitarian context, as Allen et al. (2013) discovered, it was not down to job titles but still to years of experience when this shift could be observed. In conclusion, this research posits that:

H2A *The importance of functional SCM skills decreases with career progression, while*

H2B *The importance of general management skills increases with career progression.*

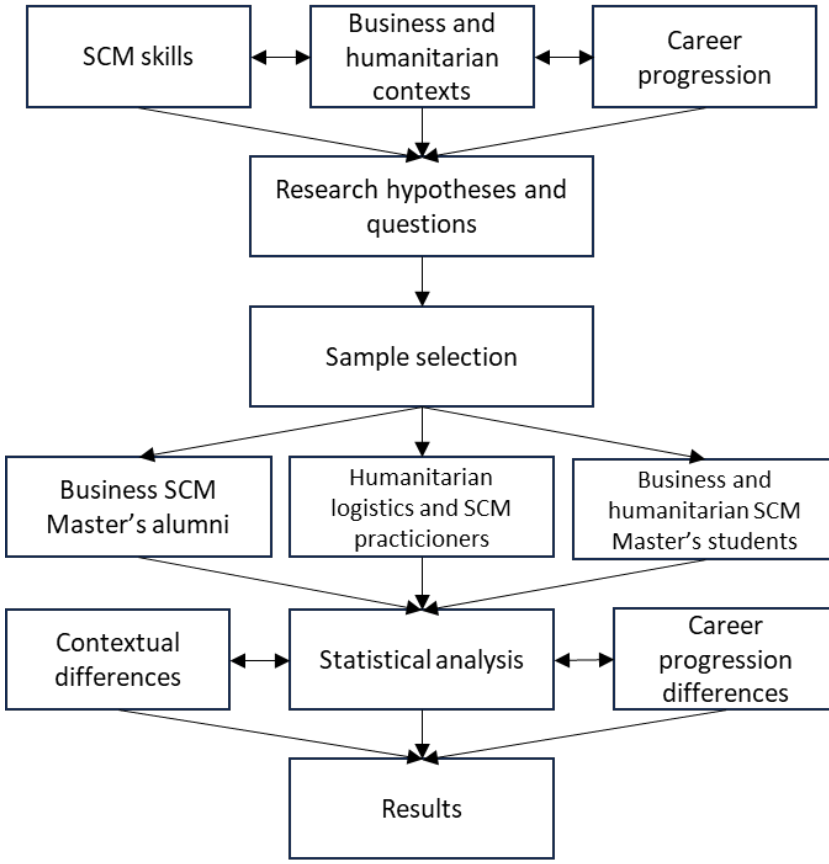

FIGURE 1 Conceptual framework of the research

Research Design

In developing the methodological framework for this study, particular emphasis was placed on the use of sophisticated statistical techniques, pivotal to extracting nuanced insights from the data. This choice was driven by the complex nature of supply chain management skill requirements, which necessitate a rigorous and multifaceted analytical approach to fully comprehend their dynamics across different sectors and career stages.

The statistical analysis, therefore, forms the cornerstone of our research, enabling us to distil a broad spectrum of responses into meaningful patterns and trends. The statistical analysis method is beneficial in minimizing risks such as bias and subjective interpretation (Yalcin et al. 2011) and has become a valuable method in education research (Hedges

and Rhoads 2010). By employing advanced statistical methods, we could accurately identify and compare the nuances in SCM skills prioritization between the commercial and humanitarian contexts. These methods included, but were not limited to, factor analysis, T-tests, and variance analysis, ensuring that our findings were not only comprehensive but also statistically robust. This analytical rigour was essential to validate the hypotheses of our study, providing a reliable foundation upon which further discussion and implications could be built.

The meticulous application of these statistical techniques was crucial in navigating the complex interplay of skills across different career levels and sectors. It allowed us to draw insightful conclusions that were both empirically sound and highly relevant to the field of SCM. This approach not only strengthens the validity of our findings but also enhances their applicability in both academic and practical realms, offering valuable insights for curriculum development and professional training in SCM. An overall summary of how this research is conducted can be seen in figure 1.

Any research to test hypotheses (H1, H2a and H2b) needs to include samples from both a business and humanitarian context, and respondents from various career levels. To collect data three mailing lists were used to comprise a relevant sample: the alumni mailing list of a business-oriented SCM master programme, the practitioner mailing list of a research centre in humanitarian logistics and SCM, and the current students of both a business, and a newer, humanitarian SCM master level academic course at a Nordic business school. Table 1 summarizes the resultant sample of the research, which was carried out between January-April 2018. The overall final response rate was 35.2%, comparable to mean survey response rates in SCM (Melnyk et al. 2012) and with response rates in each cohort well exceeding the levels Larson (2005) reported for logistics and SCM surveys.

Mailing lists do not reflect respondent demographics in the research, as some respondents on the alumni list also worked in the past in the humanitarian context, while some students were former, or current, practitioners from both business and humanitarian sectors. To address this, the survey included a question to self-report the relevant context of the respondent.

At the same time, career levels were assessed in terms of Flöthmann and Hoberg's (2017) management level categories of Analysts, Managers, and Executives, thereby aligning work experience and job titles. Table 2 shows the resultant respondent demographics as it was also relevant for group splits to test the hypotheses of this research.

TABLE 1 Resultant Sample

Mailing list	Initial sample	Bouncing	Resultant sample	Initial responses	Responses after reminder	Response rate of resultant sample
Students	148	91	57	30	39	68.4%
Humanitarian practitioners	165	56	109	17	22	20.1%
Alumni	178	6	172	43	58	33.7%
Total	491	153	338	90	119	35.2 %

TABLE 2 Respondent Demographics

Mailing list	Relevant context (n = 116)		Career level (n = 96)		
	Business	Humanitarian	Analysts	Managers	Executives
Students	25 (21.6%)	14 (12.1%)	17 (17.5%)	3 (3.1%)	0 (0%)
Humanitarian practitioners	5 (4.3%)	16 (13.8%)	6 (6.2%)	5 (5.2%)	9 (9.4%)
Alumni	52 (44.8%)	4 (3.4%)	34 (35.4%)	12 (12.5%)	11 (11.5%)
Total	82 (70.7%)	34 (29.3%)	57 (59.4%)	20 (20.8%)	20 (20.8%)

The table indicates total numbers per group, and the percentage of these after having removed missing responses. After removal there were 116 valid responses for relevant context, vs 96 for career levels. The fall-off is greater for career levels, but this is explained by 19 missing responses from the student mailing list, which is, after all, less surprising.

Respondents were asked to rate the skills in the T-shaped model as proposed by Mangan and Christopher (2005) and refined further by Tatham et al. (2017), on a 7-point Likert scale. While the model was later refined for specific contexts (Kovács, Tatham, and Larson 2012; Heaslip et al. 2019), this study used the same scales as Tatham et al. (2017) used for the business context, to ensure the comparability of findings. The same skill groupings and labels were used as well, with GMS for general management skills, PSS for problem-solving skills, IPS for interpersonal skills, and FLS for functional logistics skills.

T-tests on the T-shaped model between early and late responders were used to check for consistency and non-response bias. There were no significant differences for skill sets but there were some for specific skills: early responders valued the skills of supplier relationship management ($t = 2.245$), information gathering ($t = 2.037$), and listening ($t = 2.848$)

significantly higher than late responders in the sample (all with $p < 0.05$). While the results do not provide an answer to the reasons behind this, this does posit the question to what extent the timing of such a survey may influence results. In fact, Tatham et al.'s (2017) survey was timed during economic turbulence and evaluated SCM skills that are of importance for companies to survive, and thrive, in such times. In other words, timing does matter, and results would need to be assessed considering their context.

Analysis and Results

First, factor analysis was used to assess the skill groupings in the T-shaped model (table 3). The results showed a strong overlap with the model itself, especially when it comes to the assignment into four groups from the T-shaped model: functional skills vs interpersonal skills, general management skills and problem-solving skills. Results confirm the T-shaped model, which is also why there is no need to rename the factors.

There are, though, some notable exceptions to the skill sets in the T-shaped model vs factor loadings. For example, supplier relationship management, that the original model groups with general management skills, came up in the area of functional skills. This is less surprising considering that it concerns *supplier* relationships management; rather, this finding may lead to reconsidering what is a functional SCM skill vs a (different) general management one – which is probably why Heaslip et al. (2019) have grouped it under what they had relabelled the 'technical logistics domain'. On the other hand, the functional skill of 'forecasting' was grouped with one of the sub-factors of problem-solving that also included information sharing and information gathering.

There were several general management skills that were not significant overall, such as finance and accounting, information technology, change management, marketing, and customer relationship management. In contrast, stress management was the only skill missing from the group of interpersonal skills, and legal specifications from the group of functional skills. The question is, however, whether these skills should be eliminated from the list of variables from the T-shaped model. Indeed, 'marketing' and 'customer relationship management', as well as 'reverse logistics' had earlier been ranked so low for the humanitarian context (Kovács, Tatham, and Larson 2012) that subsequent research has changed the label of customer relationship management to 'beneficiary focus' and eliminated the others from the model (Heaslip et al. 2019).

TABLE 3 Factors in the T-shaped Model

Skill	Category	Mean score	Component total	% of variance
Warehousing	FLS	0.86	7.55	22.89
Transportation management	FLS	0.86		
Customs, import and export	FLS	0.83		
Port/airport management	FLS	0.81		
Logistics information systems	FLS	0.75		
Inventory management	FLS	0.74		
Purchasing / procurement	FLS	0.65		
Reverse logistics	FLS	0.63		
Supplier relationship management	GMS	0.54		
Oral communication	IPS	0.86	6.09	18.47
People management	IPS	0.74		
Negotiation	IPS	0.71		
Written communication	IPS	0.58		
Listening	IPS	0.57		
Leadership	IPS	0.53		
Meeting facilitation	IPS	0.49		
Project management	GMS	0.77	2.45	7.43
Risk management	GMS	0.70		
Strategic management	GMS	0.68		
Problem identification	PSS	0.91	2.12	6.43
Problem solving	PSS	0.87		
Problem analysis	PSS	0.87		
Information sharing	PSS	0.81	1.67	5.05
Information gathering	PSS	0.81		
Forecasting	FLS	0.64		

Interestingly, 'marketing' was also lowest ranked in the business context in another research (Tatham et al. 2017), but other than that, these results have not been replicated in that context. Therefore, factor analysis was run for business vs humanitarian context (see Appendix 1) and also for different levels in career progression (see Appendix 2). Results differ here across contexts and career levels, but more importantly, all the variables re-appear when doing such an analysis. In conclusion, as there seems to be such a group dependence of the factors, the findings do not suggest eliminating any of the variables from the T-shaped model. However, other tests are needed to better understand the differences across contexts and levels in one's career progression.

Contextual Differences

Next, further tests were conducted to establish which of the differences between the business vs humanitarian context are significant. Table 4 shows the results of the skills ratings for each context, as well as the results of the T-test. As for ratings, this study cannot confirm Kovács and Tatham's (2010) results of the humanitarian responses being more polarized; rather, they are generally higher. Interestingly, in neither context do functional logistics skills appear among the top ten ratings: for the business context, 'forecasting' as the first functional logistics skill appears as number fourteen, whereas for the humanitarian context, 'transportation management' gets the eleventh-highest rating.

Looking at skill sets, in fact both the business and the humanitarian context value problem-solving skills higher than other skill groups (6.08 business vs 6.17 humanitarian), also in both cases followed by interpersonal skills (5.63 and 5.78, respectively). Only then do differences arise, with general management skills rated higher for the business context (5.38 and 5.32, respectively) vs functional logistics ones rated higher in the humanitarian context (4.79 and 5.41, respectively). But apart from these descriptive statistics, the only difference in skill sets that is significant is for functional logistics skills, that the business context values less than the humanitarian one ($t = -2.064$, at $p < 0.05$). Therefore, only a larger emphasis on functional logistics skills in the humanitarian context can be confirmed.

Yet, on the individual skill level, very few differences turned out to be significant, with the following exceptions: the higher importance of 'information technology' in the business context, and the higher importance of 'customs, import and export', 'transportation management', and 'port/airport management' in the humanitarian context.

These results are not in line with prior literature that had informed H1. While back in 2010, Kovács and Tatham (2010) found more skills to be valued significantly differently than not between the business and humanitarian contexts, one of the few that was not significantly different was that of 'transportation'. On the other hand, 'port/airport management' was ranked second lowest in the business context in an Australian business sample (Tatham et al. 2017), although Australia as an island country might differ from other locations. In conclusion, however, there is some support for H1 overall, though with different than expected specifications. Results show that there are some significant differences be-

TABLE 4 Contextual Differences

	Context	N	Mean	SD	SEM	F	t
General management skills (GMS)							
Finance and accounting	Business	55	4.56	1.385	.187	.434	−1.335
	Humanitarian	19	5.05	1.353	.310		
Information technology	Business	56	5.79	1.202	.161	.162	2.309*
	Humanitarian	19	5.05	1.177	.270		
Change management	Business	55	5.93	.959	.129	17.462	1.792
	Humanitarian	15	5.07	1.792	.463		
Marketing	Business	54	4.15	1.510	.205	.020	.785
	Humanitarian	16	3.81	1.471	.368		
Project management	Business	57	5.79	1.423	.189	1.182	.111
	Humanitarian	20	5.75	1.164	.260		
Strategic management	Business	56	5.46	1.401	.187	.848	−1.235
	Humanitarian	20	5.90	1.210	.270		
Customer relationship management	Business	56	5.77	1.112	.149	3.887	1.130
	Humanitarian	18	5.39	1.577	.372		
Supplier relationship management	Business	56	5.36	1.623	.217	3.363	−1.653
	Humanitarian	20	6.00	1.026	.229		
Risk management	Business	55	5.60	1.382	.186	.042	−.851
	Humanitarian	20	5.90	1.252	.280		
Problem-solving skills (PSS)							
Problem identification	Business	56	6.20	1.135	.152	2.181	−.747
	Humanitarian	17	6.41	.618	.150		
Information gathering	Business	57	5.74	.992	.131	.859	−.144
	Humanitarian	18	5.78	1.215	.286		
Problem analysis	Business	56	6.16	1.218	.163	2.430	−.571
	Humanitarian	18	6.33	.686	.162		
Information sharing	Business	57	5.86	.953	.126	.081	−.540
	Humanitarian	20	6.00	1.124	.251		
Problem solving	Business	55	6.42	1.013	.137	.185	.384
	Humanitarian	16	6.31	.793	.198		
Interpersonal skills (IPS)							
Listening	Business	56	5.55	1.320	.176	2.200	−1.181
	Humanitarian	20	5.95	1.191	.266		
Oral communication	Business	57	6.21	.921	.122	2.243	−1.007
	Humanitarian	18	6.44	.616	.145		
Written communication	Business	57	5.84	1.279	.169	.159	−.302
	Humanitarian	18	5.94	1.162	.274		

Continued on the next page

TABLE 4 *Continued from the previous page*

	Context	N	Mean	SD	SEM	F	t
People management	Business	57	5.84	1.222	.162	.090	−.472
	Humanitarian	18	6.00	1.283	.302		
Meeting facilitation	Business	57	4.65	1.408	.186	.030	−.473
	Humanitarian	18	4.83	1.543	.364		
Negotiation	Business	56	5.95	1.135	.152	.948	.340
	Humanitarian	19	5.84	1.214	.279		
Stress management	Business	56	5.41	1.449	.194	.065	−.166
	Humanitarian	19	5.47	1.349	.309		
Leadership	Business	57	5.56	1.376	.182	.060	−.485
	Humanitarian	19	5.74	1.327	.304		
Functional logistics skills (FLS)							
Legal specifications	Business	55	4.47	1.476	.199	1.973	−1.374
	Humanitarian	19	5.00	1.333	.306		
Customs, import and export	Business	53	4.77	1.502	.206	.867	−2.194*
	Humanitarian	19	5.63	1.342	.308		
Transportation management	Business	56	4.84	1.827	.244	5.877	−3.006**
	Humanitarian	19	5.89	1.100	.252		
Inventory management	Business	54	4.89	1.798	.245	2.124	−1.183
	Humanitarian	19	5.42	1.305	.299		
Warehousing	Business	55	4.73	1.870	.252	2.079	−1.467
	Humanitarian	19	5.42	1.465	.336		
Purchasing / procurement	Business	55	5.13	1.678	.226	2.664	−.737
	Humanitarian	18	5.44	1.247	.294		
Forecasting	Business	57	5.72	1.278	.169	.137	.856
	Humanitarian	17	5.41	1.372	.333		
Reverse logistics	Business	54	4.30	1.574	.214	.048	−.605
	Humanitarian	18	4.56	1.580	.372		
Port/airport management	Business	53	3.51	1.957	.269	10.008	−5.296**
	Humanitarian	20	5.55	1.234	.276		
Logistics information systems	Business	55	5.49	1.585	.214	1.844	−.702
	Humanitarian	18	5.78	1.215	.286		

Notes **p < .01, *p < .05.

tween the skills emphasized for the business vs the humanitarian context of SCM. Specifically, there is:

- A larger emphasis on the skill set of functional logistics skills in the humanitarian context,

- A larger emphasis on the skill of 'information technology' in the business context, and
- A larger emphasis on the skills of 'customs, import and export', 'transportation management', and 'port/airport management' in the humanitarian context.

With the maturation of humanitarian logistics as a field, concurrent with the increasing professionalization of humanitarian logisticians, there is less of a need to emphasize the differences of the field overall, which may explain why the results of this study differ so much from surveys carried out a decade earlier. At the same time, however, differences that are still evident boil down to the specificities of the humanitarian context. For example, large scale disasters are characterized by the delivery of international aid, hence the emphasis on cross-border transportation where customs, import and export are frequently required, as well as port/airport management that deals with typical points of entry of such deliveries – air transport allows fastest delivery of goods in need at the early disaster response phase, especially when other (land) infrastructure is damaged, while ports (sea ports) are used for large shipments, such as food commodities. Also, while the digitalization of supply chains is an important topic overall, in this regard at least, the humanitarian context may still lag behind the business context, if the need is to deliver aid in areas without any functioning electricity, information and/or telecommunication infrastructure.

Differences in career progression

Differentiating the emphasis on skill sets between analysts, managers, and executives in supply chain management (as in Flöthmann and Hoberg 2017), this study could confirm the upwards trend in emphasis on general management skills and problem-solving skills as well as interpersonal skills throughout their career progression. The downward trend for any focus on functional logistics skills is less clear, however: it increases from analysts to managers, and decreases only on the executive level (table 5). As Mangan and Christopher (2005) stated, supply chain managers are indeed 'managers first and logisticians second', or, as Tatham et al. (2017) put it, functional SCM skills are required for the earlier, entry levels of the job.

Details for individual skills were tested in a one-way ANOVA test across management levels. Again, the importance of very few individual skills

TABLE 5 Skill sets in career progression

	GMS	PPS	IPS	FLS
Analysts	5.35	6.00	5.48	5.02
Managers	5.39	6.13	5.66	5.19
Executives	5.52	6.34	6.03	4.67

changes significantly over time (table 6). To better understand the actual progression, however, post hoc analyses (table 7) revealed that results are only significant for:

- An increase in the importance of 'information sharing' from analysts to executives,
- First a decrease in the importance of 'leadership' from analysts to managers, and then an increase when it comes to executives,
- A steady increase in the importance of 'listening' from analysts to managers to executives, and
- A steady decrease in the importance of 'logistics information systems' from analysts to managers to executives.

It is important to note that the variables 'leadership' and 'listening' did not meet the requirements of variances homogeneity tests. As the null hypothesis was rejected, Games-Howell post-hoc analysis was thus applied, which is recommended in the cases of differences among variances in the population (Field 2013).

In conclusion, H2a can only partially be confirmed. Even though there is a large drop in the emphasis on the functional logistics skill set among executives, this is not a steady downwards trend. On the other hand, the increase in other skill sets is steady, and not only general management skills, but also problem-solving and interpersonal skill sets are emphasized more strongly the more a person progresses in their supply chain career.

Conclusions

This research aimed to analyse the differences in logistics and supply chain management (SCM) skills requirements between business and humanitarian contexts and across various career levels of supply chain managers. The study's findings provide nuanced insights into these varying SCM skill requirements, which are essential for both educational institutions and practitioners in the field.

This investigation addressed two key research questions:

TABLE 6 Differences in skills in career progression

		N	Mean	SD	SE	95% Confidence Interval for Mean		F
						Lower Bound	Upper Bound	
General management skills								
Finance and accounting	Analyst	55	4.42	1.474	.199	4.02	4.82	2.334
	Manager	20	4.70	1.174	.263	4.15	5.25	
	Executive	19	5.21	1.316	.302	4.58	5.84	
	Total	94	4.64	1.405	.145	4.35	4.93	
Information technology	Analyst	55	5.49	1.318	.178	5.13	5.85	.308
	Manager	20	5.75	1.209	.270	5.18	6.32	
	Executive	19	5.58	1.170	.268	5.02	6.14	
	Total	94	5.56	1.258	.130	5.31	5.82	
Change management	Analyst	51	5.65	1.309	.183	5.28	6.02	1.482
	Manager	18	6.22	.732	.173	5.86	6.59	
	Executive	18	5.83	1.339	.316	5.17	6.50	
	Total	87	5.80	1.228	.132	5.54	6.07	
Marketing	Analyst	53	4.19	1.532	.210	3.77	4.61	2.908
	Manager	18	3.17	1.618	.381	2.36	3.97	
	Executive	18	4.00	1.572	.370	3.22	4.78	
	Total	89	3.94	1.591	.169	3.61	4.28	
Project management	Analyst	56	5.79	1.345	.180	5.43	6.15	.518
	Manager	20	6.00	1.170	.262	5.45	6.55	
	Executive	20	6.10	1.252	.280	5.51	6.69	
	Total	96	5.90	1.285	.131	5.64	6.16	
Strategic management	Analyst	56	5.57	1.248	.167	5.24	5.91	.401
	Manager	20	5.85	.933	.209	5.41	6.29	
	Executive	19	5.74	1.558	.357	4.99	6.49	
	Total	95	5.66	1.251	.128	5.41	5.92	
Customer relationship management	Analyst	56	5.84	1.233	.165	5.51	6.17	.757
	Manager	20	5.45	1.234	.276	4.87	6.03	
	Executive	18	5.67	1.237	.291	5.05	6.28	
	Total	94	5.72	1.230	.127	5.47	5.98	
Supplier relationship management	Analyst	56	5.48	1.427	.191	5.10	5.86	.211
	Manager	20	5.65	1.461	.327	4.97	6.33	
	Executive	20	5.70	1.525	.341	4.99	6.41	
	Total	96	5.56	1.442	.147	5.27	5.85	
Risk management	Analyst	55	5.69	1.345	.181	5.33	6.05	.187
	Manager	20	5.75	1.070	.239	5.25	6.25	
	Executive	19	5.89	1.150	.264	5.34	6.45	
	Total	94	5.74	1.244	.128	5.49	6.00	

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TABLE 6 *Continued from the previous page*

		N	Mean	SD	SE	95% Confidence Interval for Mean		F
						Lower Bound	Upper Bound	
Problem-solving skills								
Problem identification	Analyst	56	6.18	1.046	.140	5.90	6.46	.482
	Manager	20	6.40	.883	.197	5.99	6.81	
	Executive	17	6.35	.786	.191	5.95	6.76	
	Total	93	6.26	.966	.100	6.06	6.46	
Information gathering	Analyst	56	5.63	1.137	.152	5.32	5.93	2.141
	Manager	19	5.79	.855	.196	5.38	6.20	
	Executive	19	6.21	1.032	.237	5.71	6.71	
	Total	94	5.78	1.079	.111	5.56	6.00	
Problem analysis	Analyst	56	6.13	1.145	.153	5.82	6.43	.073
	Manager	20	6.20	1.105	.247	5.68	6.72	
	Executive	18	6.22	.808	.191	5.82	6.62	
	Total	94	6.16	1.071	.110	5.94	6.38	
Information sharing	Analyst	56	5.73	1.070	.143	5.45	6.02	4.390*
	Manager	20	5.75	1.118	.250	5.23	6.27	
	Executive	20	6.50	.761	.170	6.14	6.86	
	Total	96	5.90	1.061	.108	5.68	6.11	
Problem solving	Analyst	54	6.35	.955	.130	6.09	6.61	.271
	Manager	19	6.53	.772	.177	6.15	6.90	
	Executive	17	6.41	.795	.193	6.00	6.82	
	Total	90	6.40	.884	.093	6.21	6.59	
Interpersonal skills								
Listening	Analyst	55	5.18	1.492	.201	4.78	5.59	7.007**
	Manager	20	5.90	1.021	.228	5.42	6.38	
	Executive	20	6.35	.671	.150	6.04	6.66	
	Total	95	5.58	1.349	.138	5.30	5.85	
Oral communication	Analyst	57	6.12	1.019	.135	5.85	6.39	.825
	Manager	20	6.15	.875	.196	5.74	6.56	
	Executive	18	6.44	.705	.166	6.09	6.79	
	Total	95	6.19	.937	.096	6.00	6.38	
Written communication	Analyst	56	5.54	1.439	.192	5.15	5.92	2.979
	Manager	20	5.60	1.231	.275	5.02	6.18	
	Executive	19	6.37	.895	.205	5.94	6.80	
	Total	95	5.72	1.334	.137	5.44	5.99	
People management	Analyst	57	5.79	1.319	.175	5.44	6.14	1.118
	Manager	19	5.79	1.357	.311	5.14	6.44	
	Executive	19	6.26	.733	.168	5.91	6.62	
	Total	95	5.88	1.237	.127	5.63	6.14	

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TABLE 6 *Continued from the previous page*

		N	Mean	SD	SE	95% Confidence Interval for Mean		F
						Lower Bound	Upper Bound	
Meeting facilitation	Analyst	56	4.43	1.488	.199	4.03	4.83	1.795
	Manager	20	4.65	1.531	.342	3.93	5.37	
	Executive	18	5.17	1.150	.271	4.59	5.74	
	Total	94	4.62	1.453	.150	4.32	4.91	
Negotiation	Analyst	56	5.89	1.289	.172	5.55	6.24	.165
	Manager	20	5.85	1.040	.233	5.36	6.34	
	Executive	18	6.06	.998	.235	5.56	6.55	
	Total	94	5.91	1.179	.122	5.67	6.16	
Stress management	Analyst	57	5.46	1.240	.164	5.13	5.79	1.706
	Manager	19	6.00	1.000	.229	5.52	6.48	
	Executive	19	5.21	1.960	.450	4.27	6.16	
	Total	95	5.52	1.383	.142	5.23	5.80	
Leadership	Analyst	57	5.44	1.389	.184	5.07	5.81	4.296*
	Manager	20	5.35	1.348	.302	4.72	5.98	
	Executive	19	6.37	.684	.157	6.04	6.70	
	Total	96	5.60	1.318	.134	5.34	5.87	
Functional logistics skills								
Legal specifications	Analyst	56	4.61	1.397	.187	4.23	4.98	.107
	Manager	20	4.75	1.552	.347	4.02	5.48	
	Executive	19	4.74	1.327	.304	4.10	5.38	
	Total	95	4.66	1.404	.144	4.38	4.95	
Customs, import and export	Analyst	54	5.00	1.479	.201	4.60	5.40	.892
	Manager	19	5.26	1.368	.314	4.60	5.92	
	Executive	19	4.63	1.535	.352	3.89	5.37	
	Total	92	4.98	1.467	.153	4.67	5.28	
Transportation management	Analyst	56	5.20	1.742	.233	4.73	5.66	.635
	Manager	19	5.32	1.635	.375	4.53	6.10	
	Executive	20	4.75	1.773	.397	3.92	5.58	
	Total	95	5.13	1.721	.177	4.78	5.48	
Inventory management	Analyst	55	5.13	1.689	.228	4.67	5.58	1.249
	Manager	20	5.30	1.490	.333	4.60	6.00	
	Executive	19	4.53	1.679	.385	3.72	5.34	
	Total	94	5.04	1.652	.170	4.70	5.38	
Warehousing	Analyst	56	5.04	1.809	.242	4.55	5.52	1.142
	Manager	19	5.16	1.740	.399	4.32	6.00	
	Executive	20	4.40	1.729	.387	3.59	5.21	
	Total	95	4.93	1.782	.183	4.56	5.29	

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TABLE 6 *Continued from the previous page*

		N	Mean	SD	SE	95% Confidence Interval for Mean		F
						Lower Bound	Upper Bound	
Purchasing / procurement	Analyst	56	5.21	1.604	.214	4.78	5.64	.958
	Manager	18	5.61	1.335	.315	4.95	6.27	
	Executive	19	5.68	1.250	.287	5.08	6.29	
	Total	93	5.39	1.489	.154	5.08	5.69	
Forecasting	Analyst	57	5.61	1.386	.184	5.25	5.98	.093
	Manager	19	5.74	1.195	.274	5.16	6.31	
	Executive	18	5.56	1.294	.305	4.91	6.20	
	Total	94	5.63	1.320	.136	5.36	5.90	
Reverse logistics	Analyst	54	4.52	1.657	.225	4.07	4.97	1.731
	Manager	20	4.70	1.750	.391	3.88	5.52	
	Executive	17	3.76	1.480	.359	3.00	4.53	
	Total	91	4.42	1.660	.174	4.07	4.76	
Port/airport management	Analyst	55	4.11	2.088	.281	3.54	4.67	.331
	Manager	18	4.50	2.093	.493	3.46	5.54	
	Executive	20	4.00	1.806	.404	3.15	4.85	
	Total	93	4.16	2.018	.209	3.75	4.58	
Logistics information systems	Analyst	55	5.73	1.459	.197	5.33	6.12	3.241*
	Manager	20	5.60	1.667	.373	4.82	6.38	
	Executive	17	4.65	1.656	.402	3.80	5.50	
	Total	92	5.50	1.579	.165	5.17	5.83	

RQ1 *How does the importance of specific SCM skills vary between business and humanitarian contexts?*

Analysis confirmed significant differences in SCM skill prioritization between these contexts. In business settings, there was a greater emphasis on skills such as information technology, customs, transportation, and port/airport management. Conversely, the humanitarian context placed higher importance on functional logistics skills. This divergence underlines the contextual uniqueness of SCM skills and calls for tailored educational and training programmes.

RQ2 *Which SCM skills are required from supply chain managers at different career levels?*

The study revealed a distinct evolution of SCM skills across career stages. Entry-level positions required strong functional logistics skills, which gradually gave way to general management skills at higher career levels. This trend was particularly pronounced in the humanitarian sector,

TABLE 7 Results from the post-hoc analysis

	Test	Level	Groups compared	Mean difference	SE	Sig	95% Confidence Interval	
							Lower Bound	Upper Bound
Information sharing	Tukey HSD	Analyst	Manager	-.018	.267	.998	-.65	.62
			Executive	-.768**	.267	.014	−1.40	-.13
		Manager	Analyst	.018	.267	.998	-.62	.65
			Executive	-.750	.324	.059	−1.52	.02
		Executive	Analyst	.768**	.267	.014	.13	1.40
			Manager	.750	.324	.059	-.02	1.52
Leadership	Games-Howell	Analysts	Manager	.089	.353	.966	-.78	.95
			Executive	-.930**	.242	.001	−1.51	-.35
		Managers	Analyst	-.089	.353	.966	-.95	.78
			Executive	−1.018**	.340	.015	−1.86	-.18
		Seniors	Analyst	.930**	.242	.001	.35	1.51
			Manager	1.018**	.340	.015	.18	1.86
Listening	Games-Howell	Analysts	Manager	-.718	.304	.057	−1.45	.02
			Executive	−1.168**	.251	.000	−1.77	-.57
		Managers	Analyst	.718	.304	.057	-.02	1.45
			Executive	-.450	.273	.241	−1.12	.22
		Seniors	Analyst	1.168**	.251	.000	.57	1.77
			Manager	.450	.273	.241	-.22	1.12
Logistics information systems	Tukey HSD	Analysts	Manager	.127	.403	.946	-.83	1.09
			Executive	1.080*	.428	.035	.06	2.10
		Managers	Analyst	-.127	.403	.946	−1.09	.83
			Executive	.953	.509	.152	-.26	2.17
		Seniors	Analyst	−1.080**	.428	.035	−2.10	-.06
			Manager	-.953	.509	.152	−2.17	.26

NOTES **p < .01, *p < .05.

suggesting a more dynamic skillset evolution influenced by experience rather than job title.

The testing of our hypotheses yielded the following insights:

H1 *Confirmed that SCM skills are distinctly prioritized in different contexts, reflecting their unique strategic and operational demands.*

H2A *and H2B Demonstrated that while functional logistics skills are crucial at entry levels, there is an increasing emphasis on general management skills as one progresses in their career.*

This was consistent across both business and humanitarian contexts.

These findings have implications for both practice and education. To reflect the changes in needs in skills over time, educational institutions should adjust their offer to different groups, according to the career stage. There is a need to provide, or refresh, skills for those who are progressing in their career, focusing on 'leadership' and 'information sharing'. While there are similarities between business and humanitarian contexts, those individuals that are aiming to move from business into the humanitarian field should look again at 'customs, import and export' skills. This skill is easily forgotten in large common markets, whether the EU, NAFTA, Mercosur, or the common market of the East African Community, but it is seeing a renaissance in importance not just for global trade beyond these markets, but also due to current trade wars and related disruptions. Apart from 'customs, import and export', training for humanitarian organizations would need to emphasize 'transportation', and 'port/airport management'. While 'information technology' was less important in the humanitarian context, it cannot be expected to remain, as the growing role of information technology in humanitarian settings could be observed (i.e. blockchain, mobile solutions, e-vouchers).

Results show some differences in the importance of specific skill sets throughout the career progression of supply chain managers, though rather on the aggregate level than when it comes to specific skills. Generally, the results of this study concur with the previous research that solid functional logistics skills are essential for the entry levels of the job, but then perhaps are taken for granted on higher management levels while giving space to the requirement of other skills such as leadership and general management overall. This may also answer the question of which skills to invest in at which level: a solid foundation of SCM skills is important at first, but building on that, managers, and especially executives, need leadership and management programmes to thrive in their career.

Perhaps even more importantly, it may be crucial to revisit the groupings of skills in the T-shaped model. Moving away from truly 'functional' logistics towards supply chain management, 'supplier relationship management' should be grouped with other SCM skills. At the same time, further studies are needed to establish whether any of the skills in the T-shaped model can de facto be eliminated from the model – and whether a different set of questions would be necessary to be able to add to

them if needed. While this research confirms the applicability of the T-shaped model, more research is needed to tune it up.

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Appendix 1: Factors in Context

Business context					Humanitarian context				
Skill	Category	Mean score	Component total	% of variance	Skill	Category	Mean score	Component total	% of variance
Warehousing	FLS	.85	7.58	22.97	Warehousing	FLS	.91	8.51	25.78
Transportation management	FLS	.82			Purchasing / procurement	FLS	.88		
Reverse logistics	FLS	.80			Transportation management	FLS	.86		
Port/airport management	FLS	.79			Customs, import and export	FLS	.84		
Purchasing / procurement	FLS	.74			Inventory management	FLS	.75		
Customs, import and export	FLS	.70			Logistics information systems	FLS	.71		
Inventory management	FLS	.67			Port/airport management	FLS	.69		
Supplier relationship management	GMS	.62			Supplier relationship management	GMS	.54		
Logistics information systems	FLS	.61			Information sharing	PSS	.94	6.05	18.34
Legal specifications	FLS	.52			Information gathering	PSS	.93		
Oral communication	IPS	.85	6.38	19.32	Risk management	GMS	.72		
Negotiation	IPS	.80			Forecasting	FLS	.62		
Meeting facilitation	IPS	.75			Information technology	GMS	.62		
People management	IPS	.72			Stress management	PSS	.61		
Listening	IPS	.57			Reverse logistics	FLS	.56		
Change management	GMS	.54			Written communication	IPS	.46		
Information gathering	PSS	.52			Project management	GMS	.44		
Written communication	IPS	.52			Problem analysis	PSS	.94	3.43	10.41
Information sharing	PSS	.49			Problem identification	PSS	.94		
Project management	GMS	.79	2.90	8.77	Problem solving	PSS	.91		
Strategic management	GMS	.74			Oral communication	IPS	.56		
Risk management	GMS	.71			Negotiation	IPS	.44		
Leadership	IPS	.49			Strategic management	GMS	.76	2.78	8.42
Problem identification	PSS	.88	2.38	7.21	Change management	GMS	.75		
Problem solving	PSS	.87			Listening	IPS	.54		
Problem analysis	PSS	.85			Meeting facilitation	IPS	.51		
					People management	IPS	.88	2.34	7.01
					Leadership	IPS	.84		

Appendix 2: Factors across career levels

Analyst					Manager					Executive				
Skill	Category	Mean score	Component total	% of variance	Skill	Category	Mean score	Component total	% of variance	Skill	Category	Mean score	Component total	% of variance
Warehousing	FLS	.90	7.06	21.40	Purchasing / procurement	FLS	.93	7.19	21.80	Problem analysis	PSS	.97	9.00	27.27
Port/airport management	FLS	.85			Warehousing	FLS	.91			Problem identification	PSS	.96		
Transportation management	FLS	.81			Transportation management	FLS	.85			Problem solving	PSS	.85		
Purchasing / procurement	FLS	.79			Supplier relationship management	GMS	.77			Listening	IPS	.80		
Inventory management	FLS	.76			Customs, import and export	FLS	.75			Written communication	IPS	.80		
Reverse logistics	FLS	.69			Logistics information systems	FLS	.72			Information gathering	PSS	.54		
Logistics information systems	FLS	.69			Inventory management	FLS	.60			Purchasing / procurement	FLS	.94	7.10	21.53
Customs, import and export	FLS	.68			Reverse logistics	FLS	.60			Project management	GMS	.81		
Supplier relationship management	GMS	.63			Port/airport management	FLS	.58			Legal specifications	FLS	.65		
Legal specifications	FLS	.57			Legal specifications	FLS	.58			Risk management	GMS	.56		
Project management	GMS	.83	5.73	17.37	Problem identification	PSS	.92	6.76	20.48	Information sharing	PSS	.54		
Strategic management	GMS	.77			Problem solving	PSS	.90			Inventory management	FLS	.54		
Risk management	GMS	.72			Problem analysis	PSS	.86			Customs, import and export	FLS	.94	4.32	13.08

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Analyst					Manager					Executive				
Skill	Category	Mean score	Component total	% of variance	Skill	Category	Mean score	Component total	% of variance	Skill	Category	Mean score	Component total	% of variance
Leadership	IPS	.59			Forecasting	FLS	.67			Transportation management	FLS	.92		
Finance and accounting	GMS	.41			Listening	IPS	.63			Port/airport management	FLS	.83		
Problem identification	PSS	.91	3.99	12.10	Written communication	IPS	.56			Logistics information systems	FLS	.81		
Problem solving	PSS	.83			Stress management	PSS	.49			Warehousing	FLS	.55		
Problem analysis	PSS	.81			People management	IPS	.92	4.48	13.56	Leadership	IPS	.84	2.74	8.29
Customer relationship management	GMS	.79	2.77	8.40	Information gathering	PSS	.88			Negotiation	IPS	.71		
Change management	GMS	.71			Oral communication	IPS	.62			People management	IPS	.64		
Forecasting	FLS	.63			Negotiation	IPS	.53							
Stress management	PSS	.49			Project management	GMS	.93	3.37	10.20					
Listening	IPS	.53	2.21	6.71	Risk management	GMS	.73							
Information sharing	PSS	.92			Customer relationship management	GMS	.71							
Information gathering	PSS	.84			Strategic management	GMS	.69							
Oral communication	IPS	.73	1.40	4.24	Marketing	GMS	.67							
Written communication	IPS	.68												
People management	IPS	.61												

Access to Credit and Loan Repayment by Households of Non-Farmers in Nigeria: New Evidence from Binary Logit Regression

Obed I. Ojonta
University of Nigeria, Nigeria
obed.ojonta@unn.edu.ng

Onyinye I. Anthony-Orji
University of Nigeria, Nigeria
onyinye.anthony-orji@unn.edu.ng

Jonathan E. Ogbuabor
University of Nigeria, Nigeria
jonathan.ogbuabor@unn.edu.ng

Ndubuisi Chukwu
University of Nigeria, Nigeria
ndubuisi.chukwu@unn.edu.ng

Anthony Orji
University of Nigeria, Nigeria
anthony.orji@unn.edu.ng

Emmanuel T. Ideba
University of Nigeria, Nigeria
tochukwuideba@gmail.com

Access to credit is the desire of every developing economy as well as a coping strategy in starting up and expanding businesses. Hence, this study critically examines how access to credit responds to loan repayment by households of non-farmers in Nigeria. To achieve this purpose, some important variables like spending on transport, other business costs, salaries/wages and rent were included in the model. Other variables in the model include age and location for the households of non-farmers. The study shows that loan repayment by households of non-farmers and their place of residence are significant drivers of access to finance in Nigeria while other characteristics of non-farmers such as spending on transport, other business costs, salaries/wages, rent and age are muted throughout.

Keywords: credit access, household, non-farmers, binary logistic regression
JEL Classification: E51, G5

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Introduction

Access to credit is the desire of every developing economy as well as a coping strategy in starting up and expanding businesses (Anthony-Orji et al. 2023). This in turn can help to reduce poverty and improve the status of payback loans (Ojonta 2022). In this paper, we examine the effect of loan repayment on access to credit by households of non-farmers

in Nigeria. This study also investigates how other variables which were included in the model are influencing access to credit by households of non-farmers in Nigeria. In general terms, Nigeria is one of the developing economies characterised by high levels of poverty, and has indeed been described as the headquarters for poverty in the world (Iheonu and Urama 2019). The level of poverty in Nigeria has been found not only to have affected the general economy of the nation but also the performance of non-farmers' households in terms of access to finance. It has also affected the consumption patterns of the people, as more than 60% of the Nigerian population spend less than one dollar per day on consumption (Pradhan 2012).

Loan repayment processes can also be relevant in explaining the dynamics of access to finance in an economy. Orji et al. (2023) posit that the dearth of loan repayment contributes to Nigeria's continued underdevelopment, as businesses have been unable to take advantage of credit opportunities that could spurred economic growth, created jobs, and reduced poverty. In addition, the nation's economy has been unstable thus far due to a lack of investment possibilities and loan availability, which has also left borrowers with high default rates and poor returns on their investments.

Indeed, the nexus between loan repayment and access to finance by households of non-farmers are serious issues that are of major concern in most developing countries like Nigeria. The issues of loan repayment are a particularly serious impediment in accessing credit for business expansion and profit making as most people in the country consider credit as a windfall (Hassan and Olaniran 2011).

Additionally, a report from the National Bureau of Statistics (NBS 2021) revealed a number of significant issues that have contributed to Nigeria's poor credit availability. Among these are the prevalence of dimensional poverty, insufficient collateral in the case of repayment default, and high interest rates issued to the borrowers. Numerous studies have been discovered in the literature explaining the economic benefits of loan repayment from various perspectives. According to Nwosu, Ojonta, and Orji (2017), loan repayment has a significant impact on various aspects of household welfare, spending habits and improvement of human capital development like the health and education sectors. However, the relevance of loan repayment in enhancing the performance of non-farmers cannot be underestimated. Nkurunziza (2005) believes that when loan repayment becomes impossible for non-farmers, it can cause obstacles and potentially slow down economic growth.

The Nigerian government has provided enormous support to ensure that loan repayment will not further constitute a hindrance to access to finance either for individuals or groups of individuals. This support is made available through provisions for the borrowers to have access to credit at little or no cost in terms of collateral and securities. Other support by the government includes establishment of various intervention schemes such as YOUWIN, which was initiated during the government of President Goodluck Jonathan, and N-Power that was instituted by the immediate past President Muhammadu Buhari's administration. These interventions were established to cushion the effects associated with the sufferings and challenges resulting from lack of access to finance, inadequacies in loan repayment, youth unemployment, and for youths that are willing to engage in small and medium scale businesses (SMEs) but lack the required capital. These government interventions are targeted at building capacity for expansion of social development through access to finance in Nigeria. It is unfortunate, however, that these efforts by the government in ensuring that the citizens of Nigeria are supported in building capacity in terms of loan repayment appear not to be yielding the desired results. The majority of businesses of non-farmers in Nigeria are still facing serious challenges, such as limited availability of access to finance. It is evident that inadequate availability of access to finance by households of non-farmers has been a critical issue in developing countries like Nigeria as the majority of them could not afford to borrow due to their inability to pay back.

Furthermore, debt repayment has grown to be a significant problem for non-farmers in Nigeria. Apart from this, access to finance by households of non-farmers is also challenged by a high level of loan repayment default by households of non-farmers among urban dwellers. This is because the local economy is characterised by many factors such as weak institutions (Ojonta and Ogbuabor 2024) and unemployment (Ojonta and Ogbuabor 2023). Against this background, the objectives of this paper include (i) to investigate how access to credit is responding to loan repayment by households of non-farmers in Nigeria, and (ii) to ascertain how the covariates in the model are impacting access to credit by households of non-farmers in Nigeria.

The next section of this paper reviews various forms of literature, followed by the third sction that discusses the data and methodology. The fourth section captures the empirical results and the last section handles the conclusion and policy recommendations.

Review of Relevant and Related Literature

THEORETICAL LITERATURE

This paper, which looks at the relationship between loan repayment and credit accessibility for non-farmers is supported by a number of theories found in the literature. Among these theories are the theory of credit rationing, the theory of imperfect information, and the theory of transaction cost.

Credit Rationing Theory

This theory was first introduced by Stiglitz and Weiss (1981). According to the theory, financial institutions may exhibit reluctance to extend loans to businesses, even if the latter are prepared to bear elevated interest rates. That is, they are unwilling to offer loans to businesses not because they cannot afford the cost of the loan but because of factors like the ability to pay back the loan, symmetric information, transaction costs, and market imperfections.

The Theory of Information Asymmetry

This very important theory was first proposed by Hoff and Stiglitz (1990). According to this theory, information is a key factor influencing how well financial markets perform. Also, the theory posits that the imperfect information problem is what causes unequal access to information in the financial market. According to this theory, moral hazard and adverse selection may result from the financial market's knowledge asymmetry. Three categories are identified by the theory to describe these information difficulties in the financial market: (i) the screen problem, which involves determining the level of default; (ii) the incentive problem, which involves conceiving and guaranteeing that credit contracts are honoured; and (iii) the enforcement problem, which involves observing credit recipients to guarantee loan repayment.

The Theory of Transaction Cost

Benston and Smith (1976) introduced the transaction cost idea. According to the notion, financial intermediaries use technical innovation to their advantage in order to maximize profit and take advantage of economies of scale. The cost of processing and obtaining the data (information) needed to make a decision throughout the transaction process, as well as the costs associated with policing and enforcement, are the main features of the transaction cost theory.

EMPIRICAL LITERATURE

This section reviews some studies in the literature related to the objectives of our study. The review brought out the nexus between access to finance and other variables both in Nigeria and other economies.

Review of Domestic Empirical Literature

Empirically, Ojonta and Ogbuabor (2021b) investigated the effect of access to credit on the performance of non-farm household businesses, with a focus on input supply in Nigeria. The findings show that input supply promotes credit accessibility in Nigeria. Another study by Asiedu et al. (2013) examined the nexus between gender and accessibility of credit in Sub-Saharan Africa. The outcome of the study confirmed that female-owned firms are more constrained than male-owned firms. Furthermore, Ojonta and Ogbuabor (2021a) conducted a study in Nigeria to ascertain how physical capital can enhance credit accessibility. The outcome of the research shows that physical capital is an essential driver of financial accessibility. A follow-up study from Ojonta, Ogbuabor, and Obiefuna (2024) also revealed how access to credit can be driven by employment in Nigeria, using the binary regression model approach. The results of the research indicate that employment promotes access to credit. Ojonta (2023) also conducted a study on the effect of credit access on non-farm households' total sales in Nigeria. The estimation result of the research shows that access to credit is an important channel in enhancing the improvement of the total sales of firms. Also, Ojonta, Obodoechi, and Ugwu (2021) conducted a study on the relationship between household credit access and start-up capital of an enterprise in Nigeria. The result of the study shows that there is a positive relationship between them. In contrast, Ololade and Olagunju (2013) employed the probit estimation approach to examine how absence of guarantors can effect credit accessibility in Nigeria. At the end, the study confirmed that presence of guarantors is an important channel in enhancing the improvement of access to money. In another recent study in Nigeria, Oke, Kehinde, and Akindele (2020) investigated the relationship between human capital development such as years of schooling and access to loans in Nigeria. The research shows that schooling plays a positive role in influencing access to credit. Enimu, Eyo, and Ajah (2017) employed multiple regression analysis to examine the role of household income in influencing loan repayment of microcredit finance groups in Nige-

ria. The research was achieved through the use of a multi-stage random sampling approach. The result of the research confirmed that household income has a positive relationship with loan repayment of microcredit group members in Nigeria.

Review of Empirical Literature outside Nigeria

Gatti and Love (2008) conducted a study on how access to credit influences firms' productivity in Bulgaria using cross-sectional data. The conclusion of the study shows that access to credit has a positive impact on total firm productivity. Berkowitz and White (2004) examined how the law of personal bankruptcy responds to access to credit in the USA. The study focused on the comparison of small firms within the economy and the finding revealed that cooperative firms are likely to have more access to credit than non-cooperative firms. Munene and Guyo (2013) also carried out a study on the impact of business characteristics on loan repayment default in Kenya. The result showed a significant relationship between profit and loan repayment default. Moreover, Fatoki and Odeyemi (2010) conducted a study for SMEs in South Africa in order to examine how microeconomic variables impact access to credit. The research indicated that managerial skills are essential in promoting access to credit in South Africa. A similar study by Musamali and Tarus (2013) in Kenya investigated how firm-specific traits influence access to finance. The study revealed that firm-specific traits are an important factor in influencing access to finance of companies in Kenya. A study developed in Libya by Zarook, Rahman, and Khanam (2013) examined the relationship between access to finance and financial performance with a focus on the level of household income. The research established that higher income households do not necessarily influence access to credit. A similar study in Uganda by Nanyondo et al. (2014) showed a contrary result, that financial performance has a positive effect on access to finance. Kiplimo et al. (2015) also investigated the determinants of small farmers' access to finance in Kenya. The study employed the logit estimation technique and revealed that factors like education level, occupation, and access to extension services affect access to finance positively and significantly. However, the study established that household income and proximity to a credit source affect access to finance negatively and significantly. As a follow up study, Fufa (2016) examined the determinants of small businesses' access to finance and sources of credit in Ethiopia. By employing the logit regression model, the study revealed that firms'

access to finance is greatly determined by the firm's size and age, location, risk-taking propensity, and prevalence of corruption problems. In another study, Chenna, Maria, and Teno (2018) investigated how smallholder farmers respond to loan accessibility in Cameroon. The study utilised the logistic regression model and found that accessing loans has a positive relationship with performance of smallholder farmers.

In sum, from the studies reviewed above, there are none that focused specifically on how loan repayment influences access to credit. This is a serious gap in the literature which our current study fills using the logistic regression model technique. We consider this a valuable addition to the literature.

Data and Research Methodology

THEORETICAL FRAMEWORK

This study hinges on the theory of information asymmetry, which was first introduced by Hoff and Stiglitz (1990). According to this theory, information is a key factor influencing how well financial markets perform. Also, the theory posits that the imperfect information problem is what causes unequal access to information in the financial market. According to this theory, moral hazard and adverse selection may result from the financial market's knowledge asymmetry. The study conducted by Diao, McMillan, and Wangwe (2018) lends some support to this theoretical perspective. The theorists perceived that the role of the information problem as a driver of loan repayment cannot be called negligible. Indeed, the proponents of this theoretical perspective established that harnessing loan repayment is an important channel through which borrowers can have access to finance.

DATA DESCRIPTION

This study employs the Nigerian 2018–19 General Household Survey (Wave 4) sample survey data. It was produced and recorded by the National Bureau of Statistics (NBS) in collaboration with various organisations, including the World Bank, the Ministry of Agriculture and Rural Development, and the National Food Reserve Agency. Based on a multi-stage stratified sampling technique, the survey is a nationally representative study of around 5,000 homes from all 36 states in Nigeria, including Abuja, the country's capital area. In our analysis, however, we only included the 244 homes whose credit access data was reported as

Households of Non-Farmers (HNFS). That is to say, we used the data that was available in this survey with a sample size of 244 because the study was centred on how loan repayment affected households of non-farmers. The study employed the available data in order to prevent anomalies, homogeneity problems, and spurious result traps.

MODEL SPECIFICATION

This study takes the same pattern as Ojonta and Ogbuabor (2021a). The study explained the logistic regression model as a mutually exclusive event estimation model in which the independent variables are either categorical or binary, while the dependent variable chooses a binary form. Based on that premise, this study used a binary logit model to calculate the impact of loan repayment on credit access by households of non-farmers in Nigeria. Given that the availability of credit for companies of non-farmers is a dependent variable that can be classified into two groups, this study employed Astari and Kismiantini's (2019) modelling technique. In this model, represents credit access by HNFS while X*i* represents the control variables employed in this study. Hence, the binary logit model is labelled as two outcomes to measure the welfare influence of loan repayment. This implies that the binary logit model is the determinant of the chances that the enterprise *i* has one of the *j* not randomly independent access to credit (0 = did not get credit; while 1 = gets credit). Hence, taking the approach by Ojonta, Ogbuabor, and Obiefuna (2024) and Justino, Litchfield, and Pham (2008), these chances can be indicated as:

$$P(\pi_i = j) = \frac{1}{1 + e^{-(z)}}, \tag{1}$$

where:™— $Z = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_p X_p$; β_o, $\beta_1 \ldots$, β_p are regression parameters; π are the model's independent variables, and is the probability that households of non-farmers eventually get credit.

All the explanatory variables in equation (1) are defined as shown in table 1. These variables are also explained as follows:

- X1 denotes REPAYMENT, which represents loan repayment by households of non-farmers. This value is measured as a binary variable where 1 = yes (if households of non-farmers are non-defaulters of loan repayment) and 2 = No (if households of non-farmers are defaulters of loan repayment). This variable is expected to have ei-

ther a positive or negative relation with households of non-farmers' ability to obtain credit. Studies like Ojonta and Ogbuabor (2021b) and Diao, McMillan, and Wangwe (2018) are consistent with this anticipation that the coefficient of this variable will be positive or negative.

- TRANSPORT, represented by the symbol X2, stands for the cost of transportation. This is a binary variable; 1 means that the household of non-farmers spent money on transportation, and 2 means the opposite (that the households of non-farmers do not spend money on transportation). According to this study, the coefficient of this variable is expected to have a negative relationship with households of non-farmers' willingness to obtain credit, following Ojonta and Ogbuabor (2021a) and Diao, McMillan, and Wangwe (2018).
- COST, represented by the symbol X3, stands for spending on other businesses by households of non-farmers. This variable takes a binary form where 1 denotes that households of non-farmers spend on other businesses while 0, otherwise denotes that households of non-farmers do not incur any cost on other business. By a priori expectation, this variable is expected to bring economic benefits to non-farmers, like profit making. Studies by Ojonta and Ogbuabor (2021b) and Odoh and Nwibo (2017) all support this.
- SALARIES/WAGES, represented by the symbol X4, stands for spending on salaries/wages by HNFS. This variable takes a binary form, where 1 means that HNFS spend from salaries and wages while 2 means that they do not. According to this study, the coefficient of this variable is expected to have a positive or a negative relationship with households of non-farmers' ability to obtain credit. As per the findings of Shehu and Sidique (2014), there was a negative correlation found between the two variables, whereas other research works such as Aziz, Wasim, and Iqbal (2017), Ojonta and Ogbuabor (2021a), and Ayambila, Osei-Akoto, and Ayamga (2017) found a positive correlation.
- AGE, represented by the symbol X5. This variable takes a binary form, where 1 means an employment age; 0, otherwise.

The residence at which the household of non-farmers is located is indicated by the symbol X6 for LOCATION. Additionally, it is a binary variable with two possible values: 1 if the non-farmers' residence is located in a rural region/area and 2 if it is in an urban region/area. We have a

TABLE 1 Measure of Variables Used in the Binary Logit Regression

Dependent Variable	Variable label	Coding	Expected Sign
Access to credit	CREDIT	1 = yes; 2 = No	Not Applicable
Independent Variables			
Spending on loan repayment (x1)	REPAYMENT	1 = yes; 2 = No	(+/-)
Spending on transport (x2)	TRANSPORT	1 = yes; 2 = No	(+/-)
Spending on other cost of businesses (x3)	COST	1 = yes; 0, otherwise	(+/-)
Spending on salaries/ wages (x4)	SALARIES	1 = yes; 2 = No	(+/-)
Age of household of non-farmers (x5)	AGE	1 = decades; 0, otherwise	(+/-)
Household Location of non-farmers (x6)	LOCATION	1 = Rural Area; 2 = Urban Area	(+/-)
Spending on rent (x7)	RENT	1 = yes; 0, otherwise	(+/-)

negative a priori expectation for this variable, in line with Atamanov and Van den Berg (2011). Given that the non-farmers must incur higher costs as a result of this location, this is also in line with economic expectations.

x7 stands for RENT, or the amount the household of non-farmers pays for rent. It is a binary variable that accepts two values: 1 for yes (if the household of non-farmers spends money on rent) and 0, otherwise (if there is no spending on rent). Ojonta and Ogbuabor (2021a) and Seng (2015) obtained negative coefficients for this variable, whereas Diao, McMillan, and Wangwe (2018) obtained positive coefficients. As a result, we generally have a positive or negative a priori expectation for the coefficient of this variable.

The Estimated Results from the Model Technique

THE DESCRIPTIONS OF DATA ANALYSIS

The overview from table 2 articulates the distribution of households of non-farmers (HNFS) in our sample according to defaulters and non-defaulters on loan repayment in both urban areas and rural areas in Nigeria. This table is self-explanatory. It shows that non-defaulters on loan repayment by HNFS have more credit access than defaulters on loan repayment in both urban and rural areas. Table 2 also reveals that HNFS have more frequency of non-defaulters of loan repayment in terms of

TABLE 2 Distributions of Access to Credit by Loan Repayment

Measure of loan repayment	Access to Credit	Non-Access to Credit		Total	
		Urban Region/Area			
Non-defaulters	18	25	9	14	27	39
Defaulters	14	4	68	92	82	96
Total	32	29	77	106	109	135

NOTE: Authors' compilations originating from NBS for 2018 General Household Survey

access to finance while defaulters of loan repayment have less frequency in terms of access to finance in both urban and rural areas. This implies that repayment compliance is a priority for credit access. It also shows that households of non-farmers (HNFS) have more repayment defaulters and fewer repayment non-defaulters in both rural and urban areas. The table also shows that in the households of non-farmers (HNFS) and loan repayment defaulters that are deprived of access to credit are fewer in number than non-defaulters in both rural areas and urban areas. This may suggest that most of the HNFS that are repayment defaulters may have been seeking funds elsewhere, possibly from formal credit markets. The table clearly reveals that HNFS resident in urban areas have more access to credit than their counterparts in the rural areas.

Table 3 shows the distributions of credit access by loan repayment in percentage terms. The percentages reaffirm the results highlighted earlier. For example, it shows that a higher percentage of HNFS in both rural areas and urban areas that do not default in repayment had more credit access than defaulters in both urban and rural areas. It also reveals that a higher percentage of non-farmers in rural areas that do not default in repayment have more credit access relative to their counterparts in urban areas.

Estimation Results and Discussion

The binary logit regression model's results, which are displayed in table 4, unveil the estimation result on how loan repayment and other macroeconomic variables in the model are responding to credit access in Nigeria.

The findings point out that repayment of loans has a coefficient (B) of 1.964 and the p-value of 0.000. The result implies that the effect of loan repayment on access to credit by households of non-farmers is positive and significant at the 1% level, as indicated in table 4. There are two cate-

TABLE 3 Percentage Share of Access to Credit by Loan Repayment

Measure of loan repayment	Access to Credit				Non-Access to Credit			
	(1)	(2)	(3)	(2)	(1)	(2)	(3)	(2)
Non-defaulters	18	56.25	25	86.21	9	11.69	14	13.21
Defaulters	14	43.75	4	13.79	68	88.31	92	86.79
Total	32	100	29	100	77	100	106	100

NOTE: Author's compilations originating from NBS for 2018 General Household Survey, (1) Urban Region/Area, (2) % Share, (3) Rural Region/Area,

gories of repayment here, with the benchmark being 'repayment defaulters'. This result is in line with research conducted by Blanchflower and Evans (2004), who discovered that loan repayment had a major influence on households of non-farmers being allowed for credit accessibility. Atamanov and Van den Berg (2011) and Owoo and Naudé (2014) are just a few of the studies that support this finding.

Table 4 further illustrates how access to credit is driven by location of non-farmers in Nigeria. Recall that this is a binary variable: if an NHF is located in a rural area, it takes on the value of 1, and if an NHF is located in an urban area, it takes on the value of 2.

According to table 4's data, this variable has a positive influence on accessing credit by households of non-farmers in Nigeria. The coefficient and p-value of the variable are 0.598 and 0.076, respectively. These two results suggest that location of non-farmers' households is positive and significant at the 10% level. The outcome of the research is in tandem with studies by Diao, McMillan, and Wangwe (2018), which similarly found a positive coefficient and suggested that households of non-farmers located in rural areas promote credit access participation. This might be because of the advantages of living in a rural region, such as access to inexpensive labour (Okotoni 2003).

The covariates in our model as captured in table 4 include various forms of spending such as: other business costs, salaries/wages, transport, rent and age of the business. The coefficients of these covariates are negative with the exception of the variable RENT, which has a positive coefficient. The results from the p-value revealed that they are all muted throughout. These findings are consistent with Mapunda, Mhando, and Waized (2018) as well as Rijkers and Söderbom (2013), respectively. Also, spending on transport has its coefficient as −0.484 while its p-value is 0.272, which implies that the covariate is not statistically significant. The

TABLE 4 Results of Binary Logit Regression

Observation: 244
Pseudo R-Square: 0.247
Correctly predicted: 78.3
Dependent Variable: Access to credit

Variables	B	Std Error	p-value	Exp(B)
REPAYMENT	1.964	0.36	(0.000)***	7.128
TRANSPORT	−0.484	0.44	0.272	0.616
COST	−0.495	0.356	0.165	0.61
SALARIES	−0.61	0.499	0.222	0.543
AGE	−0.399	0.377	0.289	0.671
LOCATION	0.598	0.337	(0.076)*	1.819
RENT	0.192	0.347	0.58	1.211
Constant	−1.095	0.568	0.054	0.334

NOTE: 1. B: Represents Coefficient Estimation 2. Std Error: Robust Standard Error 3. Exp(B): The Odd ratio computed as exponential of Coefficient 4. p-value: Computed for test of significance ***, * Indicate the significance level at 1% and 10%, respectively.

finding is line with the result of studies by Ojonta and Ogbuabor (2021a), Mapunda, Mhando, and Waized (2018), Okotoni (2003), and Owoo and Naudé (2014), respectively.

Conclusion and Policy Recommendation

The core purpose of this work is to investigate the effect of loan repayment on access to credit by households of non-farmers in Nigeria. The estimation result of the regression as reported in table 4 revealed that loan repayment is positive and significantly impacting credit access by households of non-farmers in Nigeria. The result implies that loan repayment is an unavoidable process in achieving access to credit, which also suggests that the higher the tendency of households of non-farmer to payback their loan the higher will be the tendency for access to credit by households of non-farmers. The policy recommendation is that loan repayment should be encouraged and promoted. This can be achieved by subsidising the interest rate in loan repayment.

In table 4, the outcome of this study also shows that the location for households of non-farmers is positive and significantly impacts credit access in Nigeria. The result means that the residence of non-farmers is an important channel in enhancing improvement of access to loans in Nigeria. The study, however, suggests that policy should focus on improving the locations of non-farmers in Nigeria. This can be feasible

through provision of basic amenities such infrastructural development, regular water supply and subsidising housing schemes. This could be of great help in encouraging the borrowers in accessing credit. Our results from table 4 also indicate that variables like spending on transport, other business costs, salaries/wages, and rent, including years of business by non-farmers in Nigeria, are muted throughout in influencing credit access. The implication of the result means that these variables do not have any form of relationship in terms of access to finance in Nigeria. This study suggests that policy recommendations should be ignored and should not be given attention. This can also go a long way to reduce wastefulness of resources.

Additionally, this paper has some limitations that should be articulated for future study. Indeed, considering the significant influence of loan repayment by households of non-farmers in promoting access to finance in Nigeria, this study could not shed light on how loan repayment could influence credit access using aggregate data. This study was limited to employ dummy or binary variables that have two options of decision, zero or one. Another limitation is that our study could not also shed light on panel data analysis and access sufficient data as quite a number of them are missing. Therefore, we recommend future research to focus on panel data analysis using a model technique that allows both continuous and other various forms of data analysis.

Competing interests

The Authors declare that they have no competing interest.

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Proizvodne zmogljivosti in cilji trajnostnega razvoja: kritični, a odtenkov polni odnosi

David Tennant, Stuart Davies, Sandria N. Tennant in Patrice Whitely

Splošno sprejeto je, da proizvodne zmogljivosti omogočajo doseganje ciljev trajnostnega razvoja Združenih narodov, vendar je malo literature, ki bi empirično preizkušala to stališče. Ta članek proučuje odnose med proizvodnimi zmogljivostmi in cilji trajnostnega razvoja ter razkriva odtenke, ki jih je treba upoštevati pri integriranih razvojnih pristopih. Z uporabo panelnih podatkov časovnih vrst, z Driscoll-Kraay prilagojenimi standardnimi napakami, proučujemo, kako izboljšanje osmih elementov indeksa proizvodnih zmogljivosti (Productive Capacity Index - PCI) vpliva na cilje trajnostnega razvoja. Ugotavljamo, da ima vsak od ciljev trajnostnega razvoja statistično pomembne odnose z več elementi PCI, rezultati pa poudarjajo področja, na katerih izboljšanje proizvodnih zmogljivosti pospešuje napredek pri enem ali več ciljih trajnostnega razvoja, lahko pa je tudi škodljivo za druge, zlasti za cilje, povezane z okoljem in dohodkovno neenakostjo. Naš pristop razvojni praksi zagotavlja nov okvir za boljše ciljanje intervencij za doseganje ciljev trajnostnega razvoja.

Ključne besede: trajnostni razvoj, proizvodna zmogljivost, gospodarska odpornost, strukturna preobrazba, cilji trajnostnega razvoja
Klasifikacija JEL: Q56, O11, O44, O40
Managing Global Transitions 22 (4): 317–347

Bibliometrična analiza literature o optimalnih valutnih območjih in monetarni integraciji

Ntombiyesibini Matonana in Andrew Phiri

Naša študija predstavlja pionirsko bibliometrično analizo literature o optimalnih valutnih območjih in monetarni integraciji, pri čemer uporablja 9.228 raziskovalnih rezultatov, objavljenih med letoma 1960 in 2022. Za celovito analizo teh podatkov uporabljamo funkcijo biblioshiny v R-studiu. Naše ugotovitve razkrivajo rastoč obseg literature o optimalnih valutnih območjih in povečano produktivnost avtorjev. Omeniti velja, da vplivni avtorji, kljub manjšemu obsegu raziskav, dosegajo obsežno število citatov in objavljajo v prestižnih revijah, kot sta *The Quarterly Journal of Economics* in *The American Economic Review*. Poleg tega naša analiza razkriva premalo zastopanost institucij zunaj Evrope in Amerike ter premalo zastopanost žensk in nebelih raziskovalcev. Predlagamo

prihodnje raziskovalne usmeritve za odpravo teh vrzeli. Predvsem pa je naša raziskava prva, ki je izvedla bibliometrično analizo optimalnih valutnih območij in denarne integracije, kar poudarja njeno izvirnost.

Ključne besede: optimalna valutna območja, monetarna integracija, bibliometrična analiza, paket biblioshiny
Klasifikacija JEL: F31, F45, G15
Managing Global Transitions 22 (4): 349–371

Veščine upravljanja oskrbovalnih verig v poslovnih in humanitarnih kontekstih

Robert Davtyan, Wojciech D. Piotrowicz in Gyöngyi Kovács

Ta študija raziskuje različne zahteve po veščinah v upravljanju oskrbovalnih verig (Supply Chain Management – SCM) v komercialnih in humanitarnih kontekstih ter na različnih kariernih ravneh. Analizirajoč 116 odgovorov glede konteksta in 96 glede kariernih ravni, raziskava potrjuje uporabnost T-oblikovanega modela, ki poudarja različne veščine, ključne za vsak sektor. Ugotovljene so bile pomembne razlike: humanitarni SCM daje prednost funkcionalni logistiki, medtem ko poslovni SCM večji poudarek namenja informacijski tehnologiji, carinam, prevozu in upravljanju pristanišč/letališč. Te ugotovitve nakazujejo dinamičen razvoj veščin, kjer funkcionalne veščine, bistvene na začetnih položajih, prehajajo v splošne vodstvene sposobnosti z napredovanjem. V humanitarnem sektorju je ta premik bolj kot z nazivom delovnega mesta povezan z izkušnjami. Implikacije teh ugotovitev so za izobraževalne institucije in prakso SCM izjemne, saj zahtevajo posodobitve učnih načrtov za izpolnjevanje spreminjajočih se zahtev industrije in podporo logističnim strokovnjakom pri prehodu med sektorji.

Ključne besede: veščine, kompetence, upravljanje oskrbovalnih verig, humanitarna logistika, anketa
Klasifikacija JEL: J16, J24, M10
Managing Global Transitions 22 (4): 373–403

Dostop do kredita in odplačevanje posojil v nekmečkih gospodinjstvih v Nigeriji: novi dokazi iz binarne logistične regresije

Obed I. Ojonta, Jonathan E. Ogbuabor, Anthony Orji, Onyinye I. Anthony-Orji, Ndubuisi Chukwu in Emmanuel T. Ideba

Dostop do kredita je želja vsakega razvijajočega se gospodarstva in tudi nujnost pri ustanavljanju in širitvi podjetij. Zato ta študija kritično pro-

učuje, kako dostop do kredita vpliva na odplačevanje posojil v nekmečkih gospodinjstvih v Nigeriji. Iz tega razloga smo v model vključili nekatere pomembne spremenljivke, kot so izdatki za prevoz, drugi poslovni stroški, plače/mezde in najemnine. Spremenljivki v modelu sta tudi starost in lokacija nekmečkih gospodinjstev. Raziskava pokaže, da sta odplačevanje posojil v nekmečkih gospodinjstvih ter mesto bivališča pomembna dejavnika dostopa do financ v Nigeriji, medtem ko druge značilnosti nekmetov, kot so izdatki za prevoz, drugi poslovni stroški, plače/mezde, najemnine in starost, nimajo večjega vpliva.

Ključne besede: dostop do kredita, gospodinjstvo, nekmetje, binarna logistična regresija
Klasifikacija JEL: E51, G5
Managing Global Transitions 22 (4): 405–422