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National competitiveness in the sustainability context

Tiffany Hui-Kuang Yu, Kun-Huang Huarng

Abstract

This research explores national competitiveness through the framework of the Global Sustainable Competitiveness Index (GSCI), linking it to GDP per capita. Using fuzzy set/Qualitative Comparative Analysis (fsQCA), it analyzes the causal complexity of GSCI data. The empirical findings provide solutions for countries at different GDP levels to achieve either high or low competitiveness. Two key research questions are addressed: First, high competitiveness is not exclusive to countries with high GDP per capita, as such countries can also exhibit low competitiveness. Second, countries with low GDP per capita consistently show low competitiveness. The analysis highlights that multiple pathways can lead to the same outcome, allowing policymakers to select strategies best suited to achieving high competitiveness.

Keywords: *fuzzy set/Qualitative Comparative Analysis (fsQCA); Global Sustainable Competitiveness Index (GSCI), GDP per capita; Sustainable Development Goals (SDGs)*

JEL Classification: P48, P51, P52

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1 INTRODUCTION

The literature has endeavored to outline sustainability, and there have been many definitions. McMichael et al. (2003) state that sustainability is transforming the ways of living to maximize the chances that environmental and social conditions will endlessly support human security, well-being, and health. Ehrenfeld (2005) defines sustainability as the possibility that all forms of lives will flourish forever. Jamieson (1998) acknowledges that there are at least two concepts of sustainability: one focuses on natural capital that should be sustained, and the other emphasizes well-being (Turner et al., 1994).

One well-known definition of sustainability development defines it as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). The United Nations (UN) Sustainable Development Goals (SDGs) comprise 17 goals for global development to be achieved by 2030 (United Nations, 2022). These 17 goals can be grouped into economic, environmental, and social categories.

Sustainable competitiveness is defined as an advantage from social, economic, and environmental aspects that a firm achieves in comparison to its competitors (Knudsen et al., 2021). Petkovski et al. (2022) use sustainable competitiveness pillars, such as social, economic, environmental, and energy, to evaluate international digitalization development. Çetin & Erkisi (2023) explore the relationship between innovation and global competitiveness in European Union member states, revealing that innovation has the highest positive effect on global competitiveness. The Global Sustainable Competitiveness Index (2022) denotes sustainable competitiveness as "the ability to generate and sustain inclusive wealth without diminishing the future capability of sustaining or increasing current wealth levels." This index (GSCI) is

calculated based on 6 pillars: National Capital and Resource Intensity (environmental category), Social Capital and Governance (social category), and Intellectual Capital and Economic Capital (economic category).

Lubin & Esty (2010) assert that executives know that how they respond to the challenge of sustainability will profoundly affect the competitiveness of their firm. It is obvious to see that sustainability highly relates to competitiveness in firms. Despite the importance of competitiveness in the context of a market economy, both practical and methodological issues remain unresolved in the assessment of a country (Ginevičius et al., 2023). Ginevičius et al. (2023) find that an increase in a country's competitiveness raises GDP per capita, too.

This study hence explores if national sustainability relates to national competitiveness by evaluating GSCI and gross domestic product (GDP) per capita via causal complexity analysis. To conduct causal complexity, it employs Fuzzy set/Qualitative Comparative Analysis (fsQCA) (Ragin, 2000), which is a popular approach for causal complexity analysis (Longest & Vaisey, 2008). The findings of this study contribute to both academia and industry. First, the theory of national competitiveness can be built with GDP per capita in the context of sustainability. Second, causal complexity solutions provide very practical suggestions to countries of different economical levels to achieve high competitiveness.

The rest of the paper runs as follows. Section 2 describes the theoretical background and the antecedents. Second 3 introduces the data and research method. Section 4 explains the empirical results. Section 5 provides the theoretical contributions and implications. Section 6 summarizes the findings, shows the limitations of this study, and points out future research directions.

2 THEORETICAL BACKGROUND

According to The Global Sustainable Competitiveness Index (2022), GSCI measures country performance, trends, and growth potential based on 190 quantitative indicators, which are further grouped into 6 pillars of natural capital (NC), resource intensity (RI), social capital (SC), intellectual capital (IC), economic sustainability (ES), and governance (G). All the references for these antecedents are discussed below and summarized in Tab. 1.

In the analysis of GSCI, NC reflects a country's ability to sustain the population and economy from now to the future. It represents the given natural environment. NC does not require human activity to build or maintain (Costanza et al., 2017). It is not the result of human activities, and its occurrence is beyond human control (Díaz et al., 2015). NC is clearly important in sustaining human life on earth (Costanza et al., 2017; Díaz et al., 2015; Assessment, 2005), but NC is quickly being depleted (Beddoe et al., 2009). However, empirical evidence demonstrates that natural resources tend to hinder and not promote economic growth (Sachs & Warner, 1997; Sachs & Warner, 2001).

Resource intensity measures the ability to efficiently manage available resources, such as natural, human (AlQershi et al., 2023), and financial capital. RI represents the available resources as a measurement of operational competitiveness. Conventional economic studies suggest that increasing a country's stock of assets provides greater opportunities for economic growth (Bulte et al., 2005). Environmental issues are clearly a worldwide concern (Akram et al., 2022; Al Mashkoor, 2022; Aslam et al., 2024; Bresciani et al., 2023; Garcia-Sanchez et al., 2024; Karamaşa et al., 2021; Karmaker et al., 2023; Ningning & Mengze, 2022; Quttainah &

Ayadi, 2024). Akram et al. (2022) urge that government regulations play a vital role for organizations and industry in regard to better environmental protection and competitiveness.

Tab. 1 - Antecedents and their related literature

Antecedent	References
Natural Capital	Costanza et al. (2017); Díaz et al. (2015); Assessment (2005); Beddoe et al. (2009); Sachs & Warner (1997); Sachs & Warner (2001);
Resource Intensity	Akram et al. (2022); Al Mashkoor (2022); Bresciani et al. (2023); Karamaşa et al. (2021); Ningning & Mengze (2022)
Social Capital	Janjuha-Jivraj (2003); Mishchuk et al. (2023)
Intellectual Capital	Halásková & Bednář (2023); Çetin & Erkisi (2023); Hana (2013)
Economic Sustainability	Alim et al. (2022); Ambec et al. (2002); Doyle & Perez Alaniz (2021); Porter & Van der Linde (1995)
Governance	Nam & Ryu (2023); Fava et al. (2021); Ulman (2014)
GDP per capita	Delgado et al. (2012); Mačiulis et al. (2009); Naomi & Akbar (2021); Jemberu & Dehning (2023)

SC represents the health, security, freedom, equality and life satisfaction that facilitate development. For example, financing, labor, information, and other forms of support are often cited as social capital available to society and business (Janjuha-Jivraj, 2003). Mishchuk et al. (2023) find that countries are highly heterogeneous at the level of social capital development. They also identify that countries with the highest social capital development are also among the leaders in terms of competitiveness and human development. Further, social innovation refers to implementing new solutions to improve the well-being of the environment (Lin et al., 2024).

IC represents the capability to generate wealth and jobs through innovation and value-added industries. Halásková & Bednář (2023) consider innovation performance as a crucial impact of countries' competitiveness. Çetin & Erkisi (2023) confirm that innovation has the highest positive effect on global competitiveness. It is also important for firms to innovate and support an innovative culture to obtain competitive advantage (Hana, 2013).

ES reflects the ability to generate wealth through sustainable economic development. Alim et al. (2022) suggest that the circular economy business model (Ferradás-González et al., 2024) benefits the environment, employees, and regional communities through sustainable business practices. A sustainable economy creates jobs and wealth and encourages the development of new knowledge and technology (Sohail, 2012). Sustainability aims to increase the quality of life by capitalizing upon all existing resources (Manea & Cozea, 2023). Economic development

and sustainability are mutually reinforcing (Porter & van der Linde, 1995; Ambec & Barla, 2002). Sustainable competitiveness is determined by economic prosperity (Doyle & Perez Alaniz, 2021).

Governance always includes serving citizens and creating social value (Sharif et al., 2010). Government efficiency facilitates the effective use of innovative resources and government performance (Huang et al., 2023). As such governance plays a positive moderating role with national competitiveness (Nam & Ryu, 2023). For example, Fava et al. (2021) show how the Italy government promoted the development of a national Bioeconomy Strategy (BIT) and then BIT II to boost its bioeconomy for the sustainability, productivity, and quality of domestic products. The strategies contribute to environmental regeneration, economic growth, and job creation in rural and abandoned areas. Ulman (2014) shows that countries rated as less internationally competitive are perceived to be more corrupt than more competitive countries.

GSCI overall provides a framework for sustainable wealth generation through guidance for resource allocation, infrastructure, market, and employment structure. Hence, in this study, these pillars are the antecedents (dependent variables), and GSCI is the outcome (dependent variable) (The Global Sustainable Competitiveness Index, 2022).

The Global Sustainable Competitiveness Index (2022) acknowledges that GDP is still the most commonly used variable to express the power (total GDP) or the wealth (GDP per capita) of a nation. GDP represents (Delgado et al., 2012) and measures (Mačiulis et al., 2009) a nation's competitiveness, but GSCI does not include GDP in its analysis. However, other studies use GDP as an indicator to analyze sustainability (Jiang et al., 2022; Wang et al., 2022; Welford, 2005). Diaye et al. (2022) show a positive association between sustainability and GDP per capita over the long term. Kang et al. (2016) show that managers in countries with medium to low GDP levels tend to assign less significance to sustainability than those who in high GDP countries. McWilliams & Siegel (2001) provide evidence to support that in countries with a high GDP, sustainability is taken into greater consideration in the managerial decision-making process. Hence, this study includes GDP per capita as one of the antecedents to enrich the analysis for three reasons. First, enhancing competitiveness is a priority for countries seeking to promote economic growth (Jemberu & Dehning, 2023). Hence, GDP relates to GSCI. Second, as mentioned above, GDP is not included in GSCI. Third, this study explores how GDP per capita affects national competitiveness and see how GDP plays a role in GSCI. Hence, this study answers the following questions.

RQ1: Do high GDP per capita countries always exhibit high competitiveness?

RQ2: Do low GDP per capita countries always exhibit low competitiveness?

To examine the causal relationships that lead to high and low GSCI, this study also conducts analysis for both outcomes below, as in Fig. 1:

High GSCI = f(NC, RI, SC, IC, ES, G, GDP per capita)

Low GSCI = f(NC, RI, SC, IC, ES, G, GDP per capita)

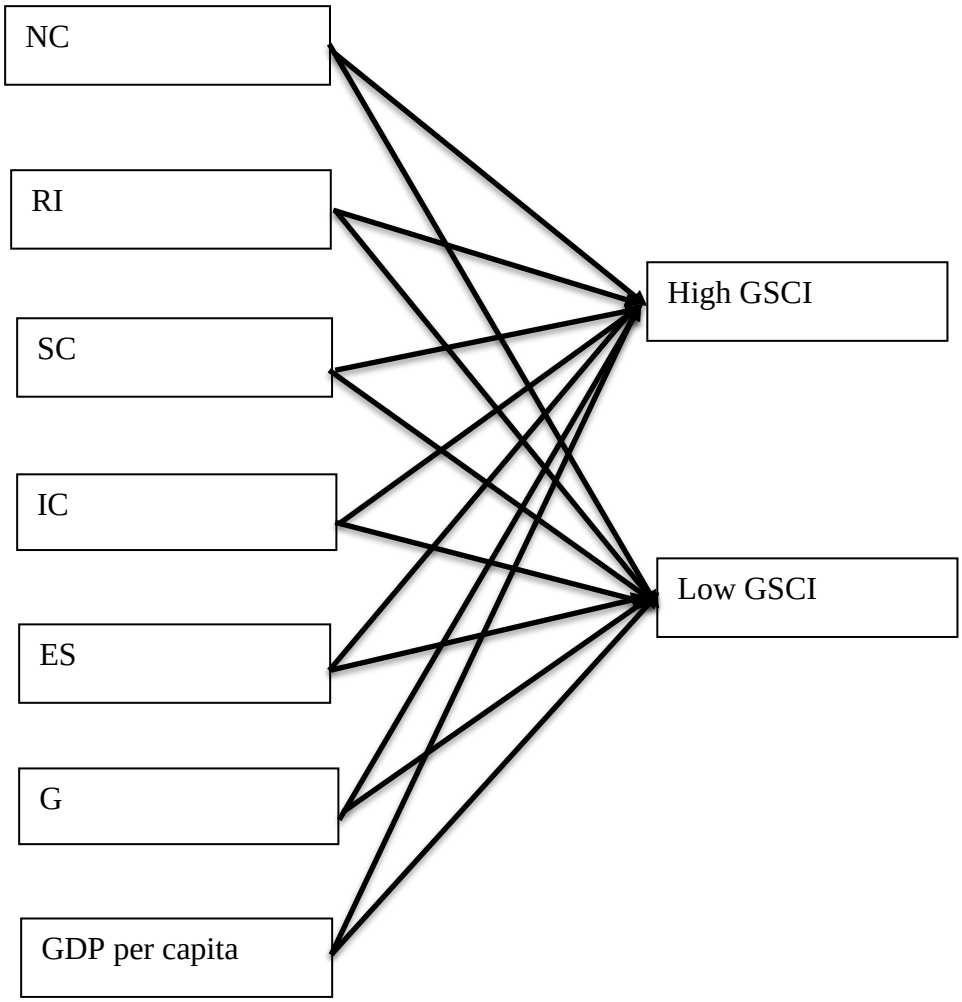

Fig. 1 - Research model.

3 RESEARCH METHODOLOGY AND DATA

3.1 Data

This research uses data from The Global Sustainable Competitiveness Index (2022) and GDP per capita 2022 from the International Monetary Foundation. According to The Global Sustainable Competitiveness Index (2022), GSCI integrates economic and financial indicators and is based purely on comparable and measurable performance data collected by international agencies, such as the World Bank Indicator database, UN agencies (United Nations Development Programme, United Nations Environment Programme, United Nations Children's Fund, Food and Agriculture Organization, World Health Organization, World Meteorological Organization, www.data.un.org), the International Monetary Fund, and other non-governmental organizations (including Transparency International, Reporters without Borders, The New Economics Foundation, The Institute for Economics and Peace, The Fund For Peace, the Joint Global Change Research Institute, the V-Dem Project). GSCI translates these data into a sustainability/competitiveness score based on realistic possible best practice. As a result, sustainable competitiveness can only achieve a perfect score of 100. GSCI mainly

uses quantitative indicators for its measurements, because the qualitative indicators are considered susceptible to manipulation by the evaluators (Okanović et al., 2019).

3.2 fsQCA

Relationships between causes and outcomes can be non-linear with abrupt changes, and so the same cause can, in specific circumstances, produce different outcomes (Urry, 2005). One interesting phenomenon in causal complexity is causal asymmetry, where the causes leading to the presence of an outcome may be quite different from those leading to the absence of the outcome (Ragin 2009). FsQCA is a research methodology that builds a better causal theory (Fiss, 2011). As a result, fsQCA with its complexity theory in business and management presents diversification of disciplines (Fiss, 2007; Rihoux et al., 2013).

The set-theoretic approach of fsQCA uses Boolean algebra to determine the solutions contributing to the outcome (Boswell & Brown, 1999; Ragin, 1987; 2009). FsQCA combines elements of qualitative and quantitative analyses to identify causal relationships in social science, business, and other fields. Unlike traditional statistical methods, fsQCA examines combinations of antecedents that lead to a particular outcome, allowing for more complex and nuanced analysis. FsQCA focuses on the complex and asymmetric relations between the outcome and its antecedents, but regression-based methods examine factors as they compute the net effect between the factors in a model (Pappas & Woodside, 2021). FsQCA is able to identify the different solutions that constitute sufficient conditions for the outcome of interest (Greckhamer et al., 2018; Ordanini et al., 2014). In other words, fsQCA provides various alternative solutions to understand the construct of the outcome (Kraus et al., 2018).

The procedure of fsQCA analysis goes as follows: (1) calibrating data (i.e., transforming observed data into the corresponding fuzzy values), (2) obtaining multiple solutions, and (3) interpreting the results (Pappas & Woodside, 2011). In data calibration, fsQCA computes the degree to which the data belong to a set (Ragin, 2000; Rihoux & Ragin, 2009). Based on the calibrated data, fsQCA identifies how antecedents combine to achieve an outcome.

The literature shows many sustainability-related studies apply fsQCA as a research method to conduct analysis. For example, Huarng & Yu (2024) use fsQCA to evaluate the causal complexity of ESG performance for firms in Taiwan. Multiple causal relationships have been found to explain that different causal combinations can achieve high ESG scores. Yu & Huarng (2024) also employ fsQCA to analyze time series for SDG performance of various countries. The results show multiple relationships for both 2020 and 2021, with some causal relationships appearing similar across the two years. Dabbous et al. (2024) also use fsQCA capture the configurations of the chosen factors that allow countries to achieve sustainability transitions and sustainable competitiveness.

4 EMPIRICAL ANALYSIS

4.1 Basic analysis and calibration

This study conducts descriptive analysis as in Tab. 2, including mean, standard deviation, minimum, maximum, and number of cases. Following Woodside (2013) and Crespo & Crespo (2016), fsQCA calibrates the outcome and the antecedents based on 95th, 50th, and 5th

percentiles of the data. Tab. 3 lists the calibration information. Data above 95th percentile are considered as High, below 5th percentile are Low (the opposite of High), and 50th percentile represents neither High nor Low.

Tab. 2 - Descriptive statistics

Antecedent	Mean	Std. Dev.	Minimum	Maximum	N Cases
GSCI	43.55	6.70	31.71	60.67	168
NC	40.68	8.20	20.00	58.37	168
RI	46.84	8.00	22.77	63.53	168
SC	45.78	8.98	26.59	66.04	168
IC	38.10	13.02	16.14	74.40	168
ES	42.85	7.300	28.27	61.59	168
G	47.04	10.72	19.29	67.18	168
GDP per capita	16668.16	23234.16	310.99	1.266e+05	168

Tab. 3 - Calibration percentiles

Percentiles	GSCI	NC	RI	SC	IC	ES	G	GDP per capita
5th	34.76	28.23	33.27	32.31	19.95	32.09	28.71	638.30
50th	41.83	39.85	47.46	44.90	36.73	41.92	46.97	6593.56
95th	56.26	55.15	59.73	60.33	62.54	55.68	65.29	71757.49

4.2 Truth table analysis

Following Pappas & Woodside (2021), this study conducts truth table analysis, which increases the validity of the findings and strengthens the rigorousness of the process. This study first removes the cases with only 1 occurrence. Next, following Huarng & Yu (2024), this study further sets raw consistency as 0.80, PRI consistency threshold as 0.70, and SYM consistency as 0.70. Afterwards, fsQCA produces the solutions for High and Low GSCI as in Tab. 4 and 5, respectively. In both tables, • and o represent High and Low antecedents, respectively. An empty cell represents the “neither nor” antecedent.

Tab. 4 - Solutions for High GSCI

NC	RI	SC	IC	ES	G	GDP per capita	Raw coverage	Unique coverage	Consistency	Solution number
		●	●	●	●	●	0.6021	0.2845	0.9952	S1
●	○	●	●	●	●		0.3449	0.0273	0.9962	S2
solution coverage: 0.629397 solution consistency: 0.995032										

Tab. 5 - Solutions for Low GSCI

NC	RI	SC	IC	ES	G	GDP per capita	Raw coverage	Unique coverage	Consistency	Solution number
		○	○	○	○	○	0.6603	0.1172	0.9891	S3
○	○			○	○	○	0.4303	0.0243	0.9959	S4
●	○	○	○		○	○	0.3453	0.0109	0.9889	S5
○	●	○	○		○	○	0.4044	0.0170	0.9945	S6
○	○	○	○	○	○		0.3978	0.0134	0.9994	S7
○	○	●	●	○	○		0.2772	0.0091	0.9908	S8
○	○	○	●	●	○	●	0.2079	0.0068	0.9801	S9
○	○	●	○	○	●	●	0.2397	0.0176	0.9766	S10
solution coverage: 0.814355 solution consistency: 0.974049										

The coverage and consistency scores are provided for each solution. Most fsQCA studies consider that solutions are satisfactory if their consistency scores are over 0.8. In this study all the solutions exhibit consistency scores higher than 0.9, showing the data in the solutions to be very consistent.

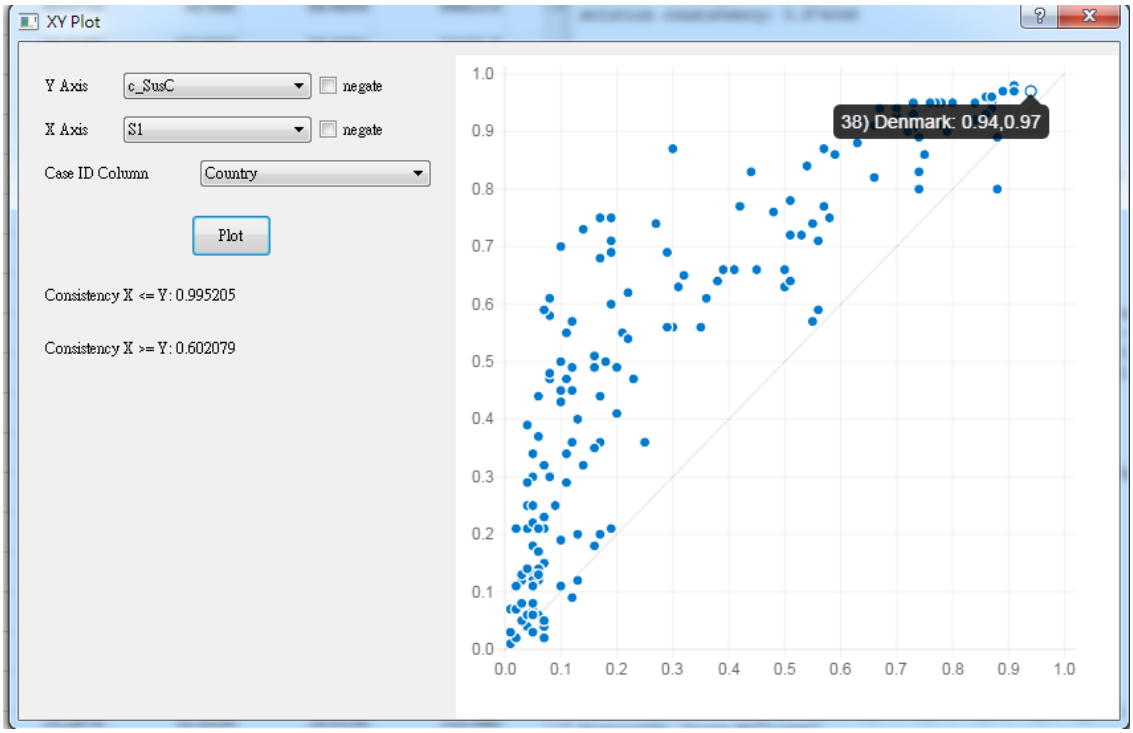

Fig. 2 - Denmark as an example country of solution S1.

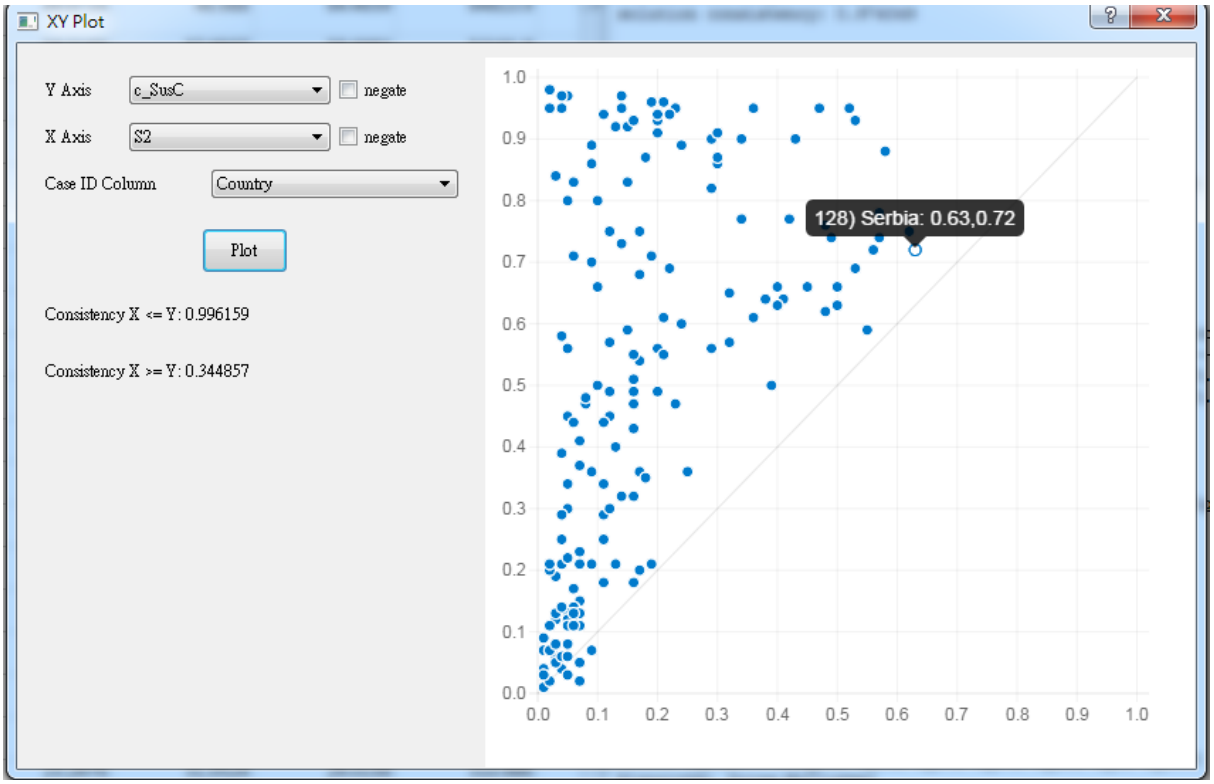

Fig. 3 - Serbia as an example country of solution S2.

For High GSCI, there are two solutions: S1 and S2. The overall solution coverage and consistency at the bottom of Tab. 4 shows satisfactory coverage and consistency, which are 0.629397 and 0.995032. S1 represents High SC AND High IC AND High ES AND High G AND High GDP per capita. S1 indicates that some High GDP per capita countries are high sustainable competitive countries. One example is Denmark, which has High GDP per capita. The XY plot of Denmark appears in Fig. 2.

In S2, GDP per capita becomes a “neither nor” antecedent, representing that some High sustainable competitive countries have neither High nor Low GDP per capita. Fig. 3 shows that Serbia is an example of solution S2.

For Low GSCI, there are eight solutions: from S3 to S10. The bottom of Tab. 5 also exhibits satisfactory coverage and consistency, which are 0.814355 and 0.974049. S3 to S6 are solutions with Low GDP per capita, S9 and S10 are solutions with High GDP per capita, and S7 and S8 are those with GDP per capita neither High nor Low.

5 DISCUSSION

5.1 Theoretical contributions

First, to answer the two research questions in this study, we examine Tab. 4 and 5 together. From Tab. 4, we see that high GDP per capita leads to high competitive countries; however, we also see high GDP per capita leads to low competitive countries in Tab. 5. To answer the first research question, high GDP per capita does not guarantee a high competitive country. On the

other hand, when we examine Tab. 5, we find that low GDP per capita always leads to low competitive countries. Hence, to answer the second research question, low GDP per capita countries always have low competitiveness.

Intuitively, many High antecedents appear in the solutions for High GSCI, but there is still one Low and "neither nor" antecedents in these solutions. On the contrary, most antecedents in the solutions for Low GSCI are Low; however, there are still some High antecedents in these solutions. Hence, the combination of antecedents, instead of single antecedents, affects the outcome. And these antecedents may be High or Low.

Third, the empirical results in this study also demonstrate equifinality. In other words, the combinations of various antecedents can lead to the same outcome. The solutions for both High and Low GSCI consist of various combinations of antecedents. For example, S1 and S2 are different, but both lead to High GSCI. Similarly, solutions from S3 to S10 are different, but lead to the same Low GSCI.

5.2 Theoretical and managerial implications

First, people tend to positively associate GDP per capita with national competitiveness (Delgado et al., 2012). The impact for the drop in GDP per capita for more competitive countries is smaller than in relatively less competitive countries (Podobnik et al., 2012). This study points out that high GDP per capita countries are not always high competitive countries. Conversely, low GDP per capita countries always lead to low competitiveness.

Second, GDP per capita alone is insufficient for measuring national competitiveness (Önsel et al., 2008). This confirms the empirical results in that there are combinations of antecedents leading to high and low national competitiveness.

The combinations of antecedents for high and low national competitiveness provide governments with valuable input to identify country-specific priorities in upgrading overall competitiveness (Delgado et al., 2012). Policy-makers of different countries can follow their own favorite combinations of antecedents (or paths) to lead their countries to high competitiveness.

5.3 Various definitions of national competitiveness

National competitiveness is a complex and multi-faceted concept shaped by a wide range of factors (Mazarr, 2022). Studies conducted across different periods often define national competitiveness according to the priorities of their time. Drawing from elements that influence firm-level competitiveness, Berger (2008) identifies four key factors for national competitiveness: the ability to sell, the ability to earn, the ability to adjust, and the ability to attract. From a productivity-based perspective, Delgado et al. (2012) highlight three drivers of foundational competitiveness: social infrastructure and political institutions, monetary and fiscal policy, and the microeconomic environment. Other studies emphasize factors such as education (Ramoniene & Lanskoronskis, 2011; Verner, 2011), culture (Jin, 2001), etc. Recent research increasingly focuses on the roles of technology (Kim et al., 2023; Sepashvili, 2020; Wang et al., 2007), innovation (Meng, 2005; López-Rubio et al., 2024; Shatalova, 2022), and entrepreneurship (Doan, 2021; Enri-Peiró, et al., 2024; López-Rubio et al., 2024) in enhancing

national competitiveness. However, these definitions generally adopt a productivity-centered approach.

Żmuda (2020), for example, explores the link between competitiveness and sustainability, proposing that these two concepts are not necessarily in conflict. Competitiveness is defined as a nation's ability to achieve developmental goals in a globalized context, which Żmuda divides into two orientations: instrumental (productivity-driven) and fundamental (development without ecological degradation). Consequently, sustainability presents a more comprehensive lens through which to assess national competitiveness.

The adage "Rome was not built in a day" aptly captures the gradual nature of building national competitiveness. With sufficient longitudinal data, analyzing a country's progress over multiple years could offer deeper insights into how improvements in sustainability contribute to competitiveness, providing a potential direction for future research.

6 CONCLUSION

This study employs fsQCA to analyze the complexity of national competitiveness within a sustainability framework. The empirical findings address two key research questions: First, high competitiveness is not exclusive to countries with high GDP per capita; such countries can also exhibit low competitiveness. Second, countries with low GDP per capita consistently demonstrate low competitiveness.

The results show that national competitiveness is shaped by a combination of factors, rather than any single determinant. Furthermore, multiple configurations of these factors can lead to the same outcome—whether high or low competitiveness. This provides policymakers with a range of options to pursue in order to enhance national competitiveness.

Based on these findings, future research on national competitiveness should consider GDP per capita as one of the key antecedents. Different GDP levels may influence a country's ability to achieve competitiveness, aligning with conclusions found in the existing literature.

This study, however, focuses on a single year's data. Future longitudinal research could explore further questions. For instance, comparing results across multiple years could reveal trends or shifts in competitiveness. Additionally, tracking countries as they move between high and low competitiveness could help identify potential causes for these changes.

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Professor Tiffany Hui-Kuang Yu
Department of Public Finance
Feng Chia University, Taiwan, R.O.C.
Email: hkyu@fcu.edu.tw

Professor Kun-Huang Huarng (Corresponding Author)
Department of Creative Technologies and Product Design
National Taipei University of Business, Taiwan, R.O.C.
Email: khhuarng@ntub.edu.tw