Kyiv School of Economics

Master Program in Public Policy and Governance

THESIS

Institutional Contexts and Cultural Drivers of Innovation:

A Global Perspective

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Thesis presented for obtaining the degree of
Master of Public Policy and Governance

Kyiv 2025

Table of content

ABSTRACT

Innovation output is a critical driver of a country's long-term economic growth. While formal institutions and cultural values are frequently mentioned in academic literature as potential contributors to national innovation performance, their joint impact remains underexplored. This study investigates how combinations of formal (e.g., government effectiveness, regulatory quality, and rule of law) and informal (e.g., secular and self-expression values) institutions influence national innovation output. Using fuzzy-set Qualitative Comparative Analysis on a sample of 53 countries, the research identifies multiple configurations that lead to both high and low scores in the innovation output of a country. Control variables include gross domestic products, foreign direct investments, and the share of skilled labor. The findings suggest that strong formal institutions are a necessary but not sufficient condition for high innovation, while cultural openness and rationality can simultaneously complement and substitute institutional gaps in specific contexts. The analysis also shows that economic factors alone do not lead to innovation in the absence of supportive institutional or cultural environments. These results contribute to a more nuanced understanding of innovation systems and provide evidence-based recommendations for policy design in transitional economies.

Keywords: innovation, institutional economics, formal and informal institutions, fsQCA, GII (Global Innovation Index), self-expression values, secular values.

Word count: 8901

INTRODUCTION

According to neoclassical theory, innovation activity is one of the key factors of economic growth alongside labor and capital (Arrow, 1972). A country's productive capacity highly depends on the ability of national enterprises to innovate - through developing new products or upgrading the existing operations (Porter, 1990). Countries that fail to establish environments conducive to innovation not only fall behind in overall prosperity but also face the risk of political instability and diverse social problems (OECD, 2015).

Among the key factors contributing to fostering innovation, cultural and institutional frameworks have been recognized as crucial. Despite this recognition, several challenges persist in this area of analysis. One significant issue stems from inconsistencies in measuring innovation. Specifically, there is uncertainty about whether financial or non-financial indicators should be used to assess the intensity and effectiveness of innovation processes within a country. In particular, severe criticism is directed to the overuse of spending on innovation as a conventional approach in approximating innovation intensity. As Mazzucato (2013, pp. 46–47) rightly demonstrates, even though the Soviet Union's spending on space and military technologies was twice that of Japan, its innovation output was twice as low compared to Japan.

Similarly, culture presents an abstract concept that cannot be directly measured, further complicating the estimation of how it can affect a country's tendency to innovate. Many studies show that open societies with lower power distance and uncertainty avoidance, supported by strong institutions, tend to produce higher innovation output (Kaasa and Vadi, 2010; Espig et. al., 2021). However, alternative models for operationalizing culture, such as Gelfand's tightness-looseness index and Inglehart and Baker's values model, which could potentially offer additional perspectives, are still rarely considered in such research.

Lastly, formal institutions are only seldomly included in research as a factor influencing a country's innovation capacity. Rule of law, deregulated economy, business support policies and competitive higher education facilities are considered to be important predictors that can stimulate economic productivity of firms and the state (North et al, 1990; Acemoglu et al, 2014). However, to the author's best knowledge, the direct impact that formal institutions may have on the innovation output was not the scope of scholarly rigorous analysis.

Accordingly, this study will examine the influence of both formal institutions and culture (as informal institutions) on a country's innovation capacity. The primary contribution of this study is twofold. On one hand, I expand the existing analysis by introducing new approaches to operationalizing culture and innovations. On the other

hand, I will analyse the joint impact of formal and informal institutions on a country's innovativeness to understand the level of interchangeability of these factors.

Additionally, the received outcome will be used for identifying and formulating the policy tools most suitable for the government to employ in fostering innovation development for the specific case of Ukraine. As a nation with limited formal institutional capacity and a culture shaped by Soviet legacy, Ukraine is characterized by relatively poor quality of both formal institutions and culture. Hence, this research will propose priority policy areas to enhance innovation capacity, contributing to sustainable and resilient recovery.

LITERATURE REVIEW

Scholars consistently attempt to explain the innovation capacity of the state through an institutional approach, by viewing the innovation output of the enterprise as a function of the existing institutional frameworks. Literature primarily employs two approaches to analyze the institutional impact on innovation. The first considers informal institutions, defined as non-regulated common practices, dominated as a behavior pattern in a particular society that on a national level is usually limited to a country's cultural features. The second approach focuses on formal institutions defined as established rules, laws, and organizations created to regulate and structure interactions in a society.

Regarding the first approach, the most commonly used practice is to utilize Hofstede's cultural dimensions to operationalize culture, including — power distance, uncertainty avoidance, individualism versus collectivism, masculinity versus femininity, indulgence versus restraint and short-term orientation versus long-term orientation (Hofstede, 2003). A significant number of evidence demonstrates that more open societies, with shorter power distance, less uncertainty, shared femininity, indulgence and individualism, have better innovation capacity (Kaasa and Vadi, 2010; Espig et. al., 2021). However, the strength of these relationships differs across studies depending on the sample size and composition or depending on the methodology used for the analysis.

For instance, analyzing twenty European countries from a regional perspective and using the data from the European Social Survey, Kaasa and Vadi (2010) show that there is a very strong correlation between innovation and power distance, uncertainty avoidance, family-related collectivism, and lower-than-average masculinity. Espig (2021) provides identical findings by expanding the sample to 71 countries and using the Global Innovation Index, as a measurement of the innovativeness of the country.

Alternative measures of culture provide very similar results. Nyssen and Deckert (2021) analyze how seven cultural dimensions — communicating, evaluating, leading, deciding, trusting, disagreeing, and scheduling — impact the innovation output of the country. Their analysis shows that consensual decision-making, task-based trust, and structured time management contribute to national innovativeness. Furthermore, Deckert and Schomaker (2022) suggest that cultural tightness — in the sense of homogenous and intolerant societies — has a negative link to national innovativeness, while cultural looseness — in the sense of tolerant and diverse societies — displays a positive impact on innovation. Overall, their results indicate that more diversity and openness in a society have a positive impact on national innovativeness (Deckert and Schomaker, 2022). The measure of culture, often used in public discussion in Ukraine, is also provided by Inglehart and Baker (2000) and captures values of survivalism/self-expression and traditionalism/secularism. However, no research has been conducted to estimate their effects on the innovation capacity of a country.

At the same time, several studies failed to detect any significant relationship between cultural indexes and innovation. For instance, Andrijauskienė and Dumčiuvienė (2021) while applying regression analysis to the European Union member states (excluding Cyprus) did not find any evidence that masculinity and long-term orientation influence national innovation performance. In doing so, they used the Summary Innovation Index from the European Innovation Scoreboard as their dependent variable (Andrijauskienė and Dumčiuvienė, 2021).

On the other hand, scholars argue that formal institutions are more important than culture for innovation to flourish. Formal institutions, including property rights, business freedom, fiscal freedom, and labor freedom are assumed to contribute to the development of "opportunity entrepreneurship" defined as the result of voluntary activity to launch a firm having identified good business opportunities (Fuentelsaz et. al, 2015). As such, each innovation activity within a firm should be interpreted as a manifestation of entrepreneurship opportunity. Yet, drawing a solid conclusion on the impact of formal institutions on innovation capacity only through generalized research on entrepreneurship is impossible.

Yet, many studies report evidence of a positive relationship between innovation and formal institutions. For instance, Roxas and Chadee (2011) analyze the impact of formal institutions on innovation capacity by using data from a survey of 900 small and medium enterprises in the Philippines. They found that formal institutions significantly impact firm innovativeness, with the rule of law being the most influential factor (Roxas and Chadee, 2011). Webb (2019) tried to conceptualize how formal and informal institutional voids interact to shape the form of entrepreneurship. Following that, Saka-Helmhout, Chappin and Vermeulen (2020) conducted a quantitative survey of firms in Ghana, Kenya, Tanzania, and Uganda in order to explore the complementary impact of formal and informal institutions on innovation productivity. They argue that even in the context of weak formal institutions, firms with high human capital and managerial experience can achieve innovation by leveraging informal networks. Nonetheless, these results, as the authors state, may be biased by self-reported innovation measures and limited proxies for firm resources and informal institutions (Saka-Helmhout et al., 2020). Also, generalizing the experience of the Philippines or Sub-Saharan Africa to other countries may be inappropriate, further limiting the validity of these findings.

In summary, scholars recognize that innovation capacity is a key driver of economic growth, shaped by both cultural and institutional frameworks. In spite of the wealth of empirical evidence supporting this view, the majority of studies possess two major drawbacks in common. First, they use a very narrow approach to measure innovations. Their operationalisation of innovation output is primarily limited to the number of patents issued, which does not allow us to understand the real economic output of the innovation. Issued patents do not necessarily mean commercialization, resulting in high profits for a firm or scientific institution. Using the results of the Global

Innovation Index as an operationalisation of innovation capacity should be considered as a more appropriate way for measuring innovation output, as it offers a particular focus on innovation output rather than general index results.

Second, culture is closely linked to formal institutions. Hence, if not analyzing them jointly in the model of innovation, we cannot estimate their individual impacts or understand their substitutional effects. Many countries experience voids either in the formal institutional frameworks or in informal values. Analyzing the combinations of cultural and institutional conditions that could still allow these countries to innovate can provide useful insights.

In this regard, the current paper attempts to answer the following research question:

To what extent do formal and informal institutions influence a country's innovation output?

The research objective is to find out what specific cultural attributes and formal institutions in the country contribute to the growth of the national innovation output.

Therefore, this study fills the gap in existing studies by proposing a new approach to measuring innovation capacity and analyzing the joint impact of both formal and informal institutions on innovation. Results of the study received on a sample of both developed and developing countries should serve as a basis for developing policy recommendations for the Ukrainian government on how to stimulate innovation output in the country for robust and sustainable recovery.

ANALYTICAL FRAMEWORK

Research uses various measures to analyze innovation, such as spending on R&D, the number of researchers, innovation infrastructure, etc. Those indicators may demonstrate how much a firm or a country spends on doing innovation without, however, accounting for practical benefits or outcomes from this activity. Therefore, in this research, innovation is assumed to be determined by three factors: knowledge creation, knowledge impact, and knowledge diffusion, as suggested by Kwan and Chiu (2015).

In general, innovation output is the product of skilled labor and resources allocated to the labor to conduct research and development (Aghion, 1990). We can scale it to the level of a country deriving innovation output function from Gross Domestic Product and skilled labor supply with no other factor impacting this process.

However, this conventional economic innovation model cannot explain the variation in innovation output across countries. For instance, even if India's population is approximately 27,5% bigger than in South Korea, their innovation performance differs in the opposite way according to WIPO. South Korea is ranked 6th in Global Innovation Index 2024 while India has only a 40th place. Considering the above argument, this research augments the conventional economic innovation model with the institutional theory of innovation. Institutional theory can provide us with “a theoretical lens through which scholars can examine the effects of the social context on the process of innovation” (Perkmann and Phillips, 2024). Previous studies allow us to derive different factors such as formal and informal institutions that impact the innovation capacity of the country. In institutional economics, an "institution" refers to the rules, norms, and conventions that shape human interaction and economic behavior (North, 1990). While depicting both formal and informal institutions, North argues that institutions determine the incentives and constraints faced by economic actors and states, with well-functioning institutions promoting investment and innovation (North, 1990).

Following North`s argument, we can distinguish among several types of formal institutions that may potentially impact innovation development and, hence, the innovation output: the rule of law, market openness, protection of property rights, and state regulation efficiency.

The rule of law refers to the ability of the state to organize economic exchange in society in a calculable and rationally justified manner (Böhm, 1989). As such, the rule of law is viewed as a foundational aspect of a market economy, as it creates a predictable and transparent environment for economic activity. It ensures that interactions between economic actors are governed by clear, enforceable rules, reducing uncertainty and transaction costs. Additionally, a low level of corruption and an effective judicial system should supplement the effective rule of law to maintain trust and ensure that innovators

can reap the rewards of their efforts. In this context, the rule of law creates a stable and conducive framework for individuals to invest in and undertake innovative activities.

Market openness is an additional determinant of innovation, as it facilitates access to both domestic and international markets for goods, services, and investments. It allows firms to engage in trade, attract foreign direct investments, and invest in new technologies, fostering an environment, where competition and collaboration drive innovation. While Adam Smith's laissez-faire philosophy emphasizes minimal state intervention, market openness does not preclude the need for institutional frameworks that ensure fair competition and protect market participants (Smith, 1776). By creating opportunities for resource flow and knowledge exchange, market openness encourages firms to innovate to remain competitive in a globalized economy.

Protection of property rights allows entrepreneurs to feel secure about their investments. Hernando de Soto suggests that a lack of well-defined and universally recognized property rights hampers economic development, pointing out that in many developing countries, unclear property rights prevent individuals from leveraging their assets for economic gain, which may stifle entrepreneurship and growth (De Soto, 1984). Well-defined and enforced intellectual property rights are especially critical for innovative enterprises to protect their innovations and provide incentives for research and development.

Regulatory efficiency balances the need for state intervention in addressing market failures with the principles of economic freedom. Innovation, often viewed as a positive externality, benefits from targeted support mechanisms, such as subsidies, tax incentives, and public investment in research and development. At the same time, overly complex or burdensome regulations can stifle creativity and entrepreneurship. Regulatory efficiency ensures that government policies stabilize markets, correct market failures, and foster innovation without imposing excessive constraints. By providing the right mix of support and freedom, a state can create an enabling environment where innovation becomes both economically viable and socially beneficial, fostering positive externalities (Barbaroux, 2014).

For this research, a distinction between different types of formal institutions is not necessary as they are self-reenforcing. Aoki argues that formal institutions do not operate in isolation; instead, their collective impact is shaped by their interactions and mutual reinforcement (2001). For example, strong property rights may be more effective in promoting investment and innovation when coupled with an efficient judicial system, the core of the rule of law, that enforces contracts. Therefore, mutually reinforcing formal institutions would have a cumulative effect on the country's innovation output.

Additionally, institutional indexes show a strong correlation in their development, indicating that a country's institutions tend to be either broadly of high quality or uniformly weak. This is because economic institutions — regardless of their

specific nature — are shaped and influenced by the political domain. Therefore, if a country's political institutions are inclusive, accountable, and transparent, they are more likely to give rise to well-functioning economic institutions. Conversely, poor political systems often produce inefficient or corrupt economic institutions of any kind.

H1: Stronger formal institutions are expected to enhance the country's innovation output.

Culture constitutes the second group of independent variables to measure the impact of informal institutions on innovation capacity. Hofstede (2003) defines culture as a patterned way of thinking, inherent to a group of people. In considering culture, we limit cultural determinants to two patterns of thinking that are dominant for a certain nation — values of self-expression and rationality (Inglehart and Welzel, 2005).

Self-expression values are closely associated with openness, creativity, and individual agency, which are vital drivers of innovation. They emphasize autonomy, diversity, and freedom of thought, creating an environment where individuals feel empowered to challenge the status quo and explore new ideas. Societies that embrace self-expression values often foster educational systems, cultural norms, and social policies that encourage critical thinking and problem-solving skills, both of which are foundational for innovation. Moreover, individuals in such societies are more likely to take risks and engage in entrepreneurial activities, contributing to a dynamic and innovative economy. Lastly, by promoting inclusivity and collaboration, self-expression values can also enhance the potential for interdisciplinary and cross-sectoral innovations.

H2: Stronger self-expression values within society are expected to enhance the country's innovation output.

In addition to self-expression values, secular values prioritize rationality, evidence-based decision-making, and a forward-looking approach to societal development. These values often underpin the institutional and cultural frameworks that encourage scientific inquiry and technological progress. In societies where secular values are dominant, public and private institutions tend to invest heavily in education, research, and development, providing a strong foundation for innovation. Rationality as a guiding principle reduces reliance on traditional or dogmatic approaches, opening pathways for creative solutions and groundbreaking discoveries. Furthermore, secular societies are more likely to embrace modernization, globalization, and technological advancements, all of which are essential components of a high-performing innovation ecosystem.

H3: Stronger secular values within society are expected to enhance the country's innovation output.

Formal and informal institutions can be considered collinear. Godlewska (2021) states that the interplay between formal and informal institutions has an impact on economic processes as informal institutions may either support or undermine formal institutions. For instance, self-expression values can promote market openness by encouraging individuals to pursue entrepreneurial endeavors and establish their own businesses. Conversely, a poor rule of law, which undermines the protection of fundamental human rights, including property rights and personal security, drives societies toward prioritizing survival and security values.

This suggests that one needs to abandon the analysis of individual institutional effects. Instead, it is necessary to define all the possible combinations of formal and informal institutions that can lead to high innovation. Specifically, this study argues that the two types of institutions are mutually reinforcing and, hence, their positive impact on innovation goes beyond a simple sum of individual effects by producing a combined influence.

H4: Culture and formal institutions have a joint impact on the country's innovation output.

RESEARCH DESIGN

This research uses a hypothesis-testing approach to examine how combinations of formal and informal institutions — rather than their individual effects — influence national innovativeness.

Dependent variable

The dependent variable in this research is the innovation output operationalized through the indicator of a country's innovation output sourced from the Global Innovation Index and provided by the World Intellectual Property Organisation (2025). Opposite to most of the research in the field, this paper uses specifically innovation output subindex rather than the general score of the country in GII. As noted in the introduction, comparing Japan and the Soviet Union shows that high R&D spending or strong innovation infrastructure doesn't always lead to high returns from innovation. The innovation output in GII measures the results of innovation activities within the economy and is composed of two pillars: knowledge and technology outputs and creative outputs (WIPO, 2025).

Independent variables

Formal institutions are operationalised through institutional indexes sourced from the Worldwide Governance Indicators. The WGI is an annually updated index, composed by the World Bank through existing data sources produced by over 30 think-tanks in the world (World Bank, 2025). The WGI defines good governance through six dimensions: voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, rule of law, and corruption control. Taking into consideration the economic policy perspective of this research, the formal institution variable is constructed as the arithmetic mean of the three dimensions of the WGI - government effectiveness, regulatory quality, and rule of law.

The cultural dimension of the nation was captured through self-expression and secular values developed by Inglehart and Welzel and sourced from the World Value Survey. The 7th wave has been used covering 66 countries across the world while utilizing a standardized survey questionnaire. The minimum sample size for most of the countries was 1200 respondents, guaranteeing high levels of representation and low levels of standard deviation (Haerpfer et al, 2022).

To cover both hypotheses 2 and 3, two different cultural variables are employed in the analysis. The first variable measures the overall secular to traditional values in a country comprising defiance, disbelief, relativism, and skepticism based on the average responses of the respondents. The second variable measures the overall level of emancipation and self-expression in a country comprising a person's perception of

autonomy, equality, choice and voice opportunities based on the average responses of the respondents.

Control variables

To account for alternative explanations and isolate the effect of formal institutions and cultural dimensions on innovation output, three control variables are included in the analysis. Control variables are selected based on the classical theory of innovation that accounts for money and human capital engaged in innovation activity. First, logged gross domestic product GDP is used to control the overall economic development of a country, as wealthier nations tend to have more resources available for innovative activities. Second, logged foreign direct investment (FDI) is included to capture the potential impact of international capital flows on innovation output. Third, the supply of skilled labor is utilized to capture the availability of human capital necessary for innovation, measured by the share of the labor force with tertiary education or equivalent qualifications. All three variables are sourced from the World Bank Open Data online resource (2025).

Table 1. Descriptive statistics for the key variables used in the analysis

Variable	N	Mean	St. Dev.	Min	Max	Threshold used for calibration		
						Low	Ambiguity	High
GII	53	28.221	11.973	10.300	56.483	16.22	24.14	42.52
Formal institutions	53	0.168	0.923	-1.338	2.083	-0.97	-0.11	1.77
Secular values	53	0.361	0.095	0.174	0.569	0.21	0.37	0.52
Self-expression values	53	0.430	0.111	0.237	0.676	0.28	0.41	0.65
Skilled labor	53	75.494	7.486	54.513	91.613	69.11	76.16	82.31
GDP logged	53	26.264	1.659	22.767	30.634	23.58	26.28	28.82
FDI logged	53	22.452	1.833	18.224	26.418	19.12	22.71	25.38

Table 1 summarizes descriptive statistics for all the variables used in the analysis. The Global Innovation Index (GII), exhibits considerable variation among nations, suggesting notable cross-national differences in innovation capacity in the sample. Similarly, formal institutional indicators demonstrate a high level of dispersion, with both strongly negative and strongly positive scores for some countries present. This variability supports the assumption that formal institutional quality might act as a key differentiator in national innovation outcomes. Comparatively, both secular and self-

expression values indicators, comprising the impact of informal institutions, are more equally distributed, meaning that cultural norms change more universally across countries than formal institutional structures.

Analytical strategy

The sample used for this study includes only those countries for which complete data were available across all indicators selected for the analysis. This includes the independent variables (formal institutions and cultural dimensions), the dependent variable (innovation output), and the control variables (logged GDP, logged FDI, and supply of skilled labor). Countries with missing data in any of these categories were excluded to ensure consistency and comparability in the statistical analysis. As a result, the final sample comprises 53 countries, representing a diverse range of geographical conditions, economic development levels, and cultural contexts.

In terms of temporal structure, the dataset combines variables coming from relatively similar periods. To eliminate the effects of crises or business cycles, the indicators are averaged over a six-year period of time, where possible. In particular, institutional variables, as well as control indicators, are constructed as arithmetic means of annual data from 2017 to 2022.

By contrast, cultural indicators sourced from the World Values Survey reflect a single year of measurement per country within the 2017–2022 timeframe, corresponding to the wave in which the survey was conducted in that specific country. This does not contradict the purpose of the analysis as culture is widely recognized to be one of the most stable political and societal characteristics of a country, typically changing more slowly than formal institutional arrangements (Fukuyama, 1995).

Table 2 provides a correlation matrix for all the variables included in the analysis. The results demonstrate a high level of correlation between dependent and independent variables suggesting a particularly strong connection of GII with formal institutions and self-expression values. Additionally, correlations point out a medium level of connection between GII and finance-related control variables (logged GDP and logged FDI), suggesting that the relationship between innovation output and a country's economic performance should be carefully examined further.

Moreover, the matrix also shows a high level of correlation between explanatory variables, predominantly between formal institutions and self-expression values. These strong associations suggest that it may be difficult to isolate the individual effect of each variable on innovation outcomes in a regression-based framework.

To overcome a potential problem of multicollinearity, this study applies fuzzy set Qualitative Comparative Analysis (fsQCA) as the central analytical method. Rather than isolating the net effect of individual variables, fsQCA allows for the exploration of how different combinations of institutional and cultural factors jointly contribute to national innovation outcomes (Berg-Schlosser et al. 2009, Thoman 2018). This approach is

particularly useful for public policy analysis as it aligns with the understanding that socio-political phenomena — in this case institutional performance and cultural embeddedness — rarely act in isolation. Instead, they operate within broader systemic configurations and can have an overlapping or complementary effect on the innovation output of the country.

Table 2. Correlation matrix

	GII	Formal institutions	Secular values	Self-expression values	Skilled labor	GDP (logged)	FDI (logged)
GII	1.000	0.866	0.557	0.729	0.141	0.556	0.664
Formal institutions	0.866	1.000	0.494	0.781	0.324	0.470	0.693
Secular values	0.557	0.494	1.000	0.647	0.186	0.185	0.367
Self-expression values	0.729	0.781	0.647	1.000	0.361	0.461	0.585
Skilled labor	0.141	0.324	0.186	0.361	1.000	0.065	0.292
GDP (logged)	0.556	0.470	0.185	0.461	0.065	1.000	0.788
FDI (logged)	0.664	0.693	0.367	0.585	0.292	0.788	1.000

An additional advantage of fsQCA is that it captures variation in a more detailed way than binary methods by allowing a partial membership. Instead of classifying conditions as simply "present" or "absent," fsQCA uses scores between 0 and 1 to represent degrees of presence (Thoman 2018). This allows the analysis to reflect the fact that institutional quality and cultural values often exist along a spectrum, rather than as clear-cut categories. As a result, fsQCA is well-suited for studying the complex interactions between formal and informal institutions in how they shape innovation systems.

Lastly, QCA, unlike other statistical methods, explicitly accounts for causal asymmetry, meaning that the factors leading to high levels of innovativeness are not simply the inverse of those leading to low innovativeness. As a result, different combinations of conditions may drive positive versus negative outcomes. This allows the analysis to capture the complex and non-linear nature of causality, where multiple, distinct pathways can lead to the same outcome (equifinality), and the absence of a

condition does not necessarily imply the opposite effect. Such an approach is particularly valuable in understanding the multifaceted institutional influences behind national innovativeness.

To use fsQCA, calibration of the above variables was performed. In fsQCA, calibration is the process of transforming raw data into set membership scores that reflect the extent to which a case (in this study, a country) belongs to a specific conceptual set. Calibration is essential because fsQCA operates not on raw variables but on qualitative set memberships ranging from full non-membership to full membership, with a qualitative crossover point at the middle where the case indicates maximum ambiguity, being neither more in nor more out of the set (Ragin, 2008). As the majority of the variables in this research are ratio variables, not necessarily being normally distributed, the 80th percentile is used as an anchor for the full membership, the 50th percentile — as the crossover point, and the 20th percentile — as an anchor for the full non-membership. The anchor values for each variable are reported in Table 1.

This study estimates both a conservative and an intermediate model using fsQCA. The conservative model identifies only those configurations of conditions that are strongly and unambiguously linked to the outcome, ensuring a high degree of certainty. In contrast, the intermediate model allows for more theoretical guidance and considers plausible simplifying assumptions, enabling the inclusion of additional configurations that may be relevant but less strictly supported by the data alone. This dual approach provides a more nuanced understanding of how combinations of institutional and cultural factors contribute to national innovativeness

Model selection is guided primarily by two key criteria central to QCA: consistency and coverage. Consistency measures the degree to which a given combination of conditions reliably leads to the outcome, reflecting the strength of the causal relationship. Coverage, on the other hand, assesses the extent to which a configuration explains instances of the outcome, indicating its empirical relevance. Together, these criteria help identify the most robust and meaningful configurations, ensuring that the selected models are both theoretically sound and empirically supported.

RESULTS

I begin the empirical investigation by performing a necessity analysis. Its main objective is to identify all the variables that are necessary for achieving either a high or a low level of Global Innovation Index output. According to Schneider and Wagemann (2012), the condition or factor can be proclaimed as necessary, if its consistency score exceeds 0.9 and its coverage score exceeds 0.6.

Table 3. Results of the Necessity Analysis

Conditions	High GII		Low GII (~GII)	
	Consistency	Coverage	Consistency	Coverage
Formal institutions	0.855	0.877	0.449	0.432
~ Formal institutions	0.446	0.463	0.872	0.849
Self-expression values	0.770	0.809	0.409	0.482
~ Self-expression values	0.507	0.515	0.806	0.766
Secular values	0.730	0.789	0.467	0.473
~ Secular values	0.513	0.507	0.792	0.733
Skilled labor	0.590	0.607	0.562	0.542
~ Skilled labor	0.555	0.575	0.593	0.575
GPD logged	0.728	0.753	0.512	0.496
~ GPD logged	0.514	0.529	0.746	0.720
FDI logged	0.758	0.804	0.473	0.470
~ FDI logged	0.500	0.503	0.803	0.757

The results of the necessity analysis, presented in Table 4, show that none of the conditions meet the above-mentioned thresholds, meaning that none of the selected conditions are strictly necessary for high or low innovation output of the country.

Nonetheless, some of them can still be considered as necessary if reducing the threshold to 0.80. For instance, well-developed formal institutions and widespread self-expression values in the country usually accompany high innovation output with acceptable levels of coverage. Similarly, the absence of formal institutions or self-expression values is identified as a necessary condition for low levels of innovativeness. Also, low levels of FDI can be viewed as a necessary condition for low levels of GII.

Building on these findings, we move to the sufficiency analysis of the conditions, under which countries demonstrate either high or low innovation output. In doing so, both conservative and intermediate models are estimated separately for high and low levels of GII.

Table 4. Results of the sufficiency analysis for high GII

	Configurations for Conservative Solution								Configurations for Intermediate Solution		
	1	2	3	4	5	6	7	8	1	2	3
Formal institutions	●	●	●	●	●			○	●		
Self-expression values	●		○	●		●	●	○		●	
Secular values			○	●	○	●	●	●		●	●
Skilled labor	●	●			○	○	●	○		○	
GDP logged	○	●	●	●	○	○	●	●			●
FDI logged		●	●	●	○	○	●	●			●
Consistency	0.851	0.887	0.838	0.938	0.829	0.835	0.890	0.865	0.877	0.886	0.887
PRI	0.689	0.811	0.530	0.894	0.362	0.573	0.810	0.434	0.815	0.785	0.814
Solution Coverage	0.319	0.439	0.290	0.508	0.222	0.248	0.398	0.192	0.855	0.390	0.547
Unique coverage	0.040	0.020	0.019	0.071	0.038	0.042	0.006	0.014	0.287	0.018	0.014
Overall solution consistency				0.841						0.835	
Overall solution coverage				0.763						0.903	

Notes: The black circles (●) denote the presence of a condition, while the empty circle (○) indicates the absence of a condition; empty cells indicate a "does not matter" situation in which the condition may be either present or absent. Every column represents a separate configuration of conditions meeting sufficiency criteria. All the configurations should be combined in one solution with the logical "AND."

Table 4 summarizes fsQCA results for conservative and intermediate solutions that lead to high GII output. Notably, formal institutions appear as a primary condition in most configurations, emphasizing their central role across cases. Their presence is particularly consistent in the conservative solutions in Configurations 1–5, supporting the idea that strong rule-based systems, including its constituting parts such as market openness, rule of law, and protection of private property rights, are necessary and sufficient for innovation success in any country.

Interestingly, self-expression and secular values — representing informal institutions — also feature prominently but more selectively across configurations. Self-expression values are present in Configurations 1, 4, 6, and 7, while secular values appear in Configurations 4, 6, 7, and 8 of the conservative solutions. This suggests that cultural norms promoting autonomy and rationality in society can substitute or reinforce formal institutions to generate high GII under certain conditions - usually high levels of GDP and FDI.

Table 5. Results of the sufficiency analysis for low GII

	Configurations for Conservative Solution							Configurations for Intermediate Solution		
	1	2	3	4	5	6	7	1	2	3
Formal institutions	○	○			○	○	●	○		
Self-expression values	○		○		○	●	●		○	
Secular values	○	●	○	○			○		○	○
Skilled labor				○	○	●				
GDP logged		○	●	○	●	●	○			
FDI logged	○	○	●	○	●	●	○			○
Consistency	0.926	0.874	0.815	0.904	0.881	0.854	0.821	0.849	0.818	0.841
PRI	0.875	0.703	0.591	0.826	0.652	0.604	0.418	0.772	0.727	0.749
Solution Coverage	0.625	0.382	0.363	0.446	0.272	0.263	0.278	0.872	0.733	0.680
Unique coverage	0.088	0.038	0.021	0.020	0.008	0.021	0.012	0.158	0.020	0.018
Overall solution consistency				0.777					0.769	
Overall solution coverage				0.798					0.928	

Notes: The black circles (●) denote the presence of a condition, while the empty circle (○) indicates the absence of a condition; empty cells indicate a "does not matter" situation in which the condition may be either present or absent. Every column represents a separate configuration of conditions meeting sufficiency criteria. All the configurations should be combined in one solution with the logical "AND."

The result also demonstrates that the presence of economic factors, in this research conceptualized as logged GDP and FDI, supports formal and informal institutions in producing innovation output in the country, as those factors are part of the equation in configurations 2-4 and 6-8. However, economic factors alone are never sufficient to achieve high GII as they should be supplemented with either formal or informal institutions in any Configuration both for conservative and intermediate solutions.

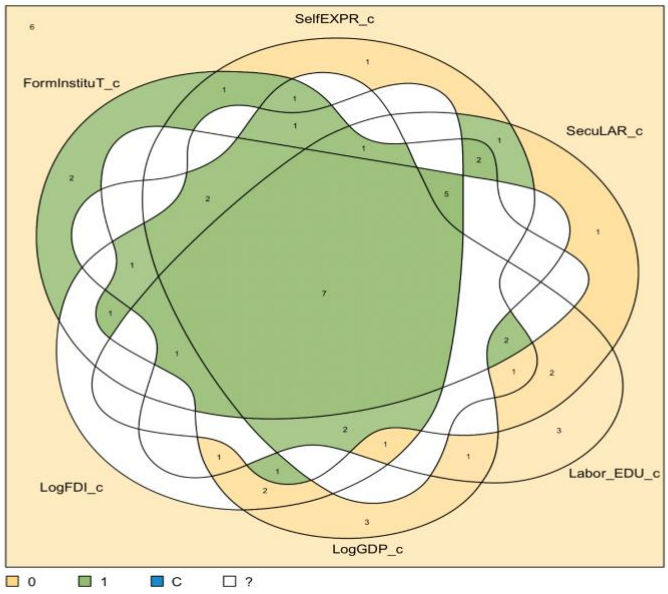
To get a better understanding of the innovation output phenomenon, a sufficiency analysis has also been implemented for the low GII. Its main objective is to understand the absence of which factors would have a significant negative impact on the countries` innovation output. In the conservative solution, the absence of formal institutions appears as a core condition in five out of seven configurations, confirming the critical role that weak institutional quality plays in suppressing innovation. Additionally, the absence of informal institutions emerges repeatedly in most configurations leading to low GII. These results suggest that both weak formal structures and restrictive cultural norms can independently or jointly hinder a country's innovative potential.

Turning to our control variables, the fsQCA results prove that classical economic theory cannot fully explain the innovation growth or decline of the country. They support the notion that economic prosperity alone is not sufficient to drive innovation if institutional and cultural support is lacking. Configurations 3, 5 and 6 where FDI and GDP are included lead to low GII because of the absence of formal and informal institutions.

Overall, the analysis shows that most of the cases leading to high innovation lie at the intersection of formal institutions, self-expression values, and economic factors (GDP and FDI), with several configurations also including secular values. The graph (see Graph 1) also reinforces the idea that no single factor is sufficient on its own to achieve high GII for the country. Similar conclusions can be drawn from the results for the low GII.

Therefore, fsQCA analysis supports all the formulated hypotheses. In particular, formal institutions are a necessary and sufficient condition for innovativeness, which is commensurate with Hypothesis 1. Similarly, cultural values in both forms are associated with both low and high GII, which is in line with Hypothesis 2 and Hypothesis 3. Finally, the finding suggesting that both formal and informal institutions have a joint impact on the country’s innovation output supports Hypothesis 4.

Graph 1. Venn diagram of the fsQCA results



CONCLUSIONS

The main purpose of this study is to explore the influence of formal and informal institutions on national innovation output across a diverse sample of countries. In doing so, this paper addresses existing gaps in the literature — specifically, the narrow operationalization of innovation, ignorance of the formal institutions impact analysis and lack of integrated analysis combining both cultural and institutional dimensions. By employing a fuzzy set Qualitative Comparative Analysis (fsQCA) and focusing on innovation output rather than input indicators, the study offers a more nuanced understanding of how institutional arrangements and societal values interact to shape national innovation outcomes.

The findings provide strong support for the hypothesis that both formal institutions and informal cultural values contribute to innovation, but their influence is not isolated. Instead, innovation thrives in configurations where multiple enabling factors — such as strong rule of law, regulatory quality, protection of private property, self-expression values, secular thinking, and economic capital — align and reinforce one another. Formal institutions consistently emerge as a core condition in most high-innovation configurations, emphasizing the critical role of legal and regulatory frameworks in ensuring high innovation outcomes. These results contribute to the knowledge within a broader institutional economics theory that formal institutions are necessary for developing entrepreneurship in the country (De Soto, 1984; North,1990; Acemoglu, et al., 2014; Fuentelsaz et al., 2015)

However, formal institutions alone are not sufficient. Self-expression values, manifesting openness, creativity and autonomy in society contrary to survival values, also plays a prominent role in multiple pathways leading to high innovation outcomes. Likewise, secular values were relevant in several high-performing configurations, highlighting the importance of rationality, evidence-based decision-making, and modernization. These findings match with academic literature where authors tend to operationalise informal institutions through Hofstede's cultural dimensions emphasizing the importance of individualism, low level of uncertainty and long-term orientation (Kaasa and Vadi, 2010; Espig et. al., 2021). This research supports the conclusions of Nyssen Guillén and Deckert, as their notion of cultural looseness — much like the secular values analyzed here — plays an important role in fostering innovation (2022).

Despite the confirmed importance of the joint impact of formal and informal institutions, none of the high-coverage configurations indicate that innovation output can be achieved without accounting for economic factors. Capital inflows, operationalised in this paper as logged GDP and FDI indicators, play a significant role in shaping national innovation performance. At the same time, the analysis shows that in the absence of capable formal institutions — such as effective governance, high-

quality regulatory frameworks, and adherence to the rule of law — as well as a culture conducive to innovation, marked by self-expression and secular values, financial indicators alone do not lead to high levels of innovation output.

Overall, these findings highlight the need for a comprehensive policy approach that combines institutional development with economic investment to foster sustainable innovation growth. From this point of view, it is important to have a balanced approach to enhancing innovation by prioritising resources investments in the most underdeveloped area in a state — formal institution, culture or financing.

This research has several limitations that open opportunities for further academic inquiry. Firstly, due to limited data availability in the World Values Survey, the sample size is smaller than in other comparative studies. As a result, using larger datasets would enable testing result generalizability. Additionally, it would be valuable to conduct similar research using Hofstede's cultural dimensions model, which offers broader country coverage. Furthermore, this study does not fully capture the complexity of the human capital variable. The data used represents the percentage of the population with vocational or higher education, which, across the selected countries, shows a relatively low standard deviation. However, this indicator does not account for the quality of education, which varies significantly according to international education rankings. Therefore, a more nuanced and in-depth analysis of human capital would be important for understanding its interaction with institutional factors in shaping innovation output. Finally, another limitation of this study lies in the use of fuzzy set Qualitative Comparative Analysis. While fsQCA is particularly useful for uncovering complex causal configurations and interactions between conditions, it does not allow for precise estimation of the magnitude of individual variable effects, limiting its ability to assess the relative strength of each factor.

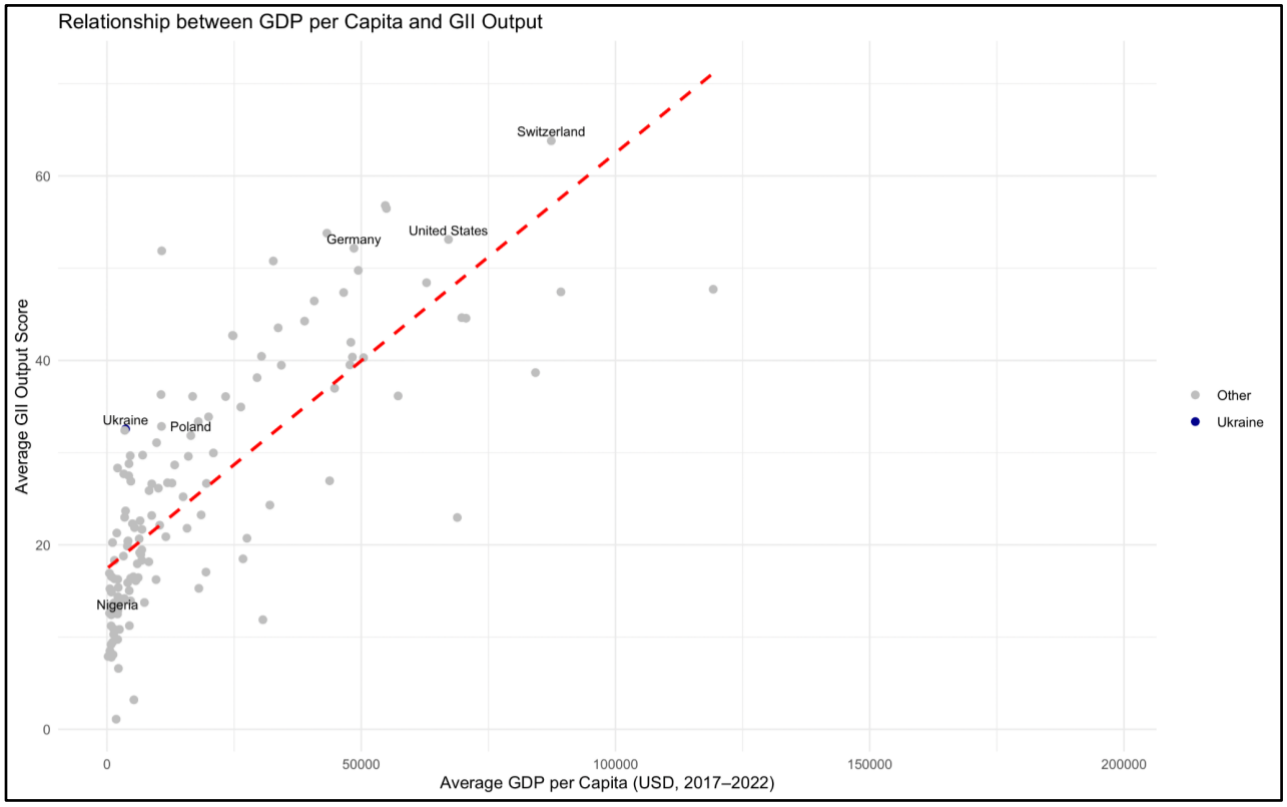
POLICY RECOMMENDATIONS FOR UKRAINE

Russia's full-scale invasion of Ukraine has inflicted severe damage on two fundamental pillars of any country's economy: labor and capital. According to the Fourth Rapid Damage and Needs Assessment (RDNA4) estimates, the direct damage to buildings and infrastructure is approximately USD 176 billion. In addition, as reported by UNHCR (2024), over 6.7 million Ukrainians remain displaced outside the country, reflecting the significant human loss due to the war. In total, based on the RDNA4, developed by the World Bank, the recovery and reconstruction needs of Ukraine are estimated at around 524 billion USD, which is approximately 2,8 times the estimated nominal GDP of Ukraine for 2024.

Under such conditions, innovation becomes a powerful multiplier that can compensate for capital losses and shrinkages of skilled labor force, enabling the country to not only survive during the war but also recover and thrive once hostilities end. As of 2025, Ukraine is emerging as one of the most dynamic countries in the defense technology sector, with over 800 companies operating in the market, more than 1,000 technological solutions deployed on the battlefield, and over 300,000 professionals employed in the industry (Ukrainian Institute for the Future, 2025). In parallel, significant investment is being attracted to the sector, leading to the development of innovation infrastructure such as laboratories, prototyping centers, and testing grounds. Educational programs are also improving, helping to build the human capital needed for long-term technological leadership. With the end of the war, many of these military-driven innovations can be redirected toward civilian use, supporting a broader economic transformation. In this context, the role of the state is to ensure a competitive and favorable environment that allows innovative companies to grow, scale, and eventually contribute to Ukraine's post-war reconstruction and global competitiveness. Hence, the results of this study can be used in order to identify possible directions for designing policies aimed at promoting innovation activities in Ukraine.

Before proceeding to policy formulation, it is necessary to note that Ukraine is doing relatively well in terms of innovation output if considering the country's low level of GDP per capita. The below graph illustrates the positioning of Ukraine with regard to its GII, given its GDP per capita. Ukraine is placed much above the position that would be expected given its level of GDP. This suggests that the country outperforms in innovation by surpassing limitations set by the level of its economic development. This also means that Ukraine possesses enormous potential for becoming an innovation leader not only regionally but also globally.

Graph 2. Plotting GII against GDP per capita for countries used in the analysis



Additionally, Table 5 compares Ukraine's performance across used in the paper variables with the sample average and score range. In terms of output, Ukraine's Global Innovation Index score is 32.566, which is above the sample mean of 28.221. On the contrary, Ukraine's score for formal institutions is -0.477, significantly below the average 0.168, indicating institutional weaknesses that may undermine long-term innovation potential but still have room for improvement. In contrast to formal institutions, secular values 0.470 are higher than the sample mean 0.361, suggesting a societal orientation toward rationality and progress Ukraine's self-expression values (0.399) are slightly below the average 0.430, pointing to moderate but still relevant levels of individual freedom. Economic and labor-related indicators in Ukraine remain below the respective sample means, implying that Ukraine faces structural limitations in terms of economic capacity and investment inflows. These numbers in general suggest that while Ukraine is performing comparatively well on innovation output, fueled by innovation culture in the country, it does so under constrained institutional and economic conditions. This highlights the importance of policy reforms.

Table 5. Descriptive statistics for Ukraine

Variable	Ukraine	Mean	Min	Max
GII	32,566	28.221	10.300	56.483
Formal institutions	-0.477	0.168	-1.338	2.083
Secular values	0.470	0.361	0.174	0.569
Self-expression values	0.399	0.430	0.237	0.676
Skilled labor	69.165	75.494	54.513	91.613
GDP logged	25.267	26.264	22.767	30.634
FDI logged	21.396	22.452	18.224	26.418

Returning to the fsQCA intermediate solutions for high GII, three distinct configurations appear relevant for stimulating higher innovation output in Ukraine:

a) Strengthening formal institutions;
b) Promoting secular and self-expression values, even in the absence of significant human capital development;
c) Advancing secular values alongside economic development, reflected in increased FDI and overall economic growth.

Among the three policy options, strengthening formal institutions offers the greatest potential benefits in both the short and long term. This is particularly relevant in the context of ongoing war, which acts as an external constraint on both cultural and economic transformation. Wartime conditions tend to reinforce traditional and survival-oriented values, making it difficult to promote shifts toward secularism or self-expression (Voicu and Tufiş, 2013). Similarly, attracting foreign direct investment is highly challenging, as investors are deterred by risks such as missile strikes and energy instability. As a result, enhancing the quality and effectiveness of formal institutions remains the most actionable and impactful path for the government to support innovation during and after the conflict.

In choosing the institutional reforms for Ukraine, one should consider that the following three indexes have been used to capture institutional effects on innovation in this study: government effectiveness, rule of law, and regulatory quality. Drawing upon this definition of institutions, Ukraine should hence focus on three main areas in framing institutional reforms aimed to support innovation output: introducing decentralisation and digitalisation policies, strengthening the rule of law and property rights, and improving market functioning. Decentralisation and digitalisation are

expected to foster the effectiveness and accountability of governmental regulations. Introducing the effective rule of law, investor protection, and intellectual property rights are anticipated to create a strong institutional framework necessary for innovation. Lastly, opening markets and promoting deregulation can help shape an effective and transparent environment encouraging companies to invest in innovation.

Decentralisation and digitalisation

Decentralisation strengthens formal institutions at the regional level, enabling local governments to become active agents in shaping innovation outcomes. When local authorities have the institutional capacity and autonomy to manage budgets, procurement, and regulation, they can better respond to the specific needs of their innovation ecosystems. This includes supporting innovation facilities, facilitating collaboration between universities and businesses, and using public procurement of innovation to stimulate demand for new technologies. In this way, decentralisation reinforces the institutional infrastructure needed to commercialize ideas and scale innovation from the ground up.

Digitalisation should also be at the core of these reforms. Scaling up e-residency and expanding the functionality of the Diia platform, including licensing, tax services, and grant access, can make compliance faster, more transparent, and less resource-intensive. By embedding more business-to-government interactions into streamlined digital processes, Ukraine can create a more responsive and accessible innovation environment for both domestic and international entrepreneurs. This would increase the effectiveness and transparency of governmental decision-making and regulation.

Rule of law, investor protection, and intellectual property rights

A functioning legal system that reliably protects contracts, investments, and ideas is fundamental to any innovation ecosystem. In Ukraine, this means prioritizing reforms in judicial independence and fostering the impartiality of court decisions. Investor confidence will only grow when property rights are clearly defined and effectively enforced, and when legal disputes can be resolved efficiently and fairly. In particular, foreign and domestic investors must be guaranteed equal access to legal remedies and protection against arbitrary expropriation or changes in regulatory frameworks. Strengthening investor protections, including clearer mechanisms for dispute resolution and legal safeguards in public-private partnerships, is essential for attracting long-term capital.

A specific focus should also be placed on protecting intellectual property. Strengthening patent law enforcement, reducing the time and cost of patent registration, and aligning Ukrainian IP practices with European standards would create a safer and more predictable environment for innovators to develop and commercialize new ideas. Policies under discussion in Ukraine such as the creation of specialized

commercial courts, implementation of fast-track IP procedures, and digital patent registries can significantly contribute to improving the rule of law for the innovation sector.

Opening markets, deregulation, and incentives for innovation

Lastly, open markets are essential for enabling innovation to grow and reach users. To support this, the government should focus on removing barriers to export, especially for defense-related products, and liberalizing the import of components and equipment needed for research, development, and production. At the same time, strengthening antitrust regulation is critical to reduce market concentration and promote fair competition. In many sectors, dominant players still limit the entry of smaller, more agile innovators. Transforming these markets from oligopolistic structures to competitive ecosystems will allow innovative companies to access customers, capital, and scale more easily.

Simplifying regulations is also necessary for fostering innovation directly, particularly in a high-risk and resource-constrained environment. A useful precedent can be found in the defense innovation sector, where Ukraine has already adopted flexible procurement procedures, streamlined technical requirements, and created mechanisms for direct funding. Similar principles can be applied to other industries. For instance, labor regulations could be updated to better reflect the needs of a modern workforce, including short-term contracting and remote work arrangements.

Financial and tax procedures also need to be simplified. Reducing reporting burdens for small innovative firms, easing access to state funding programs, and minimizing the cost of compliance would allow early-stage companies to focus on growth. A clear policy step in this direction would be introducing a moratorium on frequent tax code changes, which currently create uncertainty and discourage long-term planning. One notable example of progress in creating an innovation-friendly tax and legal environment is Diia.City — a special regime tailored for tech companies that offers reduced tax rates and guarantees legal stability for 25 years. This model demonstrates how long-term predictability and targeted incentives can foster business growth. Building on this foundation, similar mechanisms could be extended to cover a wider range of startups and research-intensive enterprises in other domains, not only IT.

In parallel, the state should create tools that help compensate for the positive externalities of innovation, meaning to reward companies that invest in creating new solutions that benefit society. Financial incentives can take several forms, including preferential tax treatment (such as lower corporate income tax rates for innovative firms or VAT exemptions on imported R&D equipment) as well as direct public grants for product development. However, these support measures should be distributed on a competitive and transparent basis, open to startups and established firms alike, and linked not only to scientific quality but also to potential for commercialization and public value.

In conclusion, advancing institutional reforms in Ukraine to enhance innovation output requires a focused approach centered on government effectiveness, rule of law, and regulatory quality. By prioritizing decentralization and digitalization, Ukraine can improve the efficiency and responsiveness of its public institutions. Strengthening the rule of law and protecting property rights will establish a reliable legal environment conducive to innovation. Furthermore, fostering market openness through deregulation can create a transparent and competitive economic environment that incentivizes innovation. Together, these reforms can lay the foundation for a dynamic innovation ecosystem, supporting sustainable economic growth in Ukraine.

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ANNEX 1. CODE IN R

```
library(dplyr)
library(WDI)
library(ggplot2)
library (readxl)
library(QCA)
library(venn)
_ _ _ _ _
#Extracting a dataset from the World Bank Governance Indicators

vdem <- read.csv (“VDEM_data.csv”)

vdem_subset <- vdem[vdem$year >= 2017 & vdem$year <= 2022, c("country_name",
        "country_text_id", "year", "e_wbgi_gee", "e_wbgi_rqe", "e_wbgi_rle")]

vdem_subset_average <- vdem_subset %>%
  filter(year >= 2017 & year <= 2022) %>%
              group_by(country_name,country_text_id) %>%
              summarise(
              avg_gee = mean(e_wbgi_gee, na.rm = TRUE),
              avg_rqe = mean(e_wbgi_rqe, na.rm = TRUE),
              avg_rle = mean(e_wbgi_rle, na.rm = TRUE),
              )
_ _ _ _ _
#Extracting a dataset from the World Values Survey

wvs_data <- read.csv("WVS_Cross_National_Wave_7_csv_v6_0.csv")

wvs_subset <- `WVS_Cross-National_Wave_7_v6_0` %>%
  select(B_COUNTRY_ALPHA, sacsecval, resemaval)

wvs_subset_average <- vws_subset %>%
              group_by(B_COUNTRY_ALPHA) %>%
              summarise(
              mean_sacsecval = mean(sacsecval, na.rm = TRUE),
              mean_resemaval = mean(resemaval, na.rm = TRUE)
              )
_ _ _ _ _
```

```
#Extracting a dataset from the Global Innovation Index (prepared by WIPO)

wipo_data <- read_excel("WIPO-GII.xlsx", sheet = "Data")  #installing data from exel
wipo_subset_average <- wipo_data %>%
           filter(`Indicator ID` == "WIPO.GII.238",  `Attribute 1` == "Score") %>%
            select(`Economy ISO3`, `2017`, `2018`, `2019`, `2020`, `2021`, `2022`)
        %>%
            group_by(`Economy ISO3`) %>%
            summarise(across(`2017`:`2022`, mean, na.rm = TRUE)) %>%
            mutate(avg_score = rowMeans(select(., `2017`:`2022`), na.rm = TRUE))
_ _ _ _ _

#Extracting control variables from the World Bank Data

indicators <- c("NY.GDP.MKTP.KD", "SL.TLF.ADVN.ZS", "BX.KLT.DINV.CD.WD")
wb_data_control <- WDI(country = "all", indicator = indicators, start = 2017, end =
2022, extra = TRUE)

wb_data_ control _log <- wb_data_control %>%
 mutate(
  log_GDP = log(NY.GDP.MKTP.KD),
  log_FDI = log(BX.KLT.DINV.CD.WD)
 )

wb_data_log_average <- wb_data_ control _log %>%
 filter(year >= 2017 & year <= 2022) %>%
            group_by(country,iso3c) %>%
            summarise(
            avg_SL_TLF_ADV = mean(SL.TLF.ADVN.ZS, na.rm = TRUE),
            avg_log_GDP = mean(log_GDP, na.rm = TRUE),
            avg_log_FDI = mean(log_FDI, na.rm = TRUE),
            )
_ _ _ _ _

#Creating a final dataset

colnames(wb_data_log_average)
colnames(wipo_subset_average)
wipo_subset_average <- wipo_subset_average %>%
rename(iso3c = `Economy ISO3`)
```

```
colnames(vws_subset_average)
vws_subset_average <- vws_subset_average %>%
  rename(iso3c = B_COUNTRY_ALPHA)
colnames(vdem_subset_average)
vdem_subset_average <- vdem_subset_average %>%
  rename(iso3c = country_text_id)
wipo_subset_average <- wipo_subset_average %>%
  rename(gii_output_avg = avg_score)

final_data <- vdem_subset_average %>%
        full_join(vws_subset_average, by = "iso3c") %>%
        full_join(wb_data_log_average, by = "iso3c") %>%
        full_join(wipo_subset_average, by = "iso3c")

colnames(final_data)
final_data <- final_data %>%
  rename(avg_labor = avg_SL_TLF_ADV)

final_data <- final_data %>%
  select(-`2017`, -`2018`, -`2019`, -`2020`, -`2021`, -`2022`, -`country`)
_ _ _ _ _

#Creating an average formal institution variable

final_data$FormInstituT <- (final_data$avg_gee + final_data$ avg_rqe + final_data$
        avg_rle)/3
_ _ _ _ _

#Descriptive statistics of the dataset

dat <- data.frame(FormInstituT, mean_sacsecval, mean_resemaval, gii_output_avg
        avg_labor, avg_log_GDP, avg_log_FDI)

dat <- na.omit(dat)

data_f <- dat %>% mutate_all(as.numeric)

stargazer(data_f, out= "Descr_stat.html")

plot(data_f, col = "red")
```

```
#Calibration for fsQCA

data_f$GII_c <- calibrate(data_f$ gii_output_avg, thresholds = "e=16.22, c=24.14,
        i=42.52")

data_f$FormInstituT_c <- calibrate(data_f$FormInstituT, thresholds = "e=-0.97, c=-
        0.11, i=1.77")

data_f$SelfEXPR_c <- calibrate(data_f$ mean_resemaval, thresholds = "e=0.28,
        c=0.41, i=0.65")

data_f$SecuLAR_c <- calibrate(data_f$ mean_sacsecval, thresholds = "e=0.21,
        c=0.37, i=0.52")

data_f$Labor_EDU_c <- calibrate(data_f$ avg_labor, thresholds = "e=69.11, c=76.16,
        i=82.31")

data_f$LogGDP_c <- calibrate(data_f$avg_log_GDP, thresholds = "e=23.58, c=26.28,
        i=28.82")

data_f$LogFDI_c <- calibrate(data_f$lavg_og_FDI, thresholds = "e=19.12, c=22.71,
        i=25.38")
_ _ _ _ _

#Necesity analysis for high and low GII

data_c <- data.frame(GII_c, FormInstituT_c, SelfEXPR_c, SecuLAR_c,
Labor_EDU_c, LogGDP_c, LogFDI_c)

attach(data_c)

pof(FormInstituT_c, GII_c, data= data_c, necessity=TRUE)
pof(~FormInstituT_c, GII_c, data= data_c, necessity=TRUE)
pof(FormInstituT_c, ~GII_c, data= data_c, necessity=TRUE)
pof(~FormInstituT_c, ~GII_c, data= data_c, necessity=TRUE)

pof(SelfEXPR_c, GII_c, data= data_c, necessity=TRUE)
pof(~SelfEXPR_c, GII_c, data= data_c, necessity=TRUE)
pof(SelfEXPR_c, ~GII_c, data= data_c, necessity=TRUE)
```

```
pof(~SelfEXPR_c, ~GII_c, data= data_c, necessity=TRUE)

pof(Labor_EDU_c, GII_c, data= data_c, necessity=TRUE)
pof(~Labor_EDU_c, GII_c, data= data_c, necessity=TRUE)
pof(Labor_EDU_c, ~GII_c, data= data_c, necessity=TRUE)
pof(~Labor_EDU_c, ~GII_c, data= data_c, necessity=TRUE)

pof(LogGDP_c, GII_c, data= data_c, necessity=TRUE)
pof(~LogGDP_c, GII_c, data= data_c, necessity=TRUE)
pof(LogGDP_c, ~GII_c, data= data_c, necessity=TRUE)
pof(~LogGDP_c, ~GII_c, data= data_c, necessity=TRUE)


– – – – –

#Sufficiency analysis for high GII

tab1 <-truthTable(data_c, outcome = "GII_c", conditions = "FormInstituT_c, SelfEXPR_c, SecuLAR_c, Labor_EDU_c, LogGDP_c, LogFDI_c", incl.cut = 0.8, sort.by = "OUT, n")
minimize(tab1, details=TRUE)
minimize(tab1, include="?", dir.exp = "FormInstituT_c, SelfEXPR_c, SecuLAR_c, Labor_EDU_c, LogGDP_c, LogFDI_c", details = TRUE)
– – – – –

#Sufficiency analysis for low GII

tab2 <-truthTable(data_c, outcome = "~GII_c", conditions = "FormInstituT_c, SelfEXPR_c, SecuLAR_c, Labor_EDU_c, LogGDP_c, LogFDI_c", incl.cut = 0.8, sort.by = "OUT, n")
minimize(tab2, details=TRUE)
minimize(tab2, include="?", dir.exp = "FormInstituT_c, SelfEXPR_c, SecuLAR_c, Labor_EDU_c, LogGDP_c, LogFDI_c", details = TRUE)
– – – – –

# GII-GDP per capita plot for Ukraine

gdp_data <- WDI(
country = "all",
indicator = "NY.GDP.PCAP.CD"
start = 2017,
```

```
end = 2022,
extra = TRUE,
cache = NULL

gdp_data <- gdp_data[gdp_data$region != "Aggregates", ]

avg_gdp <- gdp_data %>%
filter(!is.na(NY.GDP.PCAP.CD)) %>%
group_by(iso3c, country) %>%
summarise(avg_gdp_per_capita = mean(NY.GDP.PCAP.CD, na.rm = TRUE)) %>%
ungroup()

merged_data <- inner_join(avg_gdp, wipo_subset_average, by = "iso3c")

countries_to_label <- c("Ukraine", "United States", "Switzerland", "India", "Nigeria")

merged_data <- merged_data %>%
mutate(
highlight = ifelse(country == "Ukraine", "Ukraine", "Other"),
label = ifelse(country %in% countries_to_label, country, "")
)

plot <- ggplot(merged_data, aes(x = avg_gdp_per_capita, y = gii_output_avg)) +
geom_point(aes(color = highlight), size = 2) +
geom_smooth(method = "lm", se = FALSE, color = "red", linetype = "dashed") +
geom_text(aes(label = label), vjust = -0.5, size = 3) +
scale_color_manual(values = c("Ukraine" = "darkblue", "Other" = "grey")) +
labs(
title = "Relationship between GDP per Capita and GII Output",
x = "Average GDP per Capita (USD, 2017–2022)",
y = "Average GII Output Score",
color = ""
) +
theme_minimal()

print(plot)
```