


Data-Mining Modeling of Corruption Perception Patterns Based on Association Rules

Andrii Bozhenko,  <https://orcid.org/0009-0004-5164-9085>

PhD, Senior Researcher, Sumy State University, Ukraine

Dariusz Krawczyk,  <https://orcid.org/0000-0003-1823-0309>

Department of Applied Social Sciences, Faculty of Organization and Management Silesian University of Technology, Poland

Karolina Hałuszko,

Querco Property, Poland

Valerii Ozarenko,

Student, Sumy State University, Ukraine

Corresponding author: Andrii Bozhenko, a.s.bozhenko@gmail.com

Type of manuscript: research paper

Abstract: Corruption is one of the many challenges facing Ukrainian society. After the full-scale war, 89% of Ukrainian citizens consider corruption to be the most serious problem for the stable development of Ukraine. In the article, it is argued that neglecting the problem of corruption in society leads to a decrease in the level of trust in public authorities, economic losses, a decrease in the country's investment attractiveness, a loss of trust from international partners, as well as other economic and political turbulences. The study aims to develop an economic and mathematical model for determining the patterns of corruption perception in Ukraine based on association rules implemented using data mining methods. The Python Numerical Python library was used to build association rules. The study of the patterns of corruption perception was analysed in terms of the legislative (based on the activities of the Verkhovna Rada of Ukraine), judicial (based on the activities of the courts) and executive (on the example of the activities of the President and his Office) branches of government. The source of primary data was the data of a survey conducted by the "Join!" Public Participation Support Program together with the USAID project "Support for Leader Organizations in Combating Corruption in Ukraine". 38 association rules were determined for the judicial system, among which the most informative consequences were "distrust in the judicial system" and "corruption is widespread in the courts". For the executive branch of government, 27 association rules were built, where the informative consequence was "citizens can influence, namely participate in public councils or public hearings to monitor state institutions and their decisions". For the legislative branch, 33 association rules were formed, where the informative consequence was "citizens can influence, namely participate in public councils or public hearings to monitor state institutions and their decisions". According to the empirical calculations, a regularity was found that Ukrainian society is democratic and believes in its power to overcome corruption in any branch of government, but members of society do not show active desire and only revolutionary manifestations are possible in a critical situation. The Verkhovna Rada of Ukraine can use the results obtained during the improvement of Ukrainian legislation, the Cabinet of Ministers of Ukraine when approving the State Program for the Implementation of the Anti-Corruption Strategy and other state bodies in developing anti-corruption programs at various levels.

Keywords: corruption, anti-corruption, association rules, corruption perception.

JEL Classification: C10, D73, O17.

Received: 11 September 2023

Accepted: 08 November 2023

Published: 31 December 2023

Funding: This research was funded by the grant from the Ministry of Education and Science of Ukraine (No. s/r 0122U000783, 0123U101945).

Publisher: Academic Research and Publishing UG (i.G.) (Germany)

Founder: Sumy State University and Academic Research and Publishing UG (i.G.) (Germany)

Cite as: Bozhenko, A., Krawczyk, D., Hałuszko, K., & Ozarenko, V. (2023). Data-Mining Modeling of Corruption Perception Patterns Based on Association Rules. *Business Ethics and Leadership*, 7(4), 181-189. [http://doi.org/10.61093/bel.7\(4\).181-189.2023](http://doi.org/10.61093/bel.7(4).181-189.2023).



Copyright: © 2023 by the author. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Data-Mining Modeling of Corruption Perception Patterns Based on Association Rules

Introduction

Corruption is the abuse of power or bribery to satisfy one's needs, obtain illegal benefits, or cause harm to others. It is a trust violation that can involve government officials and individuals in the private sector. Corruption can take various forms, such as extortion of bribes, improper use of public funds, abuse of power, lobbying for personal interests, etc. It is a serious problem in many countries, as corruption can lead to distrust of citizens in government structures, violate equality and justice, and slow down the economic development of the country. Corruption is one of the many challenges facing Ukrainian society. It is difficult to determine where corruption started in Ukraine, but its presence and negative consequences are obvious. These are a low level of trust in state authorities, which leads to disregard for laws; economic losses due to tax evasion and, in general, the growth of the shadow economy; low investment attractiveness; a decrease in trust from the world community, which affects the level of support in our time of need.

According to the national survey “The State of Corruption in Ukraine. Perception, experience, attitude”, conducted by the Program for the Promotion of Public Activity “Join!” together with the USAID Project “Supporting Leader Organizations in Combating Corruption in Ukraine “VzayemoDiya” (SACCI) (USAID, 2023), the problem of corruption ranks second in importance after war. According to 2021 research, the state budget of Ukraine loses 455 billion UAH every year due to corruption, as well as about 500 billion UAH of unreceived potential investments, which is approximately equal to the volume of the country's state budget.

The perception of corruption is a complex concept, as it includes objective facts and subjective opinions of the population regarding the corrupt activities of various bodies, which can be influenced, among other things, by insufficient or distorted information. A comprehensive investigation of corruption in the Ukrainian government requires an analysis of violations by the state and the population, which relate to several factors and include cases of abuse of power, extortion of bribes, and other forms of unlawful personal gain. In this case, constructing a system of association rules will help solve the mentioned issue.

Literature Review

The study of the corruption processes is carried out in legal, social, political, and economic aspects, indicating its all-encompassing nature of influence on various spheres of activity of both an individual and the state. Combating corruption is important for forming a favourable business environment and compliance with the principles of social justice and law and order in society (Kuzior et al., 2022). Today, digital tools provide practical tools to ensure transparency, openness and effective resource management. Here are some key aspects of the importance of digitalization in the fight against corruption: e-Government (Mistry & Jalal, 2012; Li et al., 2021; Zhao et al., 2021; Alsaad, 2022); e-audit (Hakim et al., 2023, Open Data (Darusalam et al., 2019; Žuffová, 2020); e-Procurement (Neupane et al., 2014; Sharma et al., 2019; Psota et al., 2020; Kartika, 2022) and public control (Paterson et al., 2019).

Understanding the patterns of the spread of corruption is key to solving the problem of public sector dysfunction in many countries. Accordingly, it is essential to consider the peculiarities of existing research in terms of the following factors of corruption perception:

- corruption can cause negative emotions among the population and violate faith in the effectiveness of government institutions (Sopilko, Armash, 2018).
- everyone encounters corruption daily, which is characterized by identifying situations where corruption can be a daily reality, such as receiving services from authorities, courts, interaction with the police or other public services. This can lead to helplessness and loss of trust in the system (Solovyev, 2012).
- trust in anti-corruption institutions, namely the creation of anti-corruption bodies, such as the National Anti-Corruption Bureau of Ukraine (NABU) and the Specialized Anti-Corruption Prosecutor's Office (SAP), was aimed at restoring trust in the justice system and fighting corruption. Citizens can evaluate the success of these institutions in combating corruption and bringing the guilty to justice (Musienko, 2019).
- corruption decreases the country's investment attractiveness and generally restrains economic growth (Nguedie, 2018).

One should also note that corrupt practices lead to a lack of transparency in the procurement system, complicating control over the expenditure of funds and causing the possibility of inefficient state programs (Verkhovna Rada of Ukraine, 2014). According to the Financial Action Task Force against Money Laundering (FATF, 2023), the volume of money laundering in Ukraine is estimated to be billions of US dollars. These figures are only rough estimates, and the actual losses may be much higher due to the difficulty of measuring corrupt practices and their economic consequences. It is also important to consider that economic losses from corruption include direct financial losses and the general impact on the development of society and the country's economy.

In the modern conditions of the development of the economy of Ukraine, the issue of the country's defence capability is important because the transparent allocation of the budget for military needs requires a unique approach and clarity in setting priorities and determining the expediency of each decision. It should not have signs of corruption processes (Oliynyk, 2020). Juarez-Garcia (2020) asserts the existence of a dual nature of implementing corruption schemes: the first level is corruption among officials of state structures, the second level is the imperfection of the regulatory and legislative framework, which enables the presence of illegal activity and the lack of proper punishment for it. Thus, the issue of determining the regularities of the spread of corruption processes in Ukraine needs to be more researched and requires a more in-depth study.

Methodology

The purpose of the work is to determine the patterns of the spread of corruption phenomena in Ukraine based on the construction of a system of associative rules. Associative analysis is a data mining method to identify relationships and dependencies between elements in a data set. The basic idea behind associative analysis is to discover association rules between different elements in a data set that often occur together.

Basic terms and concepts in associative analysis: association rule, which states if set X occurs, then the probability of meeting set Y is also high:

$$X \rightarrow Y \tag{1}$$

where X i Y – set of elements.

support (support, 2) – the share of transactions in the data set where a particular rule is found (Olson & Araz, 2023; Kaushik et al., 2021; Telikani et al., 2020). High support means that this rule occurs frequently.

$$S(A \rightarrow B) = P(A|B) = \frac{n(\{A;B\} \in d_i)}{N} \tag{2}$$

where D – transaction database;
 N – number of transactions;
 d_i – each transaction;
 $A \rightarrow B$ – the rule of association.

confidence (confidence, C, 3) – the probability that the association rule is true. It is defined as the fraction of transactions where the rule is detected among transactions containing the set X (Olson & Araz, 2023; Kaushik et al., 2021; Telikani et al., 2020).

$$C(A \rightarrow B) = P(A|B) = \frac{n1(\{A;B\} \in d_i)}{n1(\{A\} \in d_i)} \tag{3}$$

where AB – the rule of association

Interval support (Lift, L) – a measure of the degree to which an association rule occurs more often than would be expected by chance.

$$L(A \rightarrow B) = C(A|B) / P(B) \tag{4}$$

A library for the Python programming language Numerical Python was used to construct the associative rules, which provides support for working with large, multidimensional arrays and matrices, along with high-level mathematical functions for working with these data structures. The source of the data was the data of the survey conducted by the Public Activity Promotion Program “Join!” together with the USAID Project “Supporting organizations-leaders in combating corruption in Ukraine “VzayemoDiya” (SACCI). For the

economic and mathematical modelling of the perception of corruption in Ukraine, three groups of indicators were chosen, which are answers to the national survey questions. To construct association rules, a transition from quantitative to binary indicators was carried out, the results of which are presented in Table 1 (for the judicial branch of government), Table 2 (for the legislative branch of government based on the example of the activities of the Verkhovna Rada of Ukraine), Table 3 (for the executive branch of government based on the example activities of the President and his Office). The value of the binary indicator “1” is assigned if the answer to the question is a sign of corruption.

Table 1. Input Data for Determining the Reasons for the Spread of Corruption in the Judicial System

№	Question from the survey	Answer code	Answer decoding	Binary indicator
1	How much do you trust the judicial system?	1	I don't trust it at all	1
		2	I'd rather not trust than trust	1
		3	Partly I trust, partly not	0
		4	I'd rather trust than not trust	0
		5	I fully trust	0
		88	Hard to say	0
		99	Refusal	0
2	Can the provision of a bribe, unofficial services or a gift be justified if it is necessary to solve an important matter for you?	1	Can always be justified	1
		2	In most cases, it can be justified	1
		3	In most cases, it cannot be justified	0
		4	Can never be justified	0
		88	Hard to say	0
		99	Refusal	0
3	How widespread is corruption in the judicial system?	1	Very common	1
		2	Partially common	0
		3	There is no corruption	0
		88	Hard to say / Refusal	0
	Are the authorities taking measures to tackle corruption in the judicial system?	1	No	1
		2	Yes	0
		88	Hard to say / Refusal	0
4	Can the public influence the reduction of corruption, and if so, how?	1= selected	Participate in public councils or public hearings to oversee public institutions and their decisions	1
5	Have you encountered corruption in the judicial system?	1	Yes	1
		2	No	0
6	How ready are you to defend your rights before bureaucrats?	1	Not ready at all	1
		2	Not ready	1
		3	Partly ready, partly not	0
		4	Finished	0
		5	Absolutely ready	0
		88	Hard to say	0
7	Do you know of any anti-corruption measures, reforms or campaigns that have been carried out by the judicial system in the last 12 months?	1	Yes	1
		2	No	0
8	Which of the following are you personally ready to participate in?	1= selected	Participate in public councils or public hearings to oversee public institutions and their decisions	1
9	Motivation for anti-corruption activity: Feeling that it is your civic duty	1	Not encouraging at all	1
		2	Rather, it does not encourage	1
		3	Rather encourages	0
		4	Very encouraging	0
		88	Hard to say	0
99	Refusal	0		

Source: Compiled by the authors

To analyze the perception of corruption in the Verkhovna Rada of Ukraine, we leave questions 2, 4, 6, 8, 9 for analysis, as well as supplemented with new questions: How much do you trust the Verkhovna Rada of Ukraine?, do you know about any anti-corruption measures, reforms or campaigns, which were conducted in the last 12 months by the Verkhovna Rada, in your opinion, how widespread is corruption in the Verkhovna Rada of Ukraine?

To analyze the perception of corruption among the President and his Office, we leave for analysis questions 2, 4, 6, 8, 9 and supplemented with new questions: To what extent do you trust the President and his Office?, Do you know about any anti-corruption measures, reforms or campaigns, which were conducted in the last 12 months by the President and his Office? In your opinion, how widespread is corruption among the President and his Office?

Results

Having developed the methodological principles of building associative rules and carrying out their practical implementation, the analysis of the obtained results becomes relevant. Associative rules were created that reflect chains of perception of corruption within three branches of government: judicial (judicial system), executive (President and his Office), legislative (Verkhovna Rada of Ukraine). Having developed the methodological principles of building association rules and carrying out their practical implementation, the analysis of the obtained results becomes relevant. Association rules were created that reflect chains of perception of corruption within three branches of government: judicial (judicial system), executive (President and his Office), legislative (Verkhovna Rada of Ukraine).

Table 2. Association Rules for the Consequence “Distrust in the Judicial System” (fragment)

№ of the rule	Reason(s)	Support	Confidence
3	Unwillingness to defend rights before bureaucrats; the feeling that it is your civic duty that does not to encourage anti-corruption activities; corruption is widespread in the courts; anti-corruption measures are not taken	212	0.7235
9	Giving a bribe is justified if necessary; anti-corruption measures are not taken; corruption is widespread in the courts	210	0.7216
12	Anti-corruption measures are not taken; readiness to participate in public councils; corruption is widespread in the courts	257	0.7672
17	Anti-corruption measures are not taken; unwillingness to defend rights before bureaucrats; corruption is widespread in the courts	354	0.7137
26	Anti-corruption measures are not taken; encountered corruption in the courts	54	0.7200
27	Faced with corruption in the courts; corruption is widespread in the courts	65	0.7471
34	Anti-corruption measures are not taken; corruption is widespread in the courts	2028	0.7553
37	Corruption is widespread in the courts	2739	0.7100

Source: Compiled by the authors

Analysing the data presented in Table 4, one should note that only associative rules were selected, with the probability of trust exceeding 70%. Regarding the rules that should be considered based on the indicator of their support, we note that the greatest support is found in rules 34 and 37. However, they are obvious because if measures to combat corruption are not used, and corruption is widespread in the courts, then, accordingly, there will be no confidence in the judiciary systems. Based on this, their description and considering is not considered. Therefore, let us analyse associative rules numbered 17, 20, and 23, for which the support level exceeds 300 units. Therefore, the following patterns are relevant for the consequence of “Distrust of the judicial system”:

- Anti-corruption measures are not used - unwillingness to defend rights before bureaucrats – corruption is widespread in courts;
- Measures to combat corruption are not used – citizens can influence, namely participate in public councils or public hearings to monitor state institutions and their decisions - corruption is widespread in courts;
- Measures to combat corruption are not used – the feeling that it is your civic duty does not encourage anti-corruption activities – corruption is widespread in the courts.

While society believes that the state needs more measures to combat corruption, citizens are not ready to participate directly in organizations to combat it. Society understands its power but is not ready to fight corruption daily by defending its rights in public associations. Moving on to the analysis of the consequence “corruption is widespread in the courts”, we note that, based on the data in Table 3, it is fair to conclude that this consequence is predominantly formed by the same three reasons as for “distrust in the judicial system”. This is logical since these are elements of one chain of consecutive events. If there is total corruption in the courts, there will be no trust in the judicial system. The respondents answered similarly, i.e., it is fair to assume that the results of the judicial branch's analysis are quite adequate.

Table 3. Association Rules for the Consequence “Corruption is Widespread in Courts” (fragment)

N ^o of the rule	Reason(s)	Support	Confidence
35	Anti-corruption measures are not taken; mistrust of the judicial system	2028	0,7833
11	Bribery is justified if necessary; mistrust of the judicial system; anti-corruption measures are not taken	210	0,7836
13	Anti-corruption measures are not taken; mistrust of the judicial system; willingness to participate in public councils	257	0,7788
7	Bribery is justified if necessary; readiness to participate in public councils; anti-corruption measures are not taken	66	0,7952
25	Anti-corruption measures are not taken; encountered corruption in the courts	59	0,7867
18	Anti-corruption measures are not taken; unwillingness to defend rights before bureaucrats; mistrust of the judicial system -	354	0,7797

Source: Compiled by the authors

In order to analyze the level of corruption perception in the executive branch, using the example of the President and his Office, the following terms were chosen, “Giving a bribe is justified if necessary”, “Distrust of the President and his Office”, “Unwillingness to defend rights before bureaucrats”, “Willingness to participate in public councils”, “The feeling that it is your civic duty does not encourage anti-corruption activities”, “Corruption is widespread among the President and his Office”, “Citizens can influence, namely participate in public councils or public hearings to monitor state institutions and their decisions”, “I know anti-corruption measures or reforms in the last 12 months by the President and his Office”. 27 associative rules were constructed. However, the result was one: “Citizens can influence, namely participate in public councils or public hearings to monitor public institutions and their decisions” (Table 4).

Table 4. Association Rules for the Executive Branch of Government (fragment)

N ^o of the rule	Reason(s)	Support	Confidence
17	Distrust of the President and his Office; willingness to participate in public councils	172	0.9198
21	I know the anti-corruption measures or reforms in the last 12 months by the President and his Office	945	0.9220
23	Willingness to participate in community councils	1278	0.9274
6	Willingness to participate in public councils; I know anti-corruption measures or reforms in the last 12 months by the President and his Office	203	0.9398
16	Willingness to participate in public councils; corruption is widespread among the President and his Office	195	0.8986
11	Bribery is justified if necessary; willingness to participate in public councils	191	0.9409
4	Distrust of the President and his Office; readiness to participate in public councils; corruption is widespread among the President and his Office	97	0.9065
22	Bribery is justified if necessary	1062	0.8599

Source: Compiled by the authors

We exclude the term “Citizens can influence, namely participate in public councils or public hearings to monitor public institutions and their decisions” from the analysis to identify other possible implications for the analysis of the executive corruption perception. The result is 2 rules (Table 5).

Table 5. Associative Rules for the Executive Branch of Government with the Exception of One Term

N ^o of the rule	Reason	Consequence	Support	Confidence
0	Distrust of the President and his Office – Unwillingness to defend rights before bureaucrats – Corruption is widespread among the President and his Office	The feeling that it is your civic duty does not encourage anti-corruption activities	100	0.625
1	Bribery is justified if necessary - Corruption is widespread among the President and his Office	Distrust of the President and his Office	157	0.6356

Source: Compiled by the authors

Therefore, based on the data in Table 7, two rules are fundamentally different: one defines the cause of distrust in the President and his Office, and the other defines the same as a consequence. Thus, the following pattern can be determined: as long as Ukrainians believe that a bribe is a justified measure to solve the problem specifically in their case, until then, corruption will be widespread among the president and his office and, as

a result, there will be distrust in them. At the same time, if society does not trust the president and his office, it will not be ready to defend its rights against other bureaucrats.

Moving on to the study of the legislative branch, we note that 33 formed association rules with a confidence level of more than 70% received the following as a consequence: “Citizens can influence, namely participate in public councils or public hearings to supervise state institutions and their decisions”, which is not expedient from the point of view of forming an information base for making balanced management decisions. Thus, we will exclude the term "Citizens can influence, namely, participate in public councils or public hearings to monitor public institutions and their decisions" from the analysis to determine other possible consequences for the analysis of the corruption perception in the legislature. As a result, 17 rules have been formed (Table 6).

Table 6. Association Rules for Analyzing the Corruption Perception in the Legislature (Fragment)

№ of the rule	Reason	Consequence	Support	Confidence
0	Bribery is justified if necessary; unwillingness to defend rights before bureaucrats; the feeling that it is your civic duty that does not encourage anti-corruption activities; corruption is widespread in the Verkhovna Rada of Ukraine	Distrust of the Verkhovna Rada of Ukraine	54	0.7297
1	Bribery is justified if necessary; unwillingness to defend rights before bureaucrats; mistrust of the Verkhovna Rada of Ukraine; corruption is widespread in the Verkhovna Rada of Ukraine	The feeling that it is your civic duty does not encourage anti-corruption activities	54	0.6835
2	Bribery is justified if necessary; unwillingness to defend rights before bureaucrats; mistrust of the Verkhovna Rada of Ukraine; the feeling that it is your civic duty does not encourage anti-corruption activities	Corruption is widespread in the Verkhovna Rada of Ukraine	54	0.7606
3	Bribery is justified if necessary; mistrust of the Verkhovna Rada of Ukraine; willingness to participate in public councils	Corruption is widespread in the Verkhovna Rada of Ukraine	62	0.7470

Source: Compiled by the authors

Based on the results accumulated in Table 5, we note that the most popular reason for mistrust of the Verkhovna Rada of Ukraine and systematic manifestations of corruption in it is “Giving a bribe is justified if necessary”. The very understanding that in Ukrainian society, it is possible to solve problems at any level with the help of a bribe leads first to “Unwillingness to defend rights before bureaucrats”, then to “Feeling that it is your civic duty not to encourage anti-corruption activities” and, as a consequence, to widespread corruption in the Verkhovna Rada. To assess the adequacy of the corruption perception model in Ukraine, we will define an approach that is not based on quantitative calculations of reliability parameter model but an approach that assesses its qualitative characteristics. This is because the built model is unique, and the toolkit used in its calculation does not have classic parameters for checking adequacy.

Analysing the developed model of corruption perception in Ukraine in terms of the specified requirements, we note that out of 7 parameters, the developed model meets such requirements as reliability, efficiency, control over results and compliance with the management level. So, while focusing on reliability, we note that association rules reflect existing regularities; the task of researchers is to find out whether these regularities are actual or not. At the same time, 10% errors are allowed when entering relevant indicators and 10% errors when calculating the level of support and confidence, which also allows us to assert a high level of reliability of the model. Thus, it is fair to note that the researched model of promoting corruption in Ukraine is adequate from the point of view of credibility, efficiency, and the ability to control the results.

Conclusion

It was determined that the Ukrainian society has an ambiguous attitude to corruption, indicating that the formation and strengthening of us as a society are still ongoing. On the one hand, Ukrainians understand the existence of a corruption problem in the country and are ready to fight it, for example by participating in public councils or public hearings to monitor state institutions and their decisions. On the other hand, they are mostly not ready to defend their rights before bureaucrats who indicates a low level of understanding by citizens of their rights. During the implementation of the set goal, associative rules were defined in terms of three branches of government: legislative (using the example of the Verkhovna Rada of Ukraine), executive (using the example of the President and his Office), judicial (using the example of the judicial system as a whole). 38 associative rules were defined for the Court system. The most informative are the consequences of “Distrust in the judicial system” and “Corruption is widespread in the courts”, according to which the

patterns of perception of corruption processes were determined. For the executive branch, 27 associative rules were constructed, of which one resulted: “Citizens can influence, namely, participate in public councils or public hearings to monitor state institutions and their decisions”. 33 associative rules were formed for the legislative branch. A significant consequence with a confidence level of more than 70% was “Citizens can influence, namely participate in public councils or public hearings to monitor public institutions and their decisions”.

The obtained results can be used by the Verkhovna Rada of Ukraine during the improvement of Ukrainian legislation on the principles of state anti-corruption policy and during thematic parliamentary hearings, anti-corruption examination of draft laws in the committee on anti-corruption policy. The Cabinet of Ministers of Ukraine can use the results of the study when approving the State Program for the Implementation of the Anti-Corruption Strategy. It was determined that the Ukrainian society has an ambiguous attitude to corruption, which indicates that the formation and strengthening of us as a society are still ongoing. On the one hand, Ukrainians understand the existence of a corruption problem in the country. For example, they are ready to fight it by participating in public councils or hearings to monitor state institutions and their decisions. On the other hand, they need more time to be ready to defend their rights before bureaucrats, which indicates a low level of understanding of their rights by citizens.

During the implementation of the set goal, associative rules were defined in terms of three branches of government: legislative (using the example of the Verkhovna Rada of Ukraine), executive (using the example of the President and his Office), judicial (using the example of the judicial system as a whole). 38 associative rules were defined for the Court system. The most informative are the consequences of “Distrust in the judicial system” and “Corruption is widespread in the courts”, according to which the patterns of perception of corruption processes were determined. For the executive branch, 27 associative rules were constructed, one of which resulted in: “Citizens can influence, namely, participate in public councils or public hearings to monitor state institutions and their decisions”. 33 associative rules were formed for the legislative branch. A significant consequence with more than 70% confidence level was “Citizens can influence, namely participate in public councils or public hearings to monitor public institutions and their decisions”.

Verkhovna Rada of Ukraine can use the obtained results during the improvement of Ukrainian legislation on the principles of state anti-corruption policy and thematic parliamentary hearings, anti-corruption examination of draft laws in the committee on anti-corruption policy. The Cabinet of Ministers of Ukraine can use the results of the study when approving the State Program for the Implementation of the Anti-Corruption Strategy.

Author Contributions: Conceptualization: Andrii Bozhenko, Valerii Ozarenko; data curation: Dariusz Krawczyk, Valerii Ozarenko; formal analysis: Dariusz Krawczyk, Karolina Hałuszko; investigation: Andrii Bozhenko, Dariusz Krawczyk, Karolina Hałuszko, Valerii Ozarenko; methodology: Valerii Ozarenko; project administration: Andrii Bozhenko; resources: Andrii Bozhenko, Dariusz Krawczyk, Karolina Hałuszko, Valerii Ozarenko; software: Valerii Ozarenko; supervision: Andrii Bozhenko; validation: Dariusz Krawczyk; visualization: Valerii Ozarenko; writing-original draft preparation: Valerii Ozarenko; writing-review and editing: Andrii Bozhenko, Dariusz Krawczyk, Karolina Hałuszko.

Conflicts of Interest: Authors declare no conflict of interest.

Data Availability Statement: Not applicable.

Informed Consent Statement: Not applicable.

References

1. Alsaad, A. (2022). E-government and corruption control: The mediating effect of law enforcement. *Electronic Government*, 18(1), 1-8. [\[Google Scholar\]](#) [\[CrossRef\]](#)
2. Anti-corruption policy in Ukraine: a multimedia textbook. National Academy of Internal Affairs (2016). Available at: [\[Link\]](#)
3. Darusalam, D., Said, J., Omar, N., Janssen, M., & Sohag, K. (2019). The Diffusion of ICT for Corruption Detection in Open Government Data. *Knowledge Engineering and Data Science*, 2(1), 10. [\[CrossRef\]](#)
4. Hakim, L., Pardomuan, R., & Tantri, M. (2023). Electronic Audit (E-Audit), Audit Judgement, Corruption Detection and Audit Quality: BPK RI. *IJHCM (International Journal of Human Capital Management)*, 7(1), 1-27. [\[Google Scholar\]](#) [\[CrossRef\]](#)

5. Juarez-Garcia, M.I. (2020). Personal Corruption & Corrupting Laws: Montesquieu's Twofold Theory of Corruption. *Business Ethics and Leadership*, 4(4), 76-84. [\[Google Scholar\]](#) [\[CrossRef\]](#)
6. Kartika, D. (2022). The Impact of E-Procurement Implementation on Public Procurement's Corruption Cases; Evidence from Indonesia and India. *Jurnal Kajian Wilayah*, 11(2), 193. [\[Google Scholar\]](#) [\[CrossRef\]](#)
7. Kaushik, M., Sharma, R., Peious, S.A., Shahin, M., Yahia, S.B., & Draheim, D. (2021, September 1). A Systematic Assessment of Numerical Association Rule Mining Methods. *SN Computer Science*. Springer. [\[Google Scholar\]](#) [\[CrossRef\]](#)
8. Kuzior, A., Vasylieva, T., Kuzmenko, O., Koibichuk, V. & Brożek, P. (2022). Global Digital Convergence: Impact of Cybersecurity, Business Transparency, Economic Transformation, and AML Efficiency. *J. Open Innov. Technol. Mark. Complex*, 8, 195. [\[Google Scholar\]](#) [\[CrossRef\]](#)
9. Li, S., Wei, W., & Ma, M. (2021). How Does E-Government Affect Corruption? Provincial Panel Evidence from China. *IEEE Access*, 9, 94879-94888. [\[Google Scholar\]](#) [\[CrossRef\]](#)
10. Lytvyn, N.A., Artemenko, O.V., Kovalova, S.S., Kobets, M.P., & Kashtan (Grygorieva), E.V. (2023). Administrative and legal mechanisms for combating corruption. *Journal of Financial Crime*, 30(1), 154-166. [\[Google Scholar\]](#) [\[CrossRef\]](#)
11. Mistry, J.J., & Jalal, A. (2012). An empirical analysis of the relationship between e-government and corruption. *International Journal of Digital Accounting Research*, 12, 145-176. [\[Google Scholar\]](#) [\[CrossRef\]](#)
12. Musienko A. (2019). About the causes of corruption or corruption-ogenic factors: Information and consultation platform. (in Ukrainian). Available at: [\[Link\]](#)
13. Neupane, A., Soar, J., & Vaidya, K. (2014). An empirical evaluation of the potential of public e-procurement to reduce corruption. *Australasian Journal of Information Systems*, 18(2), 21-44. [\[Google Scholar\]](#) [\[CrossRef\]](#)
14. Nguedie, Y.H.N. (2018). Corruption, Investment and Economic Growth in Developing Countries: A Panel Smooth Transition Regression Approach. *SocioEconomic Challenges*, 2(1), 63-68. [\[Google Scholar\]](#) [\[CrossRef\]](#)
15. NumPy Documentation. NumPy. Available at: [\[Link\]](#)
16. Oliynyk, O.O. (2020). To characterize the regulatory framework for the activities of the national council for anti-corruption policy. *Juridical Science*, 3(105), 244-250. (in Ukrainian). [\[Google Scholar\]](#) [\[CrossRef\]](#)
17. Olson, D.L., & Araz, Ö.M. (2023). Association Rules. In *International Series in Operations Research and Management Science* (Vol. 341, pp. 35-52). Springer. [\[CrossRef\]](#)
18. Paterson, A.S., Changwony, F., & Miller, P.B. (2019). Accounting control, governance and anti-corruption initiatives in public sector organisations. *British Accounting Review*. Academic Press. [\[Google Scholar\]](#) [\[CrossRef\]](#)
19. Psota, V., Chyzhevska, L., Osychka, O., Zaika, S., & Koval, N. (2020). Competition in public procurement in the fight against corruption: Analysis of an example of Ukraine. *Intellectual Economics*, 14(1), 89-112. [\[Google Scholar\]](#) [\[CrossRef\]](#)
20. Sharma, S.K., Sengupta, A., & Panja, S.C. (2019). Mapping Corruption Risks in Public Procurement: Uncovering Improvement Opportunities and Strengthening Controls. *Public Performance and Management Review*, 42(4), 947-975. [\[Google Scholar\]](#) [\[CrossRef\]](#)
21. Solovyov, V.M. (2012). Prevention and counteraction of corruption in the state administration of Ukraine: monograph. Kyiv: Institute of Legislation of the Verkhovna Rada of Ukraine. 508 p. (in Ukrainian)
22. Sopilko, I.M., & Armash, H.O. (2018). Corruption in Ukraine as legacy of the soviet state administration. *Scientific Works of National Aviation University. Series: Law Journal "Air and Space Law*, 2(47). (in Ukrainian). [\[CrossRef\]](#)
23. Telikani, A., Gandomi, A.H., & Shahbahrani, A. (2020). A survey of evolutionary computation for association rule mining. *Information Sciences*, 524, 318-352. [\[Google Scholar\]](#) [\[CrossRef\]](#)
24. The FATF Recommendations (2023). Available at: [\[Link\]](#)
25. USAID (2023). State of corruption in Ukraine 2023: perception, experience, attitude. Available at: [\[Link\]](#)
26. Zhao, H., Ahn, M.J., & Manoharan, A.P. (2021). E-Government, Corruption Reduction and the Role of Culture: A Study Based on Panel Data of 57 Countries. *International Journal of E-Planning Research*, 10(3), 86-104. [\[Google Scholar\]](#) [\[CrossRef\]](#)
27. Žuffová, M. (2020). Do FOI laws and open government data deliver as anti-corruption policies? Evidence from a cross-country study. *Government Information Quarterly*, 37(3). [\[Google Scholar\]](#) [\[CrossRef\]](#)