The Impact of Digitalization and E-Governance on Economic Growth in Ukraine

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To what extent do the digitalization of the economy and the implementation of e-governance initiatives promote economic growth in Ukraine?

Economics

Word count: 3982 words

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Introduction

Economic growth is a central objective for countries worldwide as it is associated with increased production and improved social standards and has widespread consequences on the population's well-being. Several factors contribute to economic growth, including investment in human capital, capital stock, political stability, and technological progress.[1] In recent decades, digitalization has emerged as one of the critical determinants of economic growth, with e-governance becoming increasingly important.[2] E-governance refers to the utilization of Information and Communication Technology (ICT) in governance, empowering civilians, improving service delivery, increasing transparency and accountability, and enhancing the efficiency of government sectors, according to the World Bank.[3]

The e-governance ecosystem in Ukraine has witnessed advancements in recent years. In 2021, the IT sector in Ukraine experienced a 36% increase in exports from $5 billion to $6.8 billion.[4] Ukraine emerged as one of the leading exporters of IT services and products in Eastern Europe, with the region's highest number of outsourced developers. The primary catalyst for this progress has been the increasing global demand for digitalizing business operations, driving the growth of the industry in Ukraine.[5]

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[1] Bassanini, Andrea, and Stefano Scarpetta. “The Driving Forces of Economic Growth: Panel Data Evidence for the Oecd Countries.”, pp. 11-16, Oecd.org, 2001, https://www.oecd.org/economy/growth/18450995.pdf.
[2] Zhang, Jinzhu, et al. “The Impact of Digital Economy on the Economic Growth and the Development Strategies in the Post-COVID-19 Era: Evidence from Countries along the ‘Belt and Road.’” Frontiers in Public Health, vol. 10, 2022, p. 856142, doi:10.3389/fpubh.2022.856142.
[3] World Bank Group. E-Government. World Bank Group, 2018.
[4] https://ukraine.ua/invest-trade/digitalization/
[5] ibid

Drawing inspiration from Estonia, a world leader in e-governance,[6] [7]the introduction of e-government in Ukraine is guided by the development model implemented in Estonia. The Trembita system, which facilitates electronic interaction among state electronic information resources in Ukraine, is based on the improved Estonian X-ROAD data exchange platform. Analyzing the Estonian experience is relevant to understanding the economic effects of digitalization and e-governance on the Ukrainian economy.

Numerous studies indicate a positive relationship between e-governance and economic growth.[8] Review studies demonstrate that e-governance enhances the productive capacity of labour by increasing marginal productivity[9]. Furthermore, the extensive literature on e-government suggests that it improves the quality and efficiency of public services while mitigating corruption[10].

The importance of this investigation lies in understanding the potential benefits of digitalization and e-governance for Ukraine's economic development, such as streamlining administrative processes, reducing corruption, and promoting transparency—areas that hinder the country's economic growth nowadays. Insights from successful experiences in Estonia can guide Ukraine's policymakers in formulating effective strategies for economic development and transparency.

Recognizing the significance of digitalization in promoting economic growth, Ukraine, a country rich in human capital and natural resources, has focused on providing electronic public services as a crucial area of activity for public authorities. **Therefore, this**

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[6] Tamkivi, Sten. "Lessons from the World's Most Tech-Savvy Government." *The Atlantic*, 24 January 2014, https://www.theatlantic.com/international/archive/2014/01/lessons-from-the-worlds-most-tech-savvy-government/283341/.

[7] Bershidsky, Leonid. "Envying Estonia's Digital Government." *Bloomberg.com*, 4 March 2015, https://www.bloomberg.com/opinion/articles/2015-03-04/envying-estonia-s-digital-government#xj4y7vzkg.

[8] Al-Kibsi, Gassan, et al. "Putting Citizens On-Line, Not in Line." *The McKinsey Quarterly*, vol. 2, 2001, pp. 64-73.

[9] Grimes, Arthur, et al. "The need for speed: impacts of internet connectivity on firm productivity." *Journal of Productivity Analysis*, vol. 37, no. 3, 2012, pp. 187-201. *JSTORE*.

[10] Andersen, Thomas Barnebeck. "E-Government as an anti-corruption strategy." *Information Economics and Policy*, vol. 21, no. 3, 2009, pp. 201-210. *Science Direct*, https://www.sciencedirect.com/science/article/abs/pii/S0167624509000110.

Extended Essay aims to answer the research question: "To what extent do the digitalization of the economy and the implementation of e-governance initiatives promote economic growth in Ukraine?" Furthermore, during the research, we will attempt to answer the questions:

1. What is the mechanism under which E-governance fosters economic growth, and whether economic models can explain the realities presented in the work?
2. What role does e-governance play in improving transparency and reducing corruption in Ukraine?

Methodology

In the previous studies on the effects of e-governance on the country's economic growth and development, cross-country analysis and secondary data were the main methods employed to collect and analyze the data. Data used in this Extended Essay is the collection of data from 2018-2022, with an expanded time frame of 2003-2022 for regression analysis data.

Furthermore, to analyze the economic impacts of digitalization and e-government on the economic growth of Ukraine, studies about these effects on the Estonian economy were analysed from different reports. The secondary data sources for this research are statistical data and reports from government agencies, international organisations, and research institutions. Additional data and statistics were gathered from databases, such as World Bank and Statista, on GDP, Corruption Perception Index (CPI), and E-Government Development Index (EGDI).

The research examines how the digitalization of the economy can lead to increased productivity, innovation, and efficiency, drawing upon theories such as the Solow-Swan economic growth model, which highlights the role of technological progress in driving long-term economic growth and will also serve as a basis for creating the regression equation for the analysis part of the essay. In this extended essay, a comparative analysis will be included by examining data from Estonia, which successfully implemented e-governance, to provide insights into the economic impact of e-governance on GDP growth and corruption.

The Aggregate Supply (AS)/Aggregate Demand (AD) diagram illustrates how the digitalization of the economy and e-governance initiatives influence economic growth in Ukraine. The quantitative data will be subjected to regression analysis to identify correlations

and patterns between e-governance and economic growth indicators. The qualitative data will be analysed thematically to identify recurring themes and challenges.

Digitalization Initiatives in Ukraine

In 2016, the program "Digital Agenda of Ukraine 2020" was developed, which was adapted to the Digital Agenda of the European Union to support the transition to the digitalisation of public administration and the economy of the country.[11]

Ukraine reformed its public procurement sector through its e-procurement system, ProZorro.[12] The country's previous procurement practices were associated with corruption and led to an annual loss of $2 billion. ProZorro has helped to reduce corruption and increase transparency in public spending.[13]

Moreover, the system has become a recommended model for e-procurement reform by the European Bank for Reconstruction and Development. ProZorro can help other countries replicate Ukraine's success in reducing corruption, increasing transparency, and enabling efficient procurement practices.[14] By March 2016, over 3,900 governmental organisations had joined the pilot project and saved more than UAH 1.5 billion (around $55 million).[15]

In contrast, the process of digital transformation in Estonia started in early 2000. Since then, Estonia has managed to transfer 99% of public services online, and 98% of Estonian nationals use eID-s. The use of the data exchange layer, X-Road, saved Estonian administration 804 working years compared to previous calendar years, and it is estimated

[11] Tsyfrova Adzhenda Ukrayiny - 2020: Kontseptual′ni Zasady (Versiya 1.0) [Digital Agenda Of. 2020. https://ucci.org.ua/uploads/files/58e78ee3c3922.pdf
[12] Neumann, Georg. “ProZorro: How a Volunteer Project Led to Nation-Wide Procurement Reform in Ukraine.” Open Contracting Partnership, 28 July 2016, https://www.open-contracting.org/2016/07/28/prozorro-volunteer-project-led-nation-wide-procurement-reform-ukraine/.
[13] ibid
[14] Kelman, Christopher R. Yukins and Steven. *Overcoming Corruption and War -- Lessons from Ukraine's Prozorro Procurement System*.
[15] ibid

that using the electronic signature saves 2% of the Estonian GDP each year. The ICT sector forms about 7% of Estonia's GDP.[16]

In comparison, Ukraine's IT sector provides about 4% of the country's GDP and almost a quarter of Ukrainian export of services.[17]

In 2019, the Ministry of Digital Transformation of Ukraine[18] was established with the main objective of the realisation of the project "Diia" ("Action"), which will soon unite all governmental entities into a single efficient online system.[19]

Diia City is often referred to as a driver of the Ukrainian economy.[20] Introducing a special regime is expected to enable the IT industry to increase revenues from $6 billion to $16.5 billion in 5 years. According to the concept's authors, the IT industry is projected to contribute 10% to the country's GDP, and the number of employment opportunities in the sector is expected to rise to 450,000.

[16] "Case Study 8: Estonia e-Government and the Creation of a Comprehensive Data Infrastructure for Public Services and Agriculture Policies Implementation." Digital Opportunities for Better Agricultural Policies, OECD, 2019, pp. 207–213.
[17]Ukraine.Ua, https://ukraine.ua/stories/digitalization/
[18] Міністерства, Прес-Офіс. "Міністерство цифрової трансформації України." Gov.ua, https://thedigital.gov.ua/
[19] Official site of the Diia service. URL: https://diia.gov.ua/ [in Ukrainian]
[20] Ukraine.Ua, https://ukraine.ua/stories/digitalization/.

Impact on Economic Growth

Economic growth refers to an increase in the produced output within an economy measured by an increase in real GDP over a time period.

Since the conceptualization of Neoclassical growth theory, developed by Robert Solow and Trevor Swan in 1956-57, technology, along with capital and labour, has been considered a key factor of economic growth.[21] Numerous studies have analysed the effects of technology on economic growth from a historical perspective. For example, Mokyr[22] studies the role of technology during the Industrial Revolution, while Jorgensen[23] explicitly references digital technologies and notes that their role was crucial in initiating investment and spread of these technologies. The possible effect of digitalization and e-governance on the economic growth is shown in the AD/AS Figure 1 below.

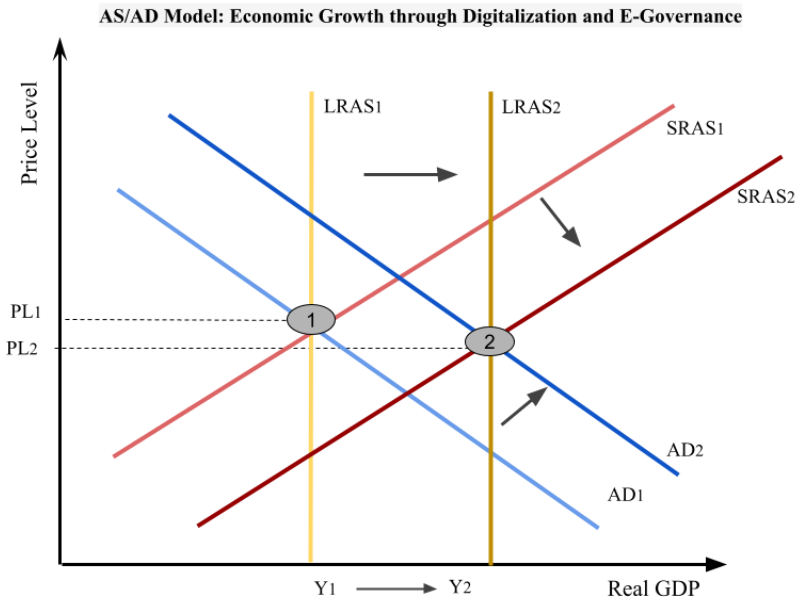

Figure 1: AS/AD Model: Economic Growth through Digitzalization and E-Governance

[21] Dimand, Robert W., and Barbara J. Spencer. "Trevor Swan and the Neoclassical Growth Model." History of Political Economy, vol. 41, no. Suppl_1, 2009, pp. 107–126, doi:10.1215/00182702-2009-019.
[22] Mokyr, Joel. "Long-Term Economic Growth and the History of Technology." *Handbook of Economic Growth*, Elsevier, 2005, pp. 1113–1180.
[23] Jorgenson, Dale W. "Chapter 10 Accounting for Growth in the Information Age." Handbook of Economic Growth, vol. 1, Part A, Elsevier, 2005, pp. 743–815.

Long-run aggregate supply (LRAS) refers to the total production capacity of an economy when all its resources are fully utilized.

LRAS shift occurs when there are changes in factors that affect the potential output of an economy. An increase in resources or productivity will lead to an outward shift of the long-run aggregate supply (LRAS) curve. The improvement in capital quality also relies on technological advancements, enabling the production of a greater output with the same level of inputs and leading to the introduction of new machinery and more advanced equipment.

Advances in digitalization and e-governance positively impact long-run aggregate supply (LRAS) through increased productivity, efficiency gains, and streamlined government processes. This leads to an expansion in the economy's real output from Y1 to Y2. The LRAS curve shifts to the right from LRAS1 to LRAS2, indicating an increase in long-run aggregate supply, as is also evidenced by real-world data, with the IT sector in Ukraine experiencing a 36% increase in exports from $5 billion to $6.8 billion in 2021.

In contrast, short-run economic growth is generally influenced by demand-side factors such as changes in consumer spending or government policy. With advances in digitalization and e-governance, increased productivity and innovation can boost consumer and business confidence, leading to higher spending and investment. The AD curve shifts outwards from AD1 to AD2, indicating increased aggregate demand.

Reduced levels of corruption and increased productivity, as a result of e-governance implementation, will further increase business confidence and investment in the economy, accelerating the time needed to start the business or resolve the issue; a rise in productivity gives the firm the ability to produce more while maintaining low or constant costs.[24] As a result, firms make more, shifting the short-run aggregate supply to the right, from SRAS1 to SRAS2.

[24] “Short Run Aggregate Supply.” Hello Vaia, https://www.hellovaia.com/explanations/macroeconomics/aggregate-supply-and-demand/short-run-aggregate-supply/

To better contextualize the significance of technology and its potential impact on Ukraine's economic growth, it's essential to consider the country's recent economic challenges. Ukraine has faced obstacles such as political insecurity, corruption, and structural inefficiencies, all of which have hindered its progress compared to other European nations.

Nevertheless, according to the Forum for Research on Eastern Europe and Emerging Economies, each 1% growth in digitisation will increase Ukraine's GDP by 0.42%.

Additionally, by joining the EU Digital Single Market, Ukraine's GDP could increase by 12.1%.

In this context, new technology is what permits labor augmentation, whereby each unit of labor becomes more productive. The formulation of neoclassical growth theory by Swan significantly impacted the research field.

The model highlights the role of technological progress, capital accumulation, and labour force growth in driving economic growth.[25] Exogenous growth factors encompass external elements like the pace of technological progress or the savings rate. Solow-Swan model underscores the interconnectedness of economic growth with the accumulation of capital and knowledge, commonly referred to as innovation, including advancements in digitalization.

By applying the Solow model in our research, we can examine to what extent the digitalization of the economy, or e-governance, contributes to the economic growth of Ukraine.

The model is built upon the aggregate neoclassical production function but incorporates modifications by incorporating the factor of technological progress. It serves as an interpretation of the classic Cobb-Douglas production function $Q = f(L, K) = AL^{\alpha}K^{\beta}$,

[25] Solow, Robert M. "A Contribution to the Theory of Economic Growth." The Quarterly Journal of Economics, vol. 70, no. 1, 1956, p. 65, doi:10.2307/1884513.

which expresses the quantity Q of output as a function of capital K, and labor L,[26] and Total Factor Productivity (TFP) A,[27] represented by EGDI in our case.

TFP is the portion of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production.[28] In the long run, the rate of economic growth depends on the TFP growth rate, which is determined by the rate of technological progress. Therefore, for purposes of this research, TFP is represented by EGDI.

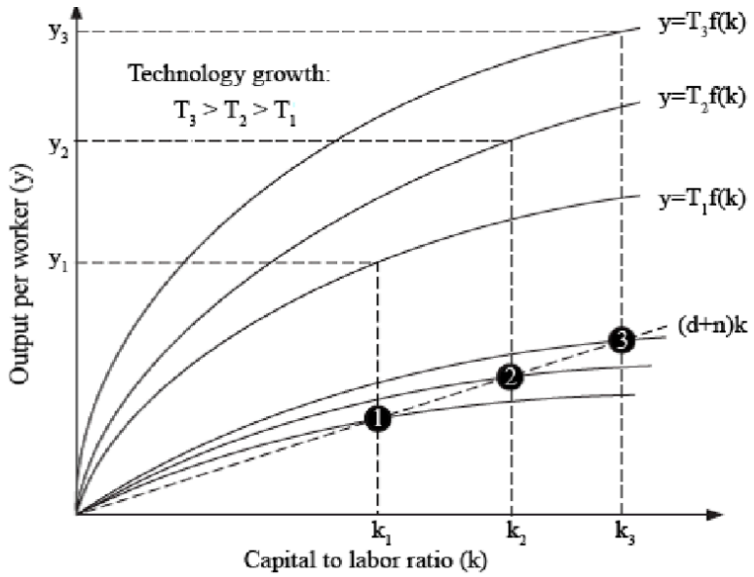

Figure 2: Technological changes in the growth model of Robert Solow[29]

Where *T* represent *A*, or *TFP*, also shown as EGDI in this essay; and *k*–capital to labour ratio.

[26] McKenzie, Tom. "Cobb-Douglas Production Function." INOMICS, https://inomics.com/terms/cobb-douglas-production-function-1456726.

[27] Solow, Robert M. "A Contribution to the Theory of Economic Growth." The Quarterly Journal of Economics, vol. 70, no. 1, 1956, p. 65, doi:10.2307/1884513.

[28] "Total Factor Productivity." The New Palgrave Dictionary of Economics, Palgrave Macmillan UK, 2008, pp. 1–4.

[29] Sredojević, Dragoslava, et al. "Technological Changes in Economic Growth Theory: Neoclassical, Endogenous, and Evolutionary-Institutional Approach." Economic Themes, vol. 54, no. 2, 2016, pp. 177–194, doi:10.1515/ethemes-2016-0009. Available from: https://www.researchgate.net/figure/Technological-changes-in-the-growth-model-of-Robert-Solow_fig3_305677305

Other Theories of Economic Growth

Apart from the Solow-Swan exogenous theory of economic growth used in this extended essay, there exist alternative approaches that indicate how nations utilize their resources and manage economic variables to achieve growth. The most popular theories of economic growth are Classical, Endogenous, and Exogenous, among others.[30]

For example, Classical Theory, developed by Adam Smith and David Ricardo, emphasizes the role of free markets and allocative efficiency in promoting economic growth.[31] It underscores the importance of labor productivity, market forces, and trade in fostering growth. However, it doesn't account for factors like technological advancements and economies of scale.

In contrast, while both exogenous and endogenous theories rely on technological progress to achieve sustained economic growth,[32] the endogenous theory focuses more on internal factors such as capital investment, public policies, and the labour force.[33]

Solow-Swan exogenous theory was chosen for this extended essay because it provides a valuable framework for understanding economic growth by incorporating technological change and capital accumulation while maintaining simplicity, making it suitable for regression analysis within this essay.

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[30] Sharipov, Ilkhom. “Contemporary Economic Growth Models and Theories: A Literature Review.” CES Working Papers, vol. 7, no. 3, 2015, pp. 759–773, https://www.econstor.eu/handle/10419/198426.
[31] Ibid (pp. 761-762)
[32] Ibid (pp. 766-771)
[33] Ganti, Akhilesh. “Exogenous Growth: Definition, Economic Theory, vs. Endogenous.” Investopedia, 14 Nov. 2010, https://www.investopedia.com/terms/e/exogenous-growth.asp.

Developing the regression model

Based on previous literature, the hypothesis suggests a positive correlation between digitalization, e-government, and a country's economic growth. To test this, the model incorporates the neoclassical production function with technological progress as a factor to examine the correlation between independent variables (EGDI, TLF, K) and dependent variable–GDP, representing an interpretation of the classic Cobb-Douglas production function, which underscores the interconnectedness of economic growth with innovation.

This framework, adapted from Kyiv National Economic University research,[34] utilises updated indexes from the World Bank and UN E-governance knowledgebase. To successfully perform the regression analysis, the time frame was expanded to 2012-2022 to increase the number of input variables, shown in Appendix 1. In addition, multiple linear regression analysis was chosen instead of panel regression analysis because it is relatively simpler to interpret and enables assessment of the individual effects of each independent variable of the GDP.

The equation for the regression is:

$$log\,(GDP) \sim log(EGDI) + log(TLF) + log(K) + factor(TIME) + \varepsilon$$

Table 1: Indicator description and source

Indicator	**Description**	**Source:**
GDP	Gross Domestic Product	World bank https://data.worldbank.org/
TLF	Total labour force	
K	Gross fixed capital formations	
EGDI	E-government development index	UN E-government knowledge base https://publicadministration.un.org/

[34] Kotenok, Andrii, et al. "The E-Government's Influence on the Country's Economy (at the Example of Ukraine and Estonia)." Proceedings of the III International Scientific Congress Society of Ambient Intelligence 2020 (ISC-SAI 2020), Atlantis Press, 2020.

T	Time	-
ε	Error	-

Table 2: Indicators for regression calculations of Economic growth for Ukraine and graphs

TIME	EGDI	TLF	K (constant 2015 US$)	GDP, PPP (Constant 2017 US$)
2018	0.6165	21244133	20630000000	521480000000
2019	-	21148251	18670000000	538160000000
2020	0.7119	20585937	11670000000	517970000000
2021	-	20285701	21150000000	535820000000
2022	0.8029	-	14070000000	379890000000

Results of the Regression analysis

Regression equation:

$$Log_{10}(GDP) = -43.917671 + 0.0185419\ TIME + 0.212412\ Log_{10}(EGDI) + 2.322079\ Log_{10}(TLF) + 0.121409\ Log_{10}(K)$$

R2	0.983723	**Adjusted R2**	0.970702

Pearson correlation matrix:

	$Log_{10}(GDP)$	TIME	$Log_{10}(EGDI)$	$Log_{10}(TLF)$	$Log_{10}(K)$
$Log_{10}(GDP)$	1	0.950673	0.787906	-0.909034	0.448439
TIME	0.950673	1	0.763082	-0.97837	0.18487
$Log_{10}(EGDI)$	0.787906	0.763082	1	-0.821311	0.305769
$Log_{10}(TLF)$	-0.909034	-0.97837	-0.821311	1	-0.117793
$Log_{10}(K)$	0.448439	0.18487	0.305769	-0.117793	1

Overall, the multiple linear regression results indicated a very strong collective significant effect between the TIME, EGDI, TLF, K, and GDP.

Based on the data presented above, the following conclusions can be made:

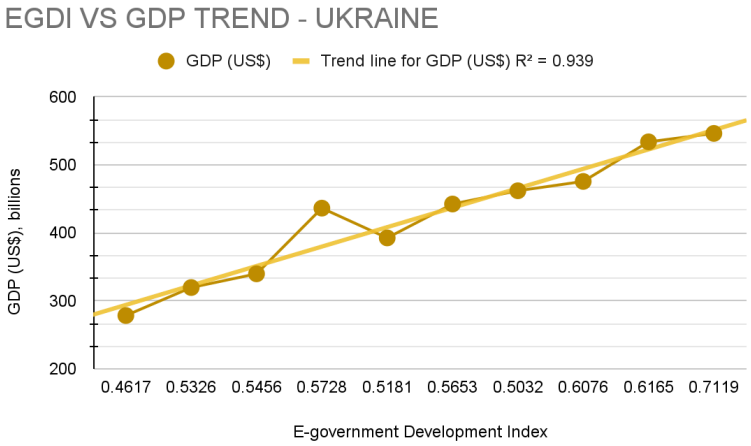
1. **X and Y relationship.** The R^2 value indicates the proportion of the variance in the dependent variable (GDP) explained by the independent variables (EGDI, TIME, TLF, K). In this case, the adjusted R^2 = 0.970702 suggests that approximately 97% of the variation in GDP can be explained by the independent variables included in the model.
2. **Pearson Correlation Table.** The correlation matrix provides insights into the strength and direction of the relationships between the variables. For instance, a moderate positive correlation (0.787906) exists between Log_{10}(GDP) and TIME, meaning that GDP tends to increase over time, which is because of factors such as population growth, long-term trends, technological progress, etc.
3. **EGDI and GDP.** There is a significant positive relationship between the EGDI and GDP. The coefficient of 0.2124 suggests that an increase in EGDI is associated with an increase in GDP. This indicates that digitalization and e-government initiatives can contribute to economic growth. Therefore, if the e-government index rises by 1%, the GDP rises by 0.2%, which is actually twice lower than predicted by FREE Network 0.42%.

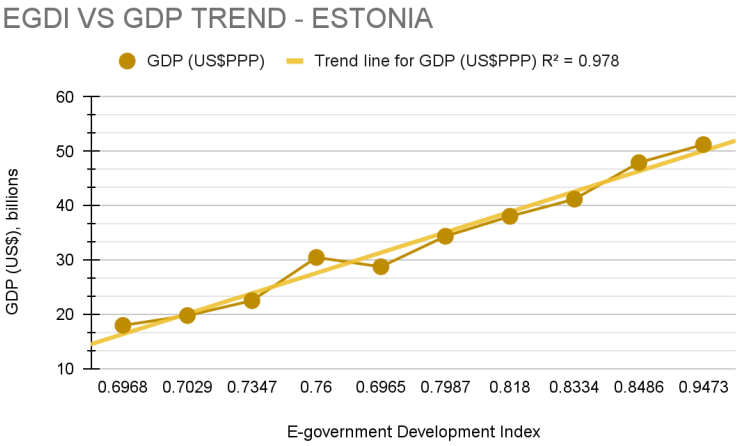
The strong positive correlation between EGDI and GDP supports the hypothesis that digitalization and e-government initiatives contribute to a country's economic growth. The findings in the research align with the Solow-Swan model, which considers the input of a nation's population, capital and advances in technology. The model indicates that a 1% increase in the e-government index leads to a 0.2% rise in GDP, suggesting that countries with better digital infrastructure and e-government services tend to have stronger economies.

Cross-country analysis: Ukraine and Estonia

In this section, we will compare the correlation between GDP and EGDI to Estonian, one of the global leaders in the EGDI.[35] Estonia has achieved remarkable success in harnessing digital technologies to enhance public services. By examining the data and graphs, we will observe how the stronger EGDI index in these countries contributes significantly to their economic prosperity.

Figure 3 and 4: EGDI and GDP trend (adapted from data from World Bank and UN E-governance knowledgebase)[36]





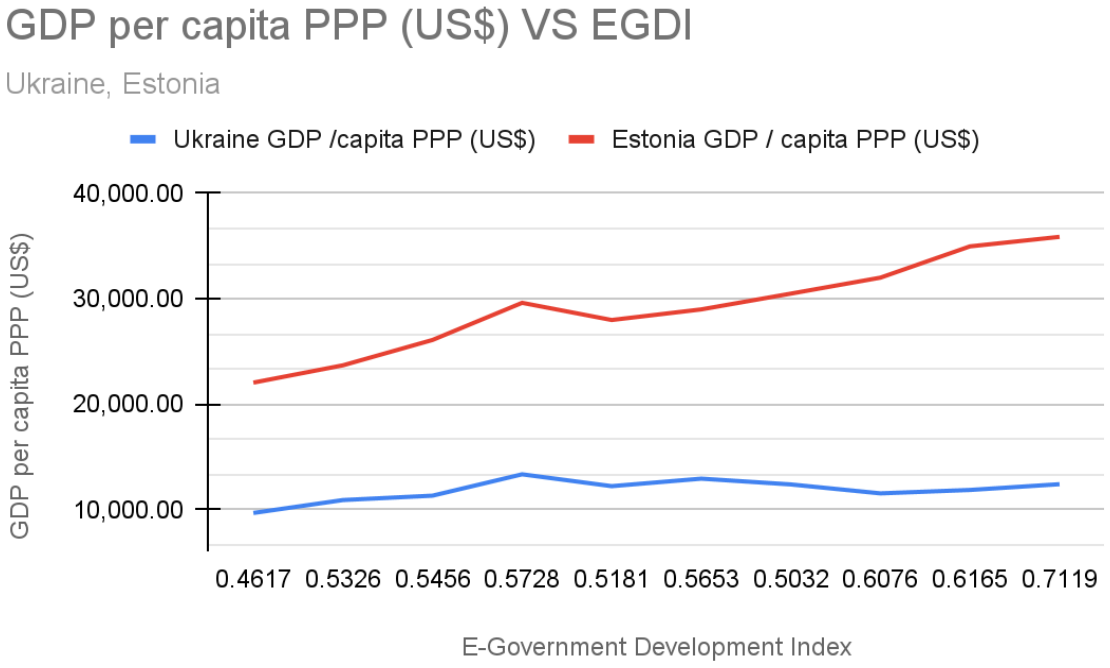
Ukraine lags behind Estonia regarding EGDI scores, suggesting a lower level of e-governance advancement. Nevertheless, both countries show the trend that as EGDI increases, GDP increases too.

However, while from the previous section, we learned that EGDI has a strong influence on a country's GDP growth, other factors must be also acknowledged. Furthermore, the cause-effect relationship between the two variables is unclear: Is it possible that higher levels of economic development contribute to an increase in EGDI, which then leads to GDP growth? To answer this question, further research and in-depth analysis are required.

[35] "E-Government Development Index (EDGI) Leaders 2022." Statista, https://www.statista.com/statistics/421580/egdi-e-government-development-index-ranking/.
[36] Publicadministration.un.org, https://publicadministration.un.org/egovkb/en-us/Data-Center.

The variation in R^2 values among the countries implies that the strength of the relationship between EGDI and GDP PPP differs. One possible reason for Estonia having a higher R^2 value than Ukraine in the correlation between EGDI and GDP could be the timing of the digitalization of their economies. Ukraine's digitalization efforts may still be in a relatively early stage or disturbed by economic crisises, with various infrastructural and institutional challenges yet to be addressed. These findings highlight the importance of e-governance development in driving economic growth, with Estonia leading in employing e-governance for economic prosperity.

Figure 5: GDP per capita (US$) and EGDI trend for Estonia and Ukraine



GDP PPP per capita considers the population size of each country. By considering GDP per capita, we can better understand the economic performance per person. A higher GDP per capita, relative to the level of EGDI, suggests that a country is effectively translating e-governance development into improved individual prosperity, which is consistent with our hypothesis since an advanced e-governance system enables more efficient and streamlined public services, leading to increased productivity and reduced administrative

burdens for businesses and individuals. This can contribute to higher economic activity and individual prosperity.

The findings highlight the importance of investing in e-governance development to foster economic growth and enhance individual prosperity.

EGDI and Corruption

Corruption involves abusing entrusted power for personal gain. It includes acts like public servants demanding or taking bribes, politicians misusing public funds or granting favors to friends and family, and corporations bribing officials. Corruption undermines trust, weakens democracy, hampers economic development, and exacerbates inequality, poverty, and environmental crises.[37]

Transparency International's Corruption Perception Index (CPI) ranks 180 countries by their perceived levels of public sector corruption on a scale from 0 (highly corrupt) to 100 (very clean).[38] In 2022, Ukraine ranked 116th with a score of 33. In comparison, Estonia ranked 13, scoring 74. [39]

Principal-agent problem

The principal-agent model suggests that corruption is a problem of asymmetric information,[40] where principals are public officials who represent the state. Corruption may arise when the agents, who, according to the model, have more information, use this position to satisfy their interests.

According to previous research,[41] Jain finds that for corruption to exist, there needs to be:

1. Discretionary power, including the power of legislation, administration, regulation;
2. economic rents associated with the power;
3. less frequent detection and low penalty of corruption.

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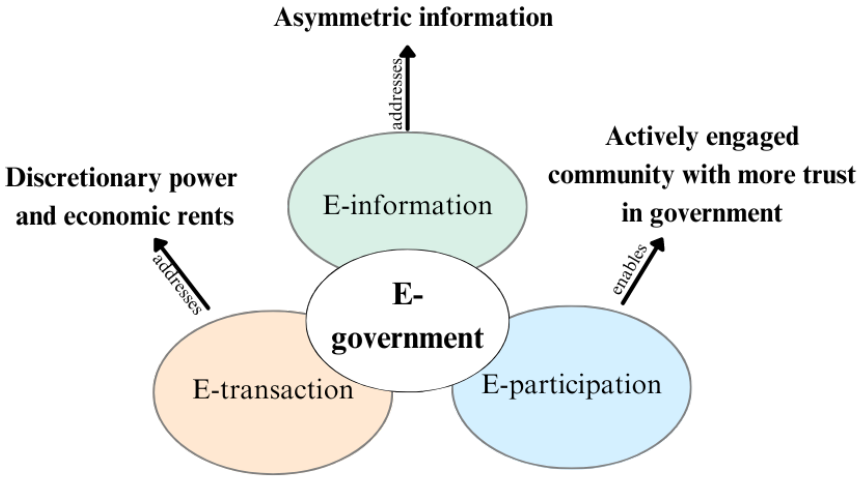
[37] "What Is Corruption?" Transparency.org, 10 Nov. 2019, https://www.transparency.org/en/what-is-corruption.
[38] "2022." Transparency.org, 31 Jan. 2023, https://www.transparency.org/en/cpi/2022.
[39] "2021." Transparency.org, 25 Jan. 2022, https://www.transparency.org/en/cpi/2021?gclid=EAIaIQobChMIner4y63C_wIVzPCyCh28bQuxEAAYASAAEgLCd_D_BwE.
[40] Klitgaard, Robert. Controlling Corruption. University of California Press, 1992.
[41] Jain, Arvind K. "Corruption: A Review." Journal of Economic Surveys, vol. 15, no. 1, 2001, pp. 71–121, doi:10.1111/1467-6419.00133.

Consequently, the e-government's success in reducing corruption is determined by its ability to eliminate the above factors.

In his work[42], Manoharan explains that e-government is three-dimensional and consists of e-information, e-transaction, and e-participation, and concludes that its implementation can reduce corruption across all dimensions.

Figure 6: Use of technology to reduce corruption across all dimensions. Student-created diagram, adapted from "A Three Dimensional Assessment of U.S. County e-Government" [43]



In the diagram, we can see how each dimension can address the causes of corruption.

Numerous cross-country studies[44] [45] [46] have demonstrated a positive correlation between the development of e-government and the decrease in corruption. In the context of Ukraine, where corruption poses a significant challenge to economic prosperity, it becomes crucial to investigate the correlation between the development of e-governance and a decrease in corruption.

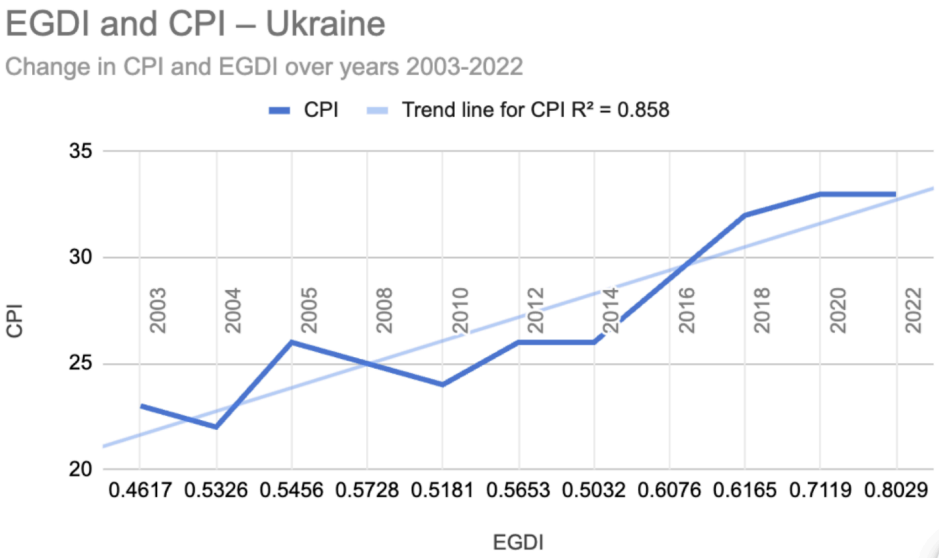
[42] Manoharan, Aroon. "A Three Dimensional Assessment of U.s. County e-Government." State and Local Government Review, vol. 45, no. 3, 2013, pp. 153–162, doi:10.1177/0160323x13494858.
[43] ibid
[44] Andersen, Thomas Barnebeck. "E-Government as an Anti-Corruption Strategy." Information Economics and Policy, vol. 21, no. 3, 2009, pp. 201–210, doi:10.1016/j.infoecopol.2008.11.003.
[45] Lio, Mon-Chi, et al. "Can the Internet Reduce Corruption? A Cross-Country Study Based on Dynamic Panel Data Models." Government Information Quarterly, vol. 28, no. 1, 2011, pp. 47–53, doi:10.1016/j.giq.2010.01.005.
[46] Elbahnasawy, Nasr G. "E-Government, Internet Adoption, and Corruption: An Empirical Investigation." World Development, vol. 57, 2014, pp. 114–126, doi:10.1016/j.worlddev.2013.12.005.

Data on Ukraine's E-Governance Development Index (EGDI) and Corruption Perceptions Index (CPI) was collected. The relationship between these indices provides valuable insights into the effectiveness of e-governance in addressing corruption.

Figure 7: Relationship between EGDI and CPI in Ukraine from 2003 to 2022

Ukraine:

Time	EGDI	CPI
2003	0.4617	23
2004	0.5326	22
2005	0.5456	26
2008	0.5728	25
2010	0.5181	24
2012	0.5653	26
2014	0.5032	26
2016	0.6076	29
2018	0.6165	32
2020	0.7119	33
2022	0.8029	33



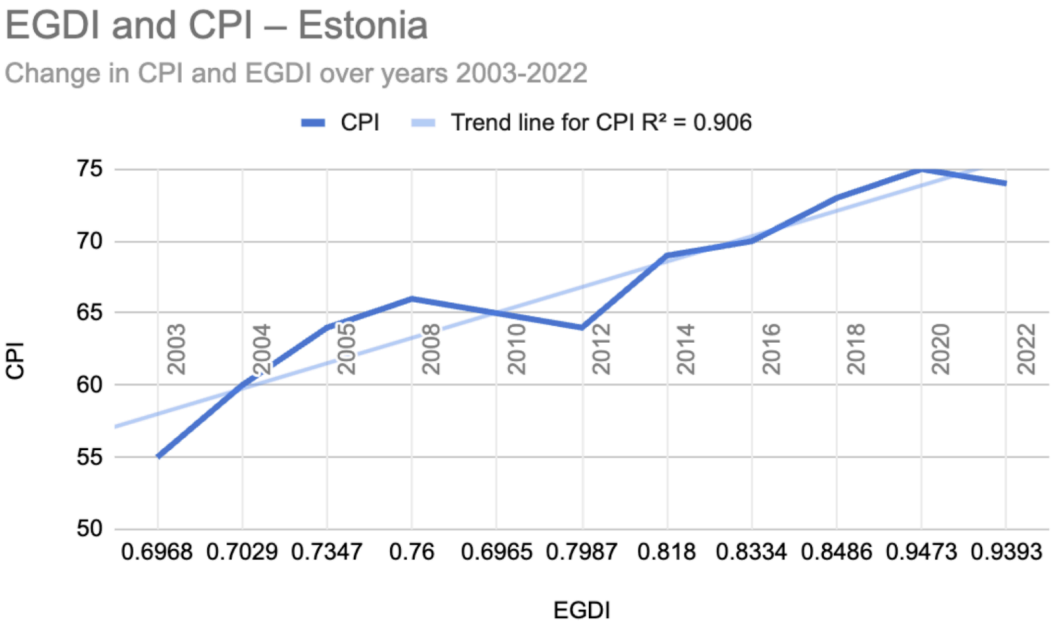
The data shows a general upward trend in both EGDI and CPI scores over the years, indicating improvements in e-governance alongside fluctuations in corruption perception. Plotting the data points on a graph and fitting a trend line reveals a strong positive correlation between EGDI and CPI, as indicated by the high R^2 coefficient of 0.858. This suggests that as e-governance improves, there is a tendency for the CPI to increase in Ukraine. However, conducting a more in-depth analysis is essential to understand the specific factors underlying this relationship.

A comparison between Estonia can be introduced to allow for a comparative perspective on the effectiveness of e-governance in different contexts.

Figure 8: Relationship between EGDI and CPI in Estonia from 2003 to 2022

Estonia:

Time	EGDI	CPI
2003	0.6968	55
2004	0.7029	60
2005	0.7347	64
2008	0.76	66
2010	0.6965	65
2012	0.7987	64
2014	0.818	69
2016	0.8334	70
2018	0.8486	73
2020	0.9473	75
2022	0.9393	74



In Estonia, the EGDI scores consistently show an upward trend, indicating the continuous improvement of e-governance practices. Correspondingly, the CPI scores demonstrate a generally positive trend, suggesting a perceived decrease in corruption levels. The high R^2 coefficient of 0.906 indicates a strong positive correlation between EGDI and CPI in Estonia.

Comparing the data for Estonia and Ukraine, it becomes evident that while Estonia consistently achieves higher EGDI and CPI scores than Ukraine, the general trend is similar for both countries. Implementing effective e-governance initiatives contributes to lower corruption levels and better economic governance. The positive correlation observed in all three countries supports the notion that advancements in e-governance can potentially reduce corruption.

The higher EGDI and CPI scores in Estonia could be attributed to factors such as strong institutional frameworks, digital infrastructure, efficient online services, and transparent governance mechanisms. The experience of Estonia can serve as a model for Ukraine in developing strategies to improve e-governance and combat corruption effectively.

Conclusion

This extended essay aimed to explore the impact of digitalization and e-governance on economic growth in Ukraine. The analysis revealed that digitalization and e-governance initiatives have the potential to promote economic growth by increasing productivity, innovation, and efficiency. The study drew upon theories such as the AS/AD and Solow-Swan growth models to establish the link between digitalization, e-governance, and economic growth.

Through a comparative analysis with Estonia, which has successfully implemented e-governance, valuable insights were gained into the economic impact of digitalization. The study used secondary research techniques, including regression analysis and thematic analysis, to examine data from previous studies and sources such as the World Bank and UN Knowledge Base.

The findings indicate a positive relationship between e-governance and economic growth, with studies showing that e-governance enhances labour productivity, improves the quality of public services, and mitigates corruption. The case of Ukraine demonstrated advancements in its e-governance ecosystem, mainly through initiatives like the Diia City and the ProZorro system, which have contributed to reducing corruption and administrative burdens, positively impacting economic growth.

Moreover, a comparison of EGDI and GDP of Ukraine and Estonia highlights that nations with robust digital infrastructure and e-government services experience stronger economic growth.

Applying the Sollow-Swan model to our analysis examined whether digitalization and e-governance positively correlate with economic growth, as hypothesized. The regression

analysis conducted for Ukraine revealed a significant positive relationship between the e-government development index (EGDI) and GDP. Notably, the coefficient of 0.2124 for the GDP regression equation shows a significant positive link, indicating that a 1% increase in the e-government index leads to a 0.2% GDP rise, affirming digitalization's economic impact. This is consistent with the Solow-Swan model, highlighting the role of technology/innovation in economic progress.

However, this finding differs from the predicted by FREE Forum 0.4% GDP increase. The difference might be due to the different methodologies or time frames used, indicating that further research may be needed to understand the reasons behind this disparity.

One limitation of the study that might explain the difference is the use of multiple regression analysis due to its simplicity in interpretation instead of panel regression, which is used in econometrics and accounts for multi-dimensional analysis. The lack of updated statistical information due to the ongoing war in Ukraine also yielded some limitations to regression analysis to fully capture the current economic situation.

The AS/AD model demonstrates the potential for e-governance to foster economic growth in Ukraine through its positive influence on aggregate demand and supply. Real-world data, exemplified by the success of the ProZorro e-procurement system to increase transparency and IT-service exports, supports this finding. However, challenges like corruption and administrative barriers may hinder the full realization of these benefits, indicating that the AS/AD model offers valuable insights but may not fully capture Ukraine's economic complexity, as it does not account for structural inefficiencies and corruption issues.

Despite advancements in e-governance, it is essential to acknowledge that successful implementation of digital initiatives requires addressing underlying issues, including

infrastructural constraints and corruption, which can hinder the effective impact on economic development.

In conclusion, the findings of this extended essay underscore the importance of digitalization and e-governance in promoting economic growth. The study provides valuable insights for policymakers and stakeholders in Ukraine to prioritize and further develop digitalization initiatives to drive economic growth, increase productivity, and improve public services. By harnessing the potential of digital technologies and embracing e-governance, Ukraine can unlock new opportunities and overcome existing challenges on its path to sustainable economic development.

Bibliography

1. “2021.” Transparency.org, 25 Jan. 2022, https://www.transparency.org/en/cpi/2021?gclid=EAIaIQobChMIner4y63C_wIVzPCyCh28bQuxEAAYASAAEgLCd_D_BwE.

2. “2022.” Transparency.org, 31 Jan. 2023, https://www.transparency.org/en/cpi/2022.

3. “About.” Gov.Ua, https://prozorro.gov.ua/en/about.

4. Al-Kibsi, Gassan, et al. “Putting Citizens On-Line, Not in Line.” The McKinsey Quarterly, vol. 2, 2001, pp. 64-73.

5. Andersen, Thomas Barnebeck. “E-Government as an Anti-Corruption Strategy.” Information Economics and Policy, vol. 21, no. 3, 2009, pp. 201–210, doi:10.1016/j.infoecopol.2008.11.003.

6. Banton, Caroline. “What Is the Neoclassical Growth Theory, and What Does It Predict?” Investopedia, 31 May 2009, https://www.investopedia.com/terms/n/neoclassical-growth-theory.asp.

7. Bassanini, Andrea, and Stefano Scarpetta. “The Driving Forces of Economic Growth: Panel Data Evidence for the Oecd Countries.”, pp. 11-16, Oecd.org, 2001, https://www.oecd.org/economy/growth/18450995.pdf.

8. “Can the Internet Reduce Corruption? A Crosscountry Study Based on Dynamic Panel Data Models.” Government Information Quarterly.

9. “Case Study 8: Estonia e-Government and the Creation of a Comprehensive Data Infrastructure for Public Services and Agriculture Policies Implementation.” Digital Opportunities for Better Agricultural Policies, OECD, 2019, pp. 207–213.

10. Comin, Diego. “Total Factor Productivity.” Oyetimes.com, https://www.oyetimes.com/wp-content/uploads/2017/01/def.pdf.

11. “Denmark, Finland and South Korea Top the 2022 UN e-Government Ranking.” United Nations Western Europe, United Nations, 5 Oct. 2022, https://unric.org/en/denmark-finland-and-south-korea-top-the-2022-un-e-government-ranking/.

12. Digital Economy and Society in the EU - What Is the Digital Single Market About?

13. Dimand, Robert W., and Barbara J. Spencer. “Trevor Swan and the Neoclassical Growth Model.” History of Political Economy, vol. 41, no. Suppl_1, 2009, pp. 107–126, doi:10.1215/00182702-2009-019.

14. “E-Government Development Index (EDGI) Leaders 2022.” Statista, https://www.statista.com/statistics/421580/egdi-e-government-development-index-ranking/.

15. Elbahnasawy, Nasr G. “E-Government, Internet Adoption, and Corruption: An Empirical Investigation.” World Development, vol. 57, 2014, pp. 114–126, doi:10.1016/j.worlddev.2013.12.005.

16. “EProcurement System ProZorro.” Observatory of Public Sector Innovation, 29 Oct. 2016, https://oecd-opsi.org/innovations/eprocurement-system-prozorro/.

17. Ganti, Akhilesh. “Exogenous Growth: Definition, Economic Theory, vs. Endogenous.” Investopedia, 14 Nov. 2010, https://www.investopedia.com/terms/e/exogenous-growth.asp.

18. Harnessing the Digital Economy for Developing Countries. Organisation for Economic Co-Operation and Development (OECD), 2016.

19. Howitt, Peter. “Endogenous Growth Theory.” Economic Growth, Palgrave Macmillan UK, 2010, pp. 68–73.

20. “Individuals Using the Internet (% of Population) - Ukraine.” World Bank Open Data, https://data.worldbank.org/indicator/IT.NET.USER.ZS?end=2021&locations=UA&start=2014.

21. Jain, Arvind K. “Corruption: A Review.” Journal of Economic Surveys, vol. 15, no. 1, 2001, pp. 71–121, doi:10.1111/1467-6419.00133.

22. Jorgenson, Dale W. “Chapter 10 Accounting for Growth in the Information Age.” Handbook of Economic Growth, vol. 1, Part A, Elsevier, 2005, pp. 743–815.

23. Klitgaard, Robert. Controlling Corruption. University of California Press, 1992.

24. Kotenok, Andrii, et al. “The E-Government’s Influence on the Country’s Economy (at the Example of Ukraine and Estonia).” Proceedings of the III International Scientific Congress Society of Ambient Intelligence 2020 (ISC-SAI 2020), Atlantis Press, 2020.

25. Kwatiah, Natasha. “The Cobb-Douglas Production Function.” Economics Discussion, 2 Mar. 2016, https://www.economicsdiscussion.net/production-function/the-cobb-douglas-production-function/18519.

26. Labhard, Vincent, and Jonne Lehtimäki. Digitalisation, Institutions and Governance, and Growth: Mechanisms and Evidence. doi:10.2866/56792.

27. Lio, Mon-Chi, et al. “Can the Internet Reduce Corruption? A Cross-Country Study Based on Dynamic Panel Data Models.” Government Information Quarterly, vol. 28, no. 1, 2011, pp. 47–53, doi:10.1016/j.giq.2010.01.005.

28. Manoharan, Aroon. “A Three Dimensional Assessment of U.s. County e-Government.” State and Local Government Review, vol. 45, no. 3, 2013, pp. 153–162, doi:10.1177/0160323x13494858.

29. McKenzie, Tom. “Cobb-Douglas Production Function.” INOMICS, https://inomics.com/terms/cobb-douglas-production-function-1456726.

30. Mokyr, Joel. “Long-Term Economic Growth and the History of Technology.” Handbook of Economic Growth, Elsevier, 2005, pp. 1113–1180.

31. Munguía, Rodrigo, et al. “Estimation of the Solow-Cobb-Douglas Economic Growth Model with a Kalman Filter: An Observability-Based Approach.” Heliyon, vol. 5, no. 6, 2019, p. e01959, doi:10.1016/j.heliyon.2019.e01959.

32. Neumann, Georg. “ProZorro: How a Volunteer Project Led to Nation-Wide Procurement Reform in Ukraine.” Open Contracting Partnership, 28 July 2016, https://www.open-contracting.org/2016/07/28/prozorro-volunteer-project-led-nation-wide-procurement-reform-ukraine/.

33. Publicadministration.un.org, https://publicadministration.un.org/egovkb/en-us/Data-Center.

34. Razumei, H. Yu, and M. M. Razumei. “Digitalization of Public Administration as a Component of Digital Transformation of Ukraine.” Public Administration and Customs Administration, no. 2(25), 2020, pp. 139–145, doi:10.32836/2310-9653-2020-2.25.

35. Sharipov, Ilkhom. “Contemporary Economic Growth Models and Theories: A Literature Review.” CES Working Papers, vol. 7, no. 3, 2015, pp. 759–773, https://www.econstor.eu/handle/10419/198426.

36. “Short Run Aggregate Supply.” Hello Vaia, https://www.hellovaia.com/explanations/macroeconomics/aggregate-supply-and-demand/short-run-aggregate-supply/

37. Solow, Robert M. “A Contribution to the Theory of Economic Growth.” The Quarterly Journal of Economics, vol. 70, no. 1, 1956, p. 65, doi:10.2307/1884513.

38. Sredojević, Dragoslava, et al. “Technological Changes in Economic Growth Theory: Neoclassical, Endogenous, and Evolutionary-Institutional Approach.” Economic Themes, vol. 54, no. 2, 2016, pp. 177–194, doi:10.1515/ethemes-2016-0009. Available from: https://www.researchgate.net/figure/Technological-changes-in-the-growth-model-of-Robert-Solow_fig3_305677305

39. Stromberg, Svante. “Ukraine’s Integration into the EU’s Digital Single Market.” FREE NETWORK, Free Policy Briefs, 14 Feb. 2021, https://freepolicybriefs.org/2021/02/15/ukraines-integration-single-market/.

40. Sutela, Pekka. “The Underachiever: Ukraine’s Economy since 1991.” Carnegie Endowment for International Peace, 9 Mar. 2012, https://carnegieendowment.org/2012/03/09/underachiever-ukraine-s-economy-since-1991-pub-47451.

41. “Theories of Growth.” Corporate Finance Institute, 7 Nov. 2019, https://corporatefinanceinstitute.com/resources/economics/theories-of-growth/.

42. “What Is Corruption?” Transparency.org, 10 Nov. 2019, https://www.transparency.org/en/what-is-corruption.

43. Wikipedia contributors. “Solow–Swan Model.” Wikipedia, The Free Encyclopedia, 28 Jan. 2023, https://en.wikipedia.org/w/index.php?title=Solow%E2%80%93Swan_model&oldid=1136027721.

44. World Bank Group. E-Government. World Bank Group, 2018.

45. Kelman, Christopher R. Yukins and Steven. Overcoming Corruption and War – Lessons from Ukraine’s Prozorro Procurement System.

46. Zhang, Jinzhu, et al. “The Impact of Digital Economy on the Economic Growth and the Development Strategies in the Post-COVID-19 Era: Evidence from Countries along the ‘Belt and Road.’” Frontiers in Public Health, vol. 10, 2022, p. 856142, doi:10.3389/fpubh.2022.856142.

47. Міністерства, Прес-Офіс. “Міністерство цифрової трансформації України.” Gov.ua, https://thedigital.gov.ua/.

48. Tsyfrova Adzhenda Ukrayiny - 2020: Kontseptual′ni Zasady (Versiya 1.0) [Digital Agenda Of Ukraine - 2020. https://ucci.org.ua/uploads/files/58e78ee3c3922.pdf

49. Ukraine.Ua, https://ukraine.ua/stories/digitalization/.

Appendix 1

Expanded table of indicators for regression calculations of Economic growth for Ukraine and graphs from 2012-2022:

TIME	EGDI	TLF	K (constant 2015 US$)	GDP, PPP (Constant 2017 US$)
2012	0.5653	21940939	20900000000	592030000000
2013	0.558	21834999	17960000000	592300000000
2014	0.5032	21670714	12950000000	532600000000
2015	0.5478	21563197	14500000000	480550000000
2016	0.6076	21453122	20710000000	492280000000
2017	0.6099	21345004	21210000000	503900000000
2018	0.6165	21244133	20630000000	521480000000
2019	-	21148251	18670000000	538160000000
2020	0.7119	20585937	11670000000	517970000000
2021	-	20285701	21150000000	535820000000
2022	0.8029	-	14070000000	379890000000