Institut européen
European Institute

LUISS
School of Government

Joint Master in Global Economic Governance and Public Affairs

The Impact of Digitalisation on Government Effectiveness in OECD Countries between 2003 and 2023: An Empirical Investigation

Supervised by Prof. Emeritus. Milad Zarin

Pollyanna Hall

2025/2026

Co-funded by
the European Union

Thesis Pitch

https://youtu.be/hLBaMwPIVqY

Statutory Declaration

I hereby declare that I have composed the present thesis autonomously and without use of any other than the cited sources or means. I have indicated parts that were taken out of published or unpublished work correctly and in a verifiable manner through a quotation. I further assure that I have not presented this thesis to any other institute or university for evaluation and that it has not been published before.

15/06/2026 Pollyanna Hall

Acknowledgements

First, I would like to express my gratitude to my thesis supervisor, Milad Zarin. His extensive knowledge on the subject area and constant support was invaluable throughout the thesis process.

I am especially grateful to the close friends I have made on this course. Their support and humour have made this process truly enjoyable.

I would also like to thank my family and boyfriend for their encouragement, advice and endless love and support, despite being separated physically.

Abstract

This thesis aims to investigate the impact of digitalisation on government effectiveness. It includes analysis on the impact of the pandemic and recommendations for artificial intelligence (AI) adoption in governments. This research is driven by the rapid evolution of AI and the potential systemic risks associated with its implementation in the public sector without appropriate precautions. This thesis uses panel data analysis on OECD countries between 2003 and 2023 and employs a pooled ordinary least squares (POLS) regression on the dependent and the independent variables. A fixed effects model and a two-step System Generalised Method of Moments estimator are used as a robustness check. The empirical findings illustrate that the baseline relationships established under POLS do not hold in the robustness checks. Instead, the results suggest that institutional persistence, represented by the lagged dependent variable, plays a significant role in explaining government effectiveness. The analysis of the COVID-19 pandemic further highlights the importance of strong institutions in mitigating the disruptive effects of exogenous shocks. As governments adopt advanced digital technologies, policymakers should prioritise strengthening institutional capacity to ensure these technologies can be implemented effectively. Although there are limitations concerning endogeneity bias and limited external validity, this research contributes to the growing analysis on the role of digitalisation in enhancing government capacity.

Table of Contents

Chapter 1: Introduction

Government effectiveness influences economic development, crisis responses and the provision of public services, all of which affect every citizens' quality of life. The World Bank (2026) identifies three main components of the Government Effectiveness indicator. First, the quality of public services, which provides a tangible measure of the government's ability to deliver policies and services that directly affect citizens' daily lives. Second, the degree of independence from political pressures, which reflects the presence of institutional checks and balances that enable governments to operate in the public interest rather than for short-term political gain. Third, the quality of policy formulation and implementation, which reflects the government's ability to design and effectively implement policies that achieve their intended objectives. The Government Effectiveness indicator demonstrates the relationship between the government and citizens, where characteristics such as transparency, accountability and responsiveness play a crucial role in enhancing government performance and public trust.

Digitalisation in the public sector is a key factor in improving government effectiveness. The E-Government Development Index (EGDI) examines the provision of online government services, the telecommunications infrastructure used by citizens to access them and the human capital required to operate them (UN E-Government Development Knowledgebase, 2026). E-government goes beyond integrating information and communication technologies (ICT) into governments. It uses digital technologies to improve public services and make citizen and business interactions with the government more efficient (European Commission, 2024). Estonia is an evident example of successful e-governance. Estonia's digital services include digital tax reporting, e-voting and drug prescriptions. In 2017, a study showed the cost of processing an e-vote was twenty times cheaper than processing a regular vote, which provides significant cost-savings. Citizens in Estonia benefit from significant time savings, as digital tax filing is streamlined through automated pre-filled tax returns (Estonian Business and Innovation Agency, 2020). E-government initiatives are intended to generate cost and time savings, enhance

transparency and improve access to public services, factors that may contribute to higher government effectiveness.

The existing literature demonstrates that digitalisation positively impacts government effectiveness. For example, Wandaogo (2022) and Durkiewicz and Janowski (2018) each analyse over 100 countries, finding a positive and statistically significant relationship. A key theoretical debate in the literature identifies the potential for reverse causality. Governments with stronger institutions may be better positioned to benefit from digital technologies, making it difficult to determine whether digitalisation improves government effectiveness or reflects it. A gap in the literature is the limited analysis on OECD countries in recent years. Consequently, there is little empirical evidence on how the COVID-19 pandemic affected government effectiveness and how these findings translate into policy recommendations for artificial intelligence (AI) adoption in the public sector.

This thesis addresses these gaps in the literature by examining the relationship between digitalisation and government effectiveness in OECD countries between 2003 and 2023. Between 2020 and 2023, the pandemic caused systemic disruption particularly in the public sector as governments enforced lockdowns, reallocated fiscal resources and managed disruptions to trade. The pandemic represents an exogenous shock that provides insights into governments' ability to respond to major external challenges and technological change. To analyse this, this study uses panel data analysis to examine the relationship between digitalisation and government effectiveness, evaluate the effects of the pandemic and provide recommendations for AI adoption in governments. The analysis employs three pooled ordinary least squares (POLS) models. As a robustness check, the third specification, which incorporates both control and dummy variables, is replicated using a fixed effects model (FEM) and a two-step System Generalised Method of Moments (GMM) estimator. To address reverse causality, a lagged dependent variable is included and estimated using a System GMM approach, which uses internal instruments to mitigate potential endogeneity. The research question in this study is: does digitalisation have an impact on government effectiveness? The two sub-questions are:

what are the direct and indirect effects of the pandemic on government effectiveness? What recommendations can be drawn for AI adoption in the public sector?

My results demonstrate that the relationships established under POLS do not hold under a FEM or System GMM estimator. Under POLS, two out of three components of the EGDI composite variable are statistically significant and display the appropriate signs. However, they lose their significance in the robustness checks. In the FEM, the Pandemic variable is the only variable with statistical significance and in the System GMM model, the lagged dependent variable, Government Size and the Federalist System variables hold significance. The results suggest that institutional persistence is an important driver of current levels of government effectiveness. The analysis on the pandemic displays similar results. The institutional persistence, represented by the lagged dependent variable, contributed approximately 74% of the effect of the pandemic on government effectiveness. The quality of institutions likely determines the severity of consequences of an exogenous shock such as the pandemic. Policymakers can use this insight for AI adoption. The quality and strength of their institutions must be prioritised to provide an environment conducive to adopting digital technologies like AI successfully.

This thesis is structured as follows. Chapter 2 highlights the importance of digitalisation and demonstrates the different channels that digitalisation improves government effectiveness. The gap in the existing literature is established and how this thesis addresses it. Chapter 3 outlines the methodology and data. I present my model, hypothesis test, regression methods and limitations. I discuss my sample and variable section and then present the summary statistics. Chapter 4 displays the results and analysis. The baseline relationships are established under POLS, followed by a discussion of the robustness checks. Additional implications of the estimation such as the effects of the pandemic and AI recommendations for policymakers are presented. Chapter 5 concludes by reinforcing the research question behind the study and summarising the key findings.

Chapter 2: Literature review

2.1 Introduction

The digital transition, which has had profound effects for the private sector, must be implemented carefully in the public sector due to systemic risks. The literature reviewed in this study identifies a positive association between digitalisation and government effectiveness and identifies the different transmission mechanisms. It highlights emerging technologies and the necessary guidelines needed to help the public sector implement new digital technologies in an ethical way.

This review covers five key areas:

1. The importance of digitalisation
2. Digitalisation and government effectiveness at the macroeconomic level
3. Mechanisms of digitalisation and government effectiveness
4. Synthesis of the literature
5. Gaps in the literature

Through this review, I provide a thorough discussion of how digitalisation leads to improved government effectiveness, the emerging technologies and the ethical debate surrounding AI implementation.

2.2 Discussion of the Literature

2.2.1 The Importance of Digitalisation

Digitalisation is a key factor for good governance and improving citizens' quality of life. There are three significant benefits of digitalisation in the public sector. Firstly, digitalisation enhances collaboration within and between departments. By integrating digital systems, there are likely fewer duplicate tasks, shorter processing times and administrative bottlenecks (Wandaogo, 2022). Secondly, digitalisation may lead to

improved productivity through automation. Initially, digital technologies were used to automate routine and standardised tasks, however, they are evolving to automate more complex activities, therefore workers can focus on higher value-added tasks, which are less vulnerable to automation (Arntz et al., 2019). Thirdly, digitalisation can improve government responsiveness and civic participation. Clear online platforms, where citizens can easily make complaints and proposals, lead to governments tackling the most pressing issues quickly. Citizens trust their governments when their concerns are being heard and acted on, which encourages higher democratic participation (Nurlinah et al., 2025).

In an era of rapid technological development, particularly with the growth of AI and advanced digital tools, it is important to assess the benefits of digital implementation in governments. This helps determine whether and how emerging technologies, such as AI, should be integrated into public administration.

A primary concern of AI implementation in the public sector are job losses. Although automation is beneficial by making work less repetitive, worker's may be concerned for their job security or losing skills that AI replaces. Governments must focus on additional training to upskill workers so they can work alongside AI and embrace technological change. Secondly, there is concern over the systemic impact of AI as governments become more exposed to data breaches and AI hallucinations. There must be sufficient investment into data security, accountability and human oversight in implementation. Thirdly, the intent of digital technology integration must be for good purposes rather than for social control and profit. For example, the EU places ethics at the heart of policy design compared to the US and China (Riso et al., 2023).

2.2.2 Digitalisation and Government Effectiveness at the Macroeconomic Level

Many studies examine the relationship between digitalisation and government effectiveness at the macroeconomic level because they are standardised international indicators. Wandaogo (2022) and Durkiewicz and Janowski (2018) each analyse over 100 countries, whereas Androniceanu and Georgescu (2023) and Dhaoui (2022) examine specific regions such as the European Union (EU) and the Middle East and North Africa

(MENA), respectively. At the macroeconomic level, it is clear that digitalisation improves government effectiveness.

There is considerable empirical support for digitalisation improving the impact of government institutions across the globe. Wandaogo (2022) provides empirical support for a significant and positive relationship between digitalisation and government effectiveness. This study uses a panel methodology to analyse 138 developing and developed countries between 2006 and 2016 and find ICT to positively impact government effectiveness. This relationship is prevalent in both developing and developed countries but particularly in the latter. Wandaogo (2022) highlight the importance of the digital transition in not only governments but in individuals and businesses too. When ICT is adopted by society, the positive impacts of a more digitalised government are more widespread. Wandaogo (2022) recommends ICT adoption within the government and policies that integrate ICT in businesses and individuals to maximise the positive impact of digitalisation on government effectiveness. Research by Chen and Aklikokou (2021) further emphasise the positive impact digitalisation exerts on a government's capacity to implement policies. This study utilises cross-national secondary data to conduct a two-step cluster analysis on 191 countries. It examines how e-government impacts government effectiveness, finding empirically that there is a positive association. However, the government institution must have the necessary characteristics to realise the benefits of digital technologies, such as institutional stability and minimal resistance from administrative departments and public officials. Similarly, Durkiewicz and Janowski's (2018) study on 193 UN member countries in 2016 provides supporting empirical evidence. They correlate analog and digital benchmarks to assess how each form of governance measures against variables such as government effectiveness. They highlight positive correlations between digitalising governance and government effectiveness. This positive relationship is not limited to the global level.

In regional areas, such as the EU, there is strong evidence supporting the relationship. Spataru and Popescu (2025) examines e-government development and government effectiveness in the EU between 2013 and 2022. They employ a multiple linear regression model to analyse the relationship between digitalisation in the public sector and the

strength of government capacity. The results illustrate the importance of digital infrastructure in government administration, as reflected in the positive and significant relationship between the level of e-government and government effectiveness. However, the benefits of digitalisation are contingent on the strength of the institutions and their anti-corruption policies. Similarly, Androniceanu and Georgescu (2023) examine the progress of digital transformation in the EU between 2019 and 2021. They employ two econometric techniques: principal component analysis and K-means clustering. The first two principal components, which are linear combinations of ten variables on digitalisation, government effectiveness and digital infrastructure, explain 77.05% of the total variance. This suggests that most of the variation across the EU is explained by two underlying factors, one of which is e-governance performance, therefore demonstrating its importance for government institutions. These findings are not restricted to the EU, as reflected in a study on the MENA region.

There is supporting evidence in the MENA region, as investigated by Dhaoui (2022). This study analyses the role of e-government on good governance and sustainable development by employing a multiple linear regression model on panel data, which consists of 15 MENA countries between 2003 and 2018. Digital technologies can enhance government effectiveness when accompanied with the necessary conditions. In the MENA region, e-governance has not been made a priority leading to stalled progress. There is difficulty in acquiring and accessing the technology for e-governance, as well as limitations in human capital due to insufficient skills and the knowledge to operate e-government platforms. The benefits of digitalisation on government efficiency can be realised if it is prioritised and there are significant investments into upskilling employees in digital literacy. Dhaoui (2022) recommends enhancing access to technology, investing in education and strengthening institutions to lead to tangible benefits of ICT on government effectiveness.

These studies often find a correlation rather than causation between digitalisation and government effectiveness. However, this is likely because of the time lag associated with implementing e-government procedures, therefore the benefits have not been fully realised yet (Dobrolyubova et al., 2019). Dobrolyubova et al. (2019) examined 74

countries including developed and developing nations and identified a positive correlation between e-governance and government effectiveness. Although Granger test results do not indicate causality, there are reasons to explain this. Firstly, e-government implementation is in its preliminary stages and since the benefits on government institutions are realised much further into the process, more time is needed for these benefits to be impacting government effectiveness scores. Secondly, there could be inconsistencies with the aggregate governance indicators due to data omissions and insufficient consideration of regional specific factors, which may lead to a lack of causality. Using regional level data and broader governance indicators could enhance analysis and lead to clearer conclusions as to whether digitalisation enhances government effectiveness.

2.2.3 Mechanisms of Digitalisation and Government Effectiveness

2.2.3.1 Administrative Efficiency

Digitalisation may enhance administrative efficiency and lead to more streamlined operations and more resources dedicated to meeting government objectives. In a cross-country analysis in tax administration, Kochanova et al. (2016) find evidence that ICT strengthens a government's ability to mobilise and allocate resources, which may improve the implementation and commitment to polices. The introduction of e-filing systems leads to improved administrative efficiency because a centralised approach reduces duplicate payments and enhances collaboration between departments. This is demonstrated in decreases in the number of tax payments made and the time taken to prepare and pay taxes. Similarly, Okunogbe (2022) found that electronic tax filing in Tajikistan firms improved administrative efficiency, as reflected in a 40% reduction in the time taken on taxes. This improves a government's capacity to deliver their services as employees can allocate more time to more complex and productive activities. These findings suggest that digital systems reduce administrative burdens and allow governments to focus on delivering their policies and services more meaningfully.

Digitalisation can further improve administrative efficiency through automation and improved data management, therefore allowing governments to focus on effectively formulating and implementing policies. Santos and Pessoa (2024) demonstrate how Robotic Process Automation (RPA) and AI can enhance the management of outsourced public services. For example, the automation of routine administrative processes and the enhanced collection of real-time data on supplier performance may increase the efficiency of outsourcing processes, which likely improves the interactions between governments and suppliers. An enhanced relationship with external suppliers can facilitate the government's ability to deliver on its other objectives. Similarly, Omar et al. (2024) find that technologies such as cloud computing and AI improve administrative efficiency. Digital technologies facilitate data sharing, information availability and data analysis, which enables faster and more informed decisions in policymaking across government institutions.

However, the efficiency gains from digitalisation depend on sufficient infrastructure and institutional capacity. Santos and Pessoa (2024) point out these technologies require the infrastructure to handle big data and the staff who are trained to operate them. Implementing digital systems may therefore require significant investment in technological infrastructure and employee training. Although these costs may be particularly challenging for governments with limited resources, these investments are often necessary to ensure that digital technologies are successfully integrated into public administration and therefore the benefits can be realised.

2.2.3.2 Transparency, Accountability and Corruption Control

Digitalisation can improve the transparency, accountability and corruption control in the public sector. Greater transparency and accountability improve information flows between citizens and governments, which potentially leads to more responsive and targeted policymaking. Corruption control helps maintain political independence by reducing the influence of private interests. Shim and Eom (2008), analysing international data, find that digitalisation positively impacts corruption control. Digitalisation reduces corruption both within and external to the government because it improves transparency

and accountability by allowing for increased monitoring of employee behaviour and their interactions with external groups. Park and Kim (2020) used a FEM to empirically analyse 214 countries between 2003 and 2016. They argue that e-government is an effective tool to reduce corruption. Digital technologies improve the transparency of operations, which helps to make corrupt officials accountable for their misconduct. When an institution reduces corruption, more funds can be potentially directed to providing more efficient public services, the citizens may place more trust in their government and there is likely enhanced coordination between employees. Similarly, Chen and Aklikokou (2018) analysed 191 countries and find a positive association between e-government and reduced corruption and consequently, government effectiveness. Moreover, Dhaoui (2022) investigates e-government and corruption in MENA, confirming that e-government is an efficient tool to reduce corruption and improve government effectiveness. Although Bhatnagar (2003) argues that advanced technology may increase corruption through using it to perform corrupt purposes, this is likely soon after its implementation and can be prevented.

2.2.3.3 Public Service Quality and Responsiveness

Digitalisation can improve government effectiveness through enhancing the quality and responsiveness of public services. Digital technologies enable governments to provide faster access to information and facilitate communication between institutions and citizens, potentially leading to higher citizen satisfaction and engagement with the government. Reddick and Turner (2012) examined how citizens interact with different government service channels in Canada and how this affects their satisfaction with government services. The study employed a logistic regression on a public opinion survey of Canadian residents to compare the use of e-government platforms with traditional channels such as telephone services or in-person visits. The findings highlight that citizens used government websites to obtain information, while the phone was used to resolve problems. Positive service experiences were associated with greater satisfaction with e-government. These findings suggest that digital platforms must be user-friendly, clear and accessible to ensure a positive user experience, which increases user satisfaction and engagement. Governments should maintain multiple service channels to ensure

responsiveness if their citizens' needs require it. Similarly, Noor (2022) examined 250 users of online public service platforms in Indonesia by employing structural equation modelling. The results illustrate a positive and significant relationship between the quality of the e-service and user satisfaction as well as loyalty. Digitalisation can make high-quality e-services that are user-friendly, highly responsive to citizen complaints and provide accurate information. This may increase citizen satisfaction, which is positively associated with continued engagement with e-services. Citizen engagement and participation is crucial for governments to effectively implement policies. Digitalisation can optimise the quality of public services and government responsiveness, potentially improving citizen engagement and therefore government effectiveness. However, the broader implementation of digitalisation may produce uneven benefits. Wahyudi et al. (2025) examined Indonesia through a qualitative literature review of peer-reviewed studies, government reports and international sources. They find that while digitalisation has improved service speed, quality and transparency, these benefits are often limited by insufficient digital infrastructure, a lack of digital skills and vulnerabilities to cyber threats. Wahyudi et al. (2025) therefore argue that for digitalisation to improve government effectiveness there must be significant investment in digital infrastructure and education.

2.2.4 Emerging Technologies

Digitalisation is evolving as new emerging technologies become the next stage of digital governance. Santos and Pessoa (2024) identify emerging technologies such as RPA and AI, which can significantly enhance government effectiveness. RPA is an automation technology using virtual software robots to carry out repetitive, routine and time-consuming tasks (SAP, 2026). These digital robots can assist employees by taking on the manual tasks which don't require any creativity or intuition such as inputting or collecting data. Workers can focus on more creative and higher value-added tasks, therefore increasing their job satisfaction and potentially leading to higher productivity. Furthermore, these virtual robots eliminate human error and can work for longer periods of time, which enhances work quality and quantity (SAP, 2026). Similarly, AI is an effective tool in automating routine tasks, conducting data analysis and providing

information for decision making (StepUp StartUps Consortium, 2025). It is an essential tool that governments should utilise when facing challenges. Digital technologies, such as cloud networks and big data analytics, positively impact government effectiveness but there are requirements for their successful implementation (Omar et al., 2024). Cloud based services allow for governments to access data and technology from cloud networks rather than from their own data centres and servers, which would need to be bought and maintained (Carlson, 2020). Cloud networks can improve operational efficiency through automating mundane data entry tasks, reducing costs as governments only pay for the active infrastructure they use, and auto-scaling, which minimises resource waste through automatic scaling up or down of resources due to demand (Smith, 2025). Cloud networks enhance citizen experience by improving the speed of services. In public services, security and reliance of data is vital and cloud networks ensure privacy is maintained. They have built in cybersecurity through advanced threat detection and encryption, this technology helps governments adhere to privacy compliance standards more easily and maintain the trust of the public (Smith, 2025). Big data analytics, which is particularly relevant for governments with large diverse datasets, analyses vast amounts of unstructured data to draw important trends and insights for public officials. Its functions range from predicting the areas of public infrastructure requiring maintenance to creating different scenarios for the impact of a conservation project. This technology is crucial in ensuring successful implementation, maintenance and impact of government projects (Gemstone, 2024). However, there are difficulties with the implementation of these technologies because governments require sufficient digital infrastructure and digital literacy skills and must navigate the ethical challenges of employing digital technologies (StepUp StartUps Consortium, 2025).

There are ethical concerns surrounding these emerging technologies, in particular AI. Institutions, such as the OECD, produce guidelines on ethical AI governance to assist governments in implementing AI safely (OECD, 2026). Some concerns include privacy breaches, hallucinations, algorithmic discrimination (Corrêa et al., 2023) and UNESCO (2026) highlights the detrimental impacts to the environment and human rights. Human oversight ought to be included throughout the process to ensure AI is monitored carefully and the environmental impact of AI technologies must be assessed, particularly their

accordance with the UN's sustainable development goals. The OECD (2026) produced the first intergovernmental principles on AI in 2019, which outline five values-based principles for policymakers and AI actors. They focus on robust, secure and transparent AI systems that ensure proper accountability for the functioning of AI. Policymakers can implement these values by investing in research in AI, upskilling employees in digital technologies and fostering international co-operation between developing countries and stakeholders to share knowledge and expertise (OECD, 2026).

Another solution to the ethical debate on AI is to incorporate human oversight into automated technology processes. The human-in-the-loop framework addresses transparency and accountability concerns over automation as it includes human involvement at different steps along the way. This role may include monitoring technological systems and intervening when needed (Goldenfein, 2024). For example, in the cockpit of an airplane there are automated warning mechanisms that assist pilots in decision making, but ultimately it is the pilot who makes the call (Humboldt Institute, 2025). This framework humanises automated decisions to encourage trust in digital technologies.

The human-in-the-loop framework can be implemented into governments but there are concerns regarding its use as a legal tool (Goldenfein, 2024). Benedikt et al. (2020) examine the role of human-in-the-loop in governments and find that the human factor is critical to its success. An enjoyable user experience for humans facilitates the transition from manual tasks to overseeing a complex technology such as AI. Governments must secure enough funding to ensure a smooth transition by presenting the human-in-the-loop framework to stakeholders as a solution to government problems. However, Goldenfein (2024) suggests human in the loop acts as a legal tool. Governments use automated systems to make decisions and by including a human in the process, governments can show they are following legal principles such as fairness and accountability. However, this integration of humans and technology may lead to confusion when mistakes happen. It is unclear whether the human, AI or the institution is responsible for the mistakes. It is important for governments to think deeply when embedding humans into automated decisions and question how they should be regulated or understood in law. The human-

in-the-loop is an effective tool to make systems seem more transparent and improve accountability, but it can obscure responsibility and prevent legal scrutiny of automated decision-making (Goldenfein, 2024).

2.3 Synthesis of the Literature

Table 2.1 summarises the methodologies and results of the academic literature mentioned. The literature confirms that digitalisation is a key tool to improve government effectiveness. At the macroeconomic level, there is broad cross country quantitative evidence demonstrating the relationship in over 100 countries. Regional groups of countries demonstrate positive relationships between digitalisation and government effectiveness. This relationship functions through varying mechanisms. First, digitalisation improves administrative efficiency by speeding up processing times, communication and reducing duplication, which leads to enhanced government capacity. Second, e-government enhances transparency, accountability and the control of corruption because of improved oversight over operations, which improves the formulation of policies and the government's level of political independence. Third, digitalisation improves the quality and responsiveness of government services, which leads to an improved user experience and engagement with e-services. However, a key theoretical debate remains as to whether digitalisation independently enhances government effectiveness as scholars such as Chen and Aklikokou (2021) and Dhaoui (2022) suggest its benefits are largely contingent upon underlying governance quality.

A major development in the literature is the emerging technologies that can have profound effects on governments. Initially, governments digitised and now there are advanced technologies such as RPA, AI and cloud platforms, which may be integrated into public services. These can revolutionise government operations, leading to significant cost savings and enhanced government effectiveness. Although there is an ethical debate surrounding algorithm discrimination, the lack of transparency in AI operations and privacy breaches. The OECD has released AI principles, which include recommended policies for governments to implement. In 2023, more than 70 OECD countries had implemented initiatives surrounding ethical AI governance (OECD, 2026). There are

significant improvements in addressing the ethical issues of these new technologies, but it requires constant updating to keep up with the rapid pace of change of digital technologies.

Table 2.1: Summary of academic literature

Study	Method	Results
Does digitalisation improve government effectiveness? Evidence from developing and developed countries. (Wandaogo, 2022)	Panel data set that consists of 138 countries between 2006 and 2016.	The results suggest that a government's use of ICT improves its effectiveness in developing and developed countries. The effect of aggregate ICT use by individuals, businesses, and government on overall government effectiveness is greater than when one actor uses it. These results highlight the need for policies that promote access to ICT across the economy.
Digitalisation and Effective Government: What is the Cause and what is the Effect? (Dobrolyubova et al., 2019)	A correlation analysis and Granger Causality test between government digitalisation and quality of public administration.	There is a direct cause and effect relationship between E-Government Development Index and Doing Business measures. However, there is no direct cause and effect relationship between government digitalisation and other governance indicators, such as government effectiveness and control of corruption.
Public Administration Digitalisation and Government Effectiveness in the EU Countries	The research employs principal component analysis (PCA) and K-means clustering to analyse the variations and correlations among 10 variables selected from	PCA reveals that the first two principal components including digitalisation and government effectiveness account for 77.05% of variance. Enhancement of e-government could lead to increased government effectiveness.

(Androniceanu and Georgescu, 2023)	Eurostat and World Bank databases.	
Channel choice and public service delivery in Canada: Comparing e-government to traditional service delivery (Reddick and Turner, 2012)	Uses logistic regression of a public opinion survey of Canadian residents. Factors include the nature of the citizen interaction with the government and citizen satisfaction with the services.	The phone is more effective for solving problems, whereas the website is more effective for getting information. Governments ought to provide different channels of communication for different tasks. A more positive experience for citizens leads to higher satisfaction with e-government.
E-Government for Sustainable Development: Evidence from MENA countries (Dhaoui, 2022)	A multiple linear regression on panel data, consisting of 15 MENA countries between 2003 and 2018.	Good governance positively contributes to sustainable development. Digitalisation improves control of corruption and government effectiveness.
E-government as an anti-corruption tool: panel data analysis across countries (Park and Kim, 2020)	A FEM on a longitudinal panel dataset of 214 countries between 2003 and 2016.	E-government significantly reduces corruption, but the effects of open government are unclear.
E-Government and Anti-Corruption: Empirical Analysis of International Data (Shim and Eom, 2008)	Uses international data on the impact of e-government on corruption.	E-government has a consistently positive impact on reducing corruption by promoting good governance.
Relating e-government development to	A two-step cluster analysis, using cross-	A positive association between e-governments' development and control

government effectiveness and control of corruption: a cluster analysis (Chen and Aklikokou, 2021)	national secondary data from 191 countries.	of corruption and government effectiveness.
Is Digitalisation improving Governance Quality? Correlating Analog and Digital Benchmarks (Durkiewicz and Janowski, 2018)	It uses data from 2016, covering 193 UN member and calculates the strengths of correlations between pairs of analog and digital measures that represent governance.	Strong positive correlations between digital indicators and government effectiveness, regulatory quality, voice and accountability. Weak correlation with e-participation and civil society indicators.
Does E-government improve Government Capacity? Evidence from Tax Administration and Public Procurement (Kochanova et al. (2016)	It uses a difference-in-difference approach with fixed effects.	ICT improves government capacity, but the impact of e-government varies by type of government activity. This effect is stronger in more developed countries.
Technology, Taxation, and Corruption: Evidence from the Introduction of Electronic Tax Filing (Okunogbe, 2022)	Randomised experimental design using firm-level data in Tajikistan.	E-filing reduces time spent on taxes by 40%. E-filing doubles taxes paid in firms that were more likely to try evading taxes.
The Role of Digitalisation in	It uses a mixed method approach: multilinear	Digitalisation through automation improves productivity and saves

Improving Accountability and Efficiency in Public Services (Omar et al., 2024)	regressions and interviews. Multilinear regressions used data on more than 50 digitalisation initiatives in 10 countries between 2015 and 2023. Qualitative analysis was on 120 public sector personnel and 250 service consumers who engaged with digital platforms.	money. AI integration led to a 30% boost in tax collection efficiency in the US.
Impacts of digitalisation on the efficiency and quality of public services: A comprehensive analysis (Santos and Pessoa, 2024)	A synthesis of academic literature.	Digitalisation enhances the efficiency and quality of outsourced public services by improving administrative processes and coordination. However, these benefits are contingent on sufficient investment.
Analysis of digital transformation of public administration in improving the effectiveness of government services in Indonesia (Wahyudi et al., 2025)	A qualitative literature review synthesising peer-reviewed studies, government documents, and international reports to identify trends in system integration, human resource capacity, technological infrastructure and governance readiness.	Digitalisation improves service speed, transparency and citizen experience. However, the benefits are uneven due to skill gaps, infrastructure issues and organisational resistance.

From Digital Tools to Effective Governance: The Conditional Impact of E-governance in EU member states (Spataru and Popescu, 2025)	Based on a multiple regression econometric model, the research explores the extent to which advancements in public service digitalisation, data transparency, and internet access contribute to strengthening governmental capacity.	The results reveal a significant and positive association between e-government and government effectiveness, confirming the role of digital infrastructure in improving public administration.
Humann-in-the-loop AI in Government: A Case Study (Benedikt et al., 2020)	Examines the Household Budget Survey to analyse the implementation of human-in-the-loop in the public sector.	Automation may lead to cost and time efficiency savings. To ensure data quality, humans should be involved closely in the operations to intervene when needed.
The effect of e-service quality on user satisfaction and loyalty in accessing e-government information (Noor, 2022)	Based on structural equation modelling, the study investigated the adoption of e-government and consumer behaviour.	The results find a significant relationship between the quality of e-government and user satisfaction and user loyalty.
Digitalisation and the Future of Work: Macroeconomic Consequences (Arntz et al., 2019)	It uses Germany as a case study to examine the impact of digitalisation on the labour market.	The results illustrate that it is not the quantity but the structure of jobs that will change due to automation.
Impact of government digital transformation on	It uses a survey of 394 people from urban to rural	Their findings demonstrate how digitalisation increases trust in the

citizen trust and participation: evidence from Gowa Regency, Indonesia (Nurlinah et al., 2025)	districts in Gowa Regency, Indonesia.	government, which is a strong factor of citizen participation.
Lost in the Loop: Who is the 'Human' of the Human in the Loop (Goldenfein, 2024)	A literature review.	Humans may be included in the loop for legal reasons to demonstrate oversight. However, this can add confusion over accountability.

2.4 Gaps in the Literature

Despite extensive research on the impact of digitalisation on government effectiveness, there are several gaps. Firstly, there is limited analysis on OECD countries between 2003 and 2023, particularly in more recent years. Secondly, this period is interesting because it encompasses the pandemic between 2020 to 2023, which many studies do not examine. During the pandemic, digital technologies were vital for operations in the private and public sector as staff had to work at home. The pandemic may have improved government capacity as the digital transition may have been accelerated by forcing institutions to implement the necessary digital infrastructure so that employees could work efficiently whilst in isolation. On the other hand, the pandemic may have negatively impacted government effectiveness due to supply bottlenecks and increased pressure on public services. The impact of the pandemic on the relationship between digitalisation and government effectiveness is significantly underexplored. In addition, AI has been evolving rapidly but governments must be careful when adopting these advanced technologies as the risks are systemic. Although there is advice for ethical AI use, governments can be slow to adopt them. This thesis aims to address these gaps by conducting a multiple linear regression to examine the relationship between digitalisation

and government effectiveness in OECD countries between 2003 and 2023. It will evaluate the impact of the COVID pandemic on this relationship and provide recommendations for AI use in governments.

Chapter 3: Methodology

3.1 Introduction

This dissertation analyses the impact of digitalisation on government effectiveness in OECD countries between 2003 and 2023. It employs POLS, FEM and GMM regressions. This chapter outlines the model and data. Section 3.2 introduces the model and its justifications based off the methodologies in the literature. Section 3.3 outlines the hypothesis test to determine whether the independent variables exhibit a significant relationship with government effectiveness. Section 3.4 discusses the choice of my regression models and section 3.5 explains the key econometric challenges. Section 3.6 defines the data sample. Section 3.7 defines the key variables, and section 3.8 presents the summary statistics of the dataset. Section 3.9 summarises the chapter.

3.2 Model

3.2.1 Introduction

A panel data analysis uses both cross-sectional data and time series data to provide a dataset high in quantity and quality data. Cross sectional data consists of observations for multiple variables for a singular time period whereas time series data expands over multiple time intervals for a single unit (Ngari, 2019). This study analyses OECD countries, which comprises of 38 members, between 2003 to 2023. Panel data analysis is most advantageous for this dataset to allow for the comparison of countries over an extended time period, compared to using purely one variable over a period of time or multiple variables at a singular point in time.

In the literature, panel data analysis is very widely used in a variety of studies and GMM is typically employed to address potential endogeneity issues caused by dynamic panel bias. On the global scale, Wandaogo (2022) conducts panel analysis on 138 countries

between 2006 and 2016 to analyse the effect of digitalisation on government effectiveness. Park and Kim (2020) analyse e-governance in combatting corruption in 214 countries between 2003 to 2016 using panel data analysis. On a regional level, Dhaoui (2022) examined 15 MENA countries in a panel analysis between 2003 and 2018 to investigate the relationship between e-governance and good governance. Spataru and Popescu (2025) analysed EU countries and argue the level of digitalisation is closely associated with government effectiveness in their panel dataset. Their study spans from 2013 to 2022, finding that the pandemic acts as a catalyst in the digital transition and improved the resilience of administrative operations in the public sector. In an analysis of OECD countries, Myovella et al. (2020) employ a panel dataset between 2006 and 2016 to conduct a comparative analysis of developed and developing economies by using OECD countries and Sub-Saharan Africa as their sample. Their study uses GMM to address potential endogeneity caused by the dynamic relationship between digitalisation and economic growth. Moreover, Nguyen (2021) uses GMM to analyse the relationship between digitalisation and economic growth in developing countries between 2006 and 2019. These studies examine multiple countries over a period of time to understand changes across countries and within countries over multiple years, supporting the use of panel data analysis in my study of OECD countries between 2003 and 2023. Although Myovella et al (2020) examines the relationship in OECD countries, their time period is between 2006 and 2016, therefore it does not encompass the effects of the pandemic. Although Spataru and Popescu (2025) includes the pandemic in their analysis of EU countries, few have explored the impact of the pandemic in OECD countries. My study fills this gap by examining the relationship between digitalisation on government effectiveness in OECD countries between 2003 and 2023 and analysing the effects of the pandemic.

3.2.2 Modelling Approach

$$ZGE_{it} = \beta_0 + \beta_1 ZGE_{it-1} + \beta_2 lnHumanCapital_{it} + \beta_3 lnOnlineServices_{it} + \beta_4 lnTelecommunications_{it} + \beta_5 lnTradeOpenness_{it} + \beta_6 lnUrbanisationRate_{it} + \beta_7 lnGovernmentSize_{it} + \beta_8 Pandemic_{it} + \beta_9 FederalistSystem_i + a_i + \lambda_t + \in_{it}$$

The variable ZGE_{it}, represents government effectiveness for country i, an OECD country, in year t. β_0 is the constant term of the equation. $\beta_1 ZGE_{it-1}$ is government effectiveness of country i at year t-1. $\beta_2 lnHumanCapital_{it}$ is the Human Capital Index, which is a component of EGDI, of country i at year t. $\beta_3 lnOnlineServices_{it}$ is the Online Services Index, a component of EGDI, of country i at year t. $\beta_4 lnTelecommunications_{it}$ is the Telecommunications Infrastructure Index, a component of EGDI, of country i at year t. $\beta_5 lnTradeOpenness_{it}$ is the sum of exports and imports as a percentage of GDP of country i at year t. $\beta_6 lnUrbanisationRate_{it}$ is the urbanisation rate of country i at year t. $\beta_7 lnGovernmentsize_{it}$ is government expenditure as a percentage of GDP of country i at year t. $\beta_8 Pandemic_{it}$ represents a dummy variable that equals 1 if country i experienced the pandemic and zero otherwise at time t. $\beta_9 FederalistSystem_i$ is a dummy variable that equals 1 if country i has a federalist governance system and zero if a unitary system. a_i represent the country-fixed effects, λ_t are the time-fixed effects and $\in_{it}$ is the error term of the equation.

The independent variables, except the lagged dependent variable and dummy variables, have been logged to stabilise the variances and reduce heteroscedasticity. The Government Effectiveness indicator uses a range from -2.5 to 2.5 and since negative values cannot be logs, it has been kept as levels and standardised so that it can be interpreted in standard deviation units, improving comparability across specifications. The coefficient of the lagged dependent variable is interpreted as follows: a 1 standard deviation increase in past government effectiveness changes the dependent variable by β standard deviations, holding all other variables constant. The coefficients on the logged variables are interpreted as follows: a 1% increase in an independent variable leads to a β/100 standard deviation change in the dependent variable, holding all other variables constant. A change in the dummy variable from 0 to 1 leads to β standard deviation change in the dependent variable, holding all other variables constant.

3.3 Hypothesis Test

I will use a hypothesis test to assess the significance of the independent variables.

Null Hypothesis:

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$$

Alternative Hypothesis:

$$H_1 : At\ least\ one\ of\ \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9 \neq 0$$

The null hypothesis states that these variables have no impact on government effectiveness in OECD countries, while the alternative hypothesis suggests that at least one variable does influence government effectiveness.

Table 3.1 shows the expected signs of the coefficients and their explanations.

Table 3.1: Expected signs and their explanations

Variable	Expected sign of coefficient	Explanation
ZGE_{it-1}	+	The lagged dependent variable captures institutional persistence. Higher past levels of government effectiveness likely positively influence current levels.
$HumanCapital_{it}$	+	A skilled workforce with digital literacy is likely to adapt well to providing and utilising digital public services as well as improving general policy formulation and implementation.
$OnlineServices_{it}$	+	Increased use of digital technologies in public sector services enhances the government's ability to convey information, increase transparency and respond to civilian complaints.

$Telecommunications_{it}$	+	Reliable ICT infrastructure allows for the implementation of more advanced technologies and increased accessibility to citizens, enhancing a government's capacity.
$TradeOpenness_{it}$	+	Trade can transfer skills and technologies, therefore economies more open to trade likely have governments with higher capabilities in which to implement policies.
$UrbanisationRate_{it}$	+	Urban areas are better connected to internet services, enhancing the reach of the government to its citizens.
$Governmentsize_{it}$	+	A larger government has a larger budget to commit to implementing and maintaining policies.
$Pandemic_{it}$	-	The pandemic years caused systemic disruption to governments, businesses and citizens.
$Federalist_{i}$	+	A de-centralised government shares its power at the federal and state level, leading to more tailored and efficient approaches to achieving the desired policy outcomes.

Source: Author's own expectations

3.4 Implementation and Software

This study conducts a robust panel data analysis on the impact of digitalisation on government effectiveness. Firstly, the dataset is constructed in an Excel file, ensuring appropriate cleaning and layout for panel data. The EGDI variable survey has been conducted during these years: 2003, 2004, 2005, 2008, 2010, 2012, 2014, 2016, 2018, 2020, 2022, 2024, therefore producing datapoints at irregular intervals. Since the EGDI

is integral to the analysis and has a linear trend, the aggregate and composite components have undergone a linear interpolation to fill in the missing values. Dhaoui's (2022) study on this relationship in MENA countries underwent the same transformation to the EGDI because of the variable's importance in the study and its linear trend allowing for linear interpolation. The dependent variable has been standardised and the independent variables excluding the lagged dependent variable and dummy variables, have been logged. The descriptive statistics are obtained and provide clear and concise preliminary trends in the dataset (Alabi and Bukola, 2023). These measures include the number of observations, the mean and standard deviation, which help describe the distribution and variation of the data.

The methodology begins with a POLS on the dependent variable, government effectiveness, and the main explanatory variable, the EGDI. The EGDI variable is substituted for its components: Human Capital Index, Online Service Index and Telecommunications Infrastructure Index, and estimated to assess the main drivers of the relationship with government effectiveness. Next, a POLS regression including the control and dummy variables is conducted, followed by a multicollinearity test. The multicollinearity test is conducted because when two or more independent variables are highly correlated, the significance of certain variables may be overinflated, which may lead to inaccurate regression results (Daoud, 2017). Variance inflation factors (VIF) measure which variables may be affected by multicollinearity, as reflected in a VIF score above 10 but it is preferable to not have a VIF score above 4 (CFI, 2020).

Having completed the POLS regressions, the methodology conducts the Hausman test to determine whether a FEM or random effects model (REM) is most appropriate for the robustness check. The FEM is suitable if there are time-invariant unobserved differences, which may be correlated with the independent variables. This is most useful because it isolates change within countries rather than focusing on cross country differences. However, the REM treats the individual effects as uncorrelated to the independent variables. The Hausman test creates two hypotheses: the null hypothesis assumes that individual effects are not correlated with the independent variables and the alternative hypothesis assumes the individual effects are correlated (Baltagi, 2014). If the p-value is

below 0.05, there is sufficient evidence to reject the null hypothesis, and the FEM is more appropriate.

There are two robustness checks that will be carried out in this analysis. First, the FEM will be employed on the panel data, regressing the dependent variable on its main explanatory variables as well as the control and dummy variables. The FEM regressions will use cluster-robust standard errors because when data is grouped into clusters, the default standard errors can be greatly overestimated (Cameron and Miller, 2015). The panel dataset in this analysis uses standard errors clustered at the country level as observations for each country span over multiple years. For example, a global shock such as the pandemic or policy reforms may have affected countries over several years, which may lead to correlated errors within countries. Second, a lagged dependent variable is added. This takes lags on the period before so it can capture past levels of government effectiveness that influence the current quality of government capacity. Moreover, it accounts for the time lags of government policies to take effect. It reflects that government effectiveness is gradual and cannot be reflected in a singular point in time. However, when a lagged dependent variable is included in a regression such as POLS and FEM, it is correlated with the error term, which leads to endogeneity in the model known as dynamic panel Nickell bias (Nickell, 1981). To mitigate this, when the lagged dependent variable is included, the analysis employs the two-step System GMM. The GMM is an estimator of Arellano and Bover (1995) and Blundell and Bond (1998) and it is a useful tool in mitigating potential endogeneity by constructing lagged variables as instruments, and it accounts for the persistence of government effectiveness over time (Vossen, 2023). The Arellano-Bond test will be carried out to identify serial correlation. The Hansen and Sargon tests will be conducted to ensure the instruments are exogenous and therefore support the GMM specification (Roodman, 2009). Finally, a table will present a summary of the different regression models to provide clear comparisons.

3.5 Limitations

This section reviews two limitations. First, it outlines how endogeneity in the sample confines the results to correlated associations and explores the attempts at mitigation. Second, it demonstrates how the external validity of the results may be limited. These limitations help the reader to understand the challenges in this data analysis and view the results with them in mind.

In the model, there are likely two sources of endogeneity. First, there may be omitted variable bias, where the estimated effect of an independent variable on the dependent variable cannot be deemed causal because omitted variables are correlated with the independent variable and biasing the results (Antonakis et al., 2010). To reduce omitted variable bias, the FEM controls for unobserved time invariant country characteristics (Baltagi, 2014). However, it does not address unobserved time varying factors. Control variables such as Government Size and Trade Openness are included to account for these time varying influences, although it is difficult to capture them completely. Second, potential endogeneity may arise from reverse causality, where the independent variable may influence the dependent variable, but the dependent variable may also impact the independent variable (Antonakis et al., 2014). Improvements in digitalisation can enhance government effectiveness but more effective governments may be better able to implement and realise the benefits from e-government initiatives. One potential solution to address this endogeneity is the inclusion of a lagged dependent variable. It absorbs part of the reverse causality that better governance may lead to increased digitalisation and vice versa by accounting for past levels of government effectiveness so that the coefficients of the independent variables are not including the effect instead. Since the inclusion of a lagged dependent variable in POLS or FEM can create dynamic panel Nickell bias (Nickell, 1981), the analysis employs GMM to address endogeneity concerns in this model.

The study's external validity may be limited due to its country selection. The study focuses on OECD countries which typically have developed economies, therefore the findings are restricted to other relatively wealthy developed countries. To improve the generalisability, further research would need to be conducted on a wider range of countries to provide conclusions applicable to different circumstances.

3.6 Sample Selection

This empirical analysis will use a panel dataset examining the impact of digitalisation on government effectiveness in OECD countries. The OECD countries are primarily developed countries, which provides a comprehensive sample of high-income countries. The analysis uses developed countries because they likely have more established institutions and digital sectors. There is a digital divide in the global economy, as reflected in digital services comprising 60% of total service exports in developed economies, compared to 44% in developing economies in 2024 (UNCTAD, 2025), therefore analysing developed economies provides more data on the relationship between digitalisation and government effectiveness. The dataset incudes annual observations from 2003 to 2023. The chosen period is particularly underexplored in existing literature on digitalisation in the public sector. Myovella et al. (2020) analysis on digitalisation and government effectiveness includes OECD countries in the panel dataset but the time period is between 2006 and 2016, therefore it does not encompass the pandemic years. Spataru and Popescu (2025) study on digitalisation and government effectiveness between 2013 and 2022 includes the effects of the pandemic but it analysed EU member states. There is a gap in the literature for studies analysing the pandemic, specifically in OECD countries.

3.7 Variable Selection

The dependent, main explanatory variables as well as control and dummy variables are examined, including their definitions and sources. Independent variables influence the dependent variable whereas the dependent variable is the outcome of changes in the independent variables (Andrade, 2021). Control variables are those that are included so that they are kept constant and do not interfere with the analysis of the outcome the explanatory variables have on the dependent variable. They help to limit omitted variable

bias by controlling variables which likely would have correlated with the independent variable. Control variables play an important role in providing credibility to results as the researcher can more accurately determine if there is a causal effect from the main explanatory variable on the dependent variable (Webb, 2017). The aim of this analysis is to determine whether digitalisation has a significant impact on government effectiveness in OECD countries, therefore digitalisation is the explanatory variable and government effectiveness is the dependent variable. The control variables include trade openness, the urbanisation rate, the size of the government and the dummy variables represent the pandemic and federalist governance systems.

3.7.1 Dependent Variable

The dependent variable, GE_{it}, is one of six Worldwide Governance Indicators, obtained from the World Development Indicators dataset by the World Bank (World Bank, 2025). These six indicators provide a comprehensive view on the quality of governance in a country, which consists of six measures: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Government Effectiveness has three main focuses: it examines the quality of the public services, how removed it is from political pressures from the civil service and its ability to implement and commit to its policies (World Bank, 2025). The Government Effectiveness Index is measured using an estimate, which ranges between -2.5 and 2.5, with low values equating poor government effectiveness, or in percentiles, which creates a range from 0 to 100. This study uses the estimate and since you cannot take the log of negative values, it has been standardised to allow for comparability (World Bank, 2025). Strong institutions are more likely to have the ability to transform economic growth into economic development and therefore improve living standards. A government, which listens to its citizens and delivers impactful policies, will be more credible, accountable and effective, all of which can be facilitated by digitalisation.

3.7.2 Independent Variables

See Table 3.1 for explanations for the expectation of these variables.

The lagged dependent variable acts as a proxy for past policies and unobserved country characteristics that contribute to the current level of government effectiveness. It accounts for policies aimed at improving public services, which are a core component of government effectiveness, but have a significant time lag that may not be realised until years later.

Digitalisation is typically measured by the EGDI, produced by the UN (UN E-Government Development Knowledgebase, 2026), or by the Digital Government Index (DGI), created by the OECD (OECD, 2025). EGDI is a survey examining the level of e-government in all 193 UN member states by analysing a government's capacity to use digital technologies in the provision of its services. It consists of three components: Human Capital Index, Online Service Index and the Telecommunication Infrastructure Index. DGI examines digital government policies, therefore analysing how governments use digital technologies in policymaking. It looks at how well a government is governing and managing their digital transformation (OECD, 2025). This analysis uses the EGDI because it is more suitable in depicting how digitalisation in government interacts with citizens. Unlike the DGI, which focuses on policy design, the EGDI captures the practical delivery of digital services through infrastructure, online accessibility and the human capital to support e-governance. This makes it more appropriate for assessing how effectively governments can reach and engage their populations through digital means, rather than how well digital policies are formulated.

$HumanCapital_{it}$ is a component of the EGDI, sourced from the UN database (UN E-Government Development Knowledgebase, 2026). It examines the human element of e-government because e-government is as effective as those that operate it. Education indicators are examined to determine how skilled the population is to work with and benefit from digital services (UN E-Government Development Knowledgebase, 2026).

$OnlineServices_{it}$ is a component of the EGDI, sourced from the UN database (UN E-Government Development Knowledgebase, 2026). It analyses how governments use digital technologies in their online services to improve governance and civic participation (UN E-Government Development Knowledgebase, 2026).

$Telecommunications_{it}$ is a component of the EGDI, sourced from the UN database (UN E-Government Development Knowledgebase, 2026). It analyses the extent to which the ICT infrastructure supports the implementation of e-government initiatives and enables citizens to access and utilise online government services. Strong ICT infrastructure enhances governments' ability to deliver services and engage with citizens through electronic channels (UN E-Government Development Knowledgebase, 2026).

3.7.3 Control Variables

$TradeOpenness_{it}$ is the total of exports and imports as a percentage of GDP, sourced from the World Development Indicators dataset by the World Bank (World Bank, 2024). A larger percentage demonstrates that the economy is more open to trade.

$UrbanisationRate_{it}$ is the percentage of population that live in urban areas, sourced from the World Development Indicators dataset by the World Bank (World Bank, 2024).

$GovernmentSize_{it}$ is government expenditure as a percentage of GDP, sourced from the International Monetary Fund (IMF, 2025). A larger government's expenditure is supposed to represent a larger government.

$Pandemic_{it}$ is a dummy variable for the years during which the Covid-19 pandemic had a significant impact on the public and private sectors. The World Health Organisation declared Covid-19 as a pandemic in 2020 (World Health Organisation, 2020) and declared its end in 2023 (World Health Organisation, 2023).

$FederalistSystem_i$ is a dummy variable for the countries that exhibit federalism as their system of government, where the political power is divided between the national government and the state level governments (Forum of Federations, 2026).

3.8 Summary Statistics

Table 3.2 displays the summary statistics of the dependent variable: government effectiveness, and the independent variables.

Table 3.2: Summary statistics of the dataset

Variable	Observations	Mean	Standard deviation	Minium	Maximum
ZGE_{it}	798	6.05e-10	1	-2.529	1.921
ZGE_{it-1}	760	0.009	0.998	-2.529	1.921
$lnHumanCapital_{it}$	798	-0.094	0.070	-0.357	0
$lnOnlineServices_{it}$	798	-0.344	0.270	-1.772	0
$lnTelecommunications_{it}$	798	-0.493	0.392	-2.207	0
$lnTradeOpenness_{it}$	798	4.431	0.529	3.060	6.021
$lnUrbanisationRate_{it}$	798	4.330	0.145	3.907	4.557
$lnGovernmentSize_{it}$	798	3.688	0.276	2.681	4.202
$Pandemic_{it}$	798	0.143	0.350	0	1
$FederalistSystem_i$	798	0.237	0.425	0	1

Source: Author's own computations based on data described in Chapter 3

The dependent variable, government effectiveness, is standardised and has a range between -2.529 to 1.921, which indicates substantial variation in government effectiveness across countries and over time, as expected in panel estimation. The Human Capital Index variable has the smallest variation of the three components of EGDI, with a standard deviation of 0.070. This suggests human capital levels are relatively stable across the dataset, as expected in OECD countries with relatively high-income economies. The Online Services Index shows moderate dispersion, which reflects the uneven adoption of digital public service provision across countries. The Telecommunications Infrastructure Index exhibits greater variation, indicating larger cross-country differences in digital infrastructure development. Among the control variables, there is considerable variation in the Trade Openness variable, which suggests differences in economic integration across countries. The Urbanisation Rate variable shows relatively limited dispersion, indicating less variation in urban population proportions, as expected in a sample of developed economies. The Government Size variable displays moderate variation, which implies differences in public sector scale across the sample. The Federalist System indicator has a mean of 0.237, which indicates that approximately 23.7% of observations correspond to federal political systems. This variation highlights the institutional differences across governance structures. The absence of extreme outliers indicates the data are unlikely to be heavily distorted by abnormal observations.

3.9 Summary

This chapter outlined the econometric model used to analyse the impact of digitalisation on government effectiveness, using POLS with FEM and GMM as robustness checks. The hypothesis test evaluates whether the independent variables have a significant relationship with the dependent variable. The selection of the sample and the dependent and independent variables were justified. I explained two limitations of my study due to endogeneity bias and limited external validity but outlined the attempts at mitigation. The choice of my time period, 2003 to 2023, was clarified because it is particularly

underexplored in OECD countries and includes the pandemic. Chapter 4 presents the results and analysis of my regressions.

Chapter 4: Results

4.1 Introduction

Section 4 presents the findings and analysis of my regressions. Section 4.2 discusses the data tests conducted on the dataset such as the multicollinearity, Hausman and Sargan-Hansen tests. Section 4.3 displays the estimated coefficients of all five models and discusses their statistical and theoretical significance. Section 4.4 provides the robustness checks by examining Models 4 and 5. Section 4.5 examines the direct and indirect effects of the pandemic, alongside the influence of institutional persistence captured by the lagged dependent variable. Section 4.5 summarises the findings and provides conclusions.

4.2 Data Tests

After conducting the POLS regression on Model 3, the multicollinearity test was performed to assess whether the independent variables are highly correlated with each other, as outlined in Table 4.1 (Daoud, 2017). A value above 4 suggests the presence of multicollinearity (CFI, 2020). Since the VIF values fall between 1.07 and 2.30, it is implied that multicollinearity is not a concern within the model.

Table 4.1: Multicollinearity test

Human Capital Index	**Online Service Index**	**Telecommunication Infrastructure Index**	**Trade Openness**
1.19	1.85	2.30	1.33
Urbanisation Rate	**Government Size**	**Pandemic**	**Federalist System**
1.35	1.32	1.16	1.07

Source: Author's own computations based on data described in Chapter 3

Among the independent variables, the Telecommunication Infrastructure Index records the highest VIF value at 2.30, therefore suggesting a relatively stronger correlation with the other independent variables compared to the remaining regressors. In contrast, the Federalist System variable displays the lowest VIF value at 1.07, which suggests minimal correlation with the other independent variables in the model. Overall, the VIF values fall below 4 therefore the independent variables do not display problematic levels of collinearity. The estimated coefficients are unlikely to suffer from inflated standard errors due to multicollinearity, therefore improving the internal validity of the regression results.

Following the confirmation of low multicollinearity among the independent variables, the Hausman test was performed on Model 3 to determine the appropriate estimator for the robustness check. The test, as outlined in Table 4.2, produced a chi-squared statistic of 154.56 and a p-value below 0.001. This provides sufficient evidence at the 1% significance level to reject the null hypothesis that the unobserved individual effects are not correlated with the independent variables. This indicates that the FEM is the more appropriate estimator for this model over the REM and will be employed in the robustness check in this panel data analysis.

Table 4.2: Hausman test

Test	Result
Chi^2	154.56
P-value	<0.001

Source: Author's own computations based on data described in Chapter 3

This panel data analysis employs the two-step System GMM model, which requires the critical assumption of exogenous instruments to be fulfilled. The Sargan and Hansen tests were conducted to check the validity of the instruments, as shown in Table 4.3. Although the Sargan test rejects the null hypothesis that the instruments are valid, the Hansen test is preferable because it is robust to the presence of heteroscedasticity. The Hansen test's p-value of 0.155 demonstrates that there is insufficient evidence to reject the null hypothesis that all the instruments are valid. Furthermore, the Difference-in-Hansen tests

fail to reject the null hypothesis of exogeneity of both the additional System GMM instruments and the IV instruments (Roodman, 2009). The Arellano-Bond test, as shown in Table 4.3, indicates significant AR(1) serial correlation, which is expected in first-differenced residuals. The AR(2) test is not significant, which suggests the absence of second-order serial correlation and supporting the validity of the GMM specification.

Table 4.3: Arellano-Bond, Hansen and Sargan tests

Tests	P-value	Result
AR(1)	0.000	Serial correlation
AR(2)	0.081	No serial correlation
Sargan test	0.017	Rejects H_0 that instruments are valid
Hansen test	0.155	Accepts H_0 that instruments are valid
Difference-in-Hansen (levels GMM)	0.147	Accepts H_0 of exogeneity of additional System GMM instruments
Difference-in-Hansen (IV instruments)	0.235	Accepts H_0 of exogeneity of IV instruments

Source: Author's own computations based on data described in Chapter 3

4.3 Main Results

The panel data analysis revealed mixed evidence regarding the relationship between digitalisation and government effectiveness in OECD countries between 2003 and 2023. Five models were conducted: POLS established the baseline relationships and FEM and GMM were employed as robustness checks. The results, as shown in Table 4.4, produced estimated coefficients, standard errors, p-values and adjusted R-squared values to assess the statistical significance of the variables and the reliability of the models.

Table 4.4: Results from POLS, FEM and System GMM regressions

Independent Variables	$POLS_1$	$POLS_2$	$POLS_3$	FEM	GMM
	(1)	(2)	(3)	(4)	(5)

lnEGDI	3.669***				
	(0.178)				
ZGE_{it-1}					1.005***
					(0.032)
$lnHumanCapital_{it}$		6.675***	5.829***	-0.235	0.125
		(0.351)	(0.324)	(0.443)	(0.368)
$lnOnlineServices_{it}$		0.182*	0.170	-0.012	0.031
		(0.109)	(0.105)	(0.125)	(0.101)
$lnTelecommunications_{it}$		1.179***	1.066***	-0.100	0.035
		(0.077)	(0.081)	(0.127)	(0.052)
$lnTradeOpenness_{it}$			0.260***	-0.152	-0.009
			(0.045)	(0.178)	(0.021)
$lnUrbanisationRate_{it}$			1.580***	-0.457	-0.105
			(0.167)	(0.600)	(0.086)
$lnGovernmentsize_{it}$			0.313***	-0.053	-0.084**
			(0.087)	(0.195)	(0.038)
$Pandemic_{it}$			-0.638***	-0.111**	-0.031
			(0.064)	(0.044)	(0.030)
$FederalistSystem_i$			0.240***	-	-0.031*
			(0.051)		(0.018)
N	798	798	798	798	760
$\bar{R}^2$	0.3475	0.5499	0.6530	0.0773	

Source: Author's own computations based on data described in Chapter 3

Note: *p<0.10, **p<0.05, ***p<0.01. Standard errors in parentheses under the coefficients.

In Model 1, the relationship between digitalisation, represented by the EGDI, and government effectiveness was established. The coefficient is estimated at 3.669 and the extremely low p-value of 0.000 provides sufficient evidence at the 1% significance level to reject the null hypothesis, therefore digitalisation positively influences government

effectiveness. This result suggests a 1% increase digitalisation in governments leads to a 0.03669 standard deviation increase in government effectiveness, holding all other variables constant. This finding suggests that advances in e-governance strengthen administrative capacity, support policy implementation and commitment, and enhances the quality of public services. The explanatory power of the model is assessed using the R-squared value and the adjusted R-squared value, which accounts for the number of predictors in the model. Both the R-squared value and adjusted R-squared value is 34.8%, meaning that the EGDI variable accounts for 34.8% of the variation in government effectiveness.

To analyse this relationship further, Model 2 breaks the composite index, EGDI, into its three components: the Human Capital Index, the Online Service Index and the Telecommunication Infrastructure Index. The Human Capital Index reflects the educational and skill base necessary for citizens to access and engage with digital government services. The coefficient of the Human Capital Index variable is estimated at 6.675 and exhibits statistical significance at the 1% level with a p-value below the threshold of 0.01. This finding implies that a more educated and skilled workforce may facilitate greater citizen participation, improve communication between governments and citizens, and enhance the responsiveness of public institutions. Through these channels, human capital can strengthen input, throughput and output legitimacy, therefore contributing to higher levels of government effectiveness. The Human Capital Index has the strongest association with government effectiveness, as reflected in having the largest coefficient among the three components. The Online Services Index and the Telecommunications Infrastructure Index rely on the Human Capital Index because citizens must have the digital literacy and skills to operate the digital services or ICT infrastructure. The Online Service Index variable demonstrates a positive relationship with its coefficient estimated at 0.182 and statistical significance at the 10% significance level. The coefficient of the Telecommunications Infrastructure Index variable is estimated at 1.179 and is statistically significant at the 1% significance level. A 1% increase in the Telecommunications Infrastructure Index leads to a 0.01179 standard deviation increase in government effectiveness, holding all other variables constant. A higher level of telecommunications infrastructure reduces barriers to accessing

government services and information, which enables governments to deliver services more efficiently and communicate more effectively with citizens. Both the R-squared and adjusted R-squared value are approximately 0.55, explaining around 55% of variation in government effectiveness.

Model 3 includes the control variables: Trade Openness, Urbanisation Rate, Government Size and the dummy variables: the Pandemic and the Federalist System. The coefficient of the Human Capital Index remains the largest among the independent variables and maintains a positive relationship and statistical significance at the 1% significance level. It is estimated at 5.829, which suggests a 1% increase in the Human Capital Index leads to a 0.05829 standard deviation increase in government effectiveness, holding all other variables constant. The Online Service Index variable is no longer statistically significant at the 10% significance level. The Telecommunications Infrastructure Index variable maintains its significance at the 1% significance level. All the control and dummy variables are statistically significant at the 1% significance level. The coefficient of the Trade Openness variable illustrates a positive relationship, with an estimated coefficient of 0.260. A 1% increase in Trade Openness leads to a 0.00260 standard deviation increase in government effectiveness, holding all other variables constant. Trade openness is proxied by the sum of exports and imports as a percentage of GDP and this result implies that a more liberalised economy may lead to increased transfer of knowledge and skills, which improves government capacity. The Urbanisation Rate variable demonstrates a positive and statistically significant relationship with government effectiveness, which suggests that higher levels of urbanisation may facilitate governments in providing public services to a larger proportion of the population. The coefficient of the Government Size variable is estimated at 0.313. This relationship illustrates that a 1% increase in Government Size leads to a 0.00313 standard deviation improvement in government effectiveness, holding all other variables constant. The Government Size variable is proxied by government expenditure as a percentage of GDP, therefore the positive relationship suggests that governments with greater fiscal resources may be better positioned to provide high-quality public services, strengthen administrative capacity and implement policies effectively. The coefficient of the Pandemic variable is estimated at -0.638, which suggests a negative impact on government effectiveness. This result

translates to a 0.638 standard deviation decrease in government effectiveness each year the pandemic occurred, holding all other variables constant. Although Spataru and Popescu (2025) suggest the pandemic accelerated the digital transition in governments and aided their operations, it is likely that the disruption outweighed the benefits of introducing digital technologies or that the benefits were not captured in my time period due to time lags from implementing e-governance initiatives. The coefficient of the Federalist System variable, which is estimated at 0.240, indicates that federalist governance systems may have an enhanced capacity to formulate, implement and commit to policies. A federalist governance system decentralises power to a regional level. Regional governments cover a smaller area and have shorter communication loops than national governments, which may improve their responsiveness and implementation of policies to address citizen concerns. Model 3 explains approximately 65% of variation in government effectiveness, according to the adjusted R-squared value. Model 3 explains 18.7% more of the variation in government effectiveness than Model 2, which demonstrates the importance of including control and dummy variables.

4.4 Robustness Checks

Robustness checks are conducted to test whether the relationships established in Model 3, using POLS, hold under FEM and GMM regressions. Model 4 employs a FEM, as decided by the Hausman test. It contains the dependent variable, government effectiveness, and the independent variables: the sub-indices of EGDI as well as the control and dummy variables. A FEM strengthens the analysis because it assesses within-country variation by controlling for time invariant differences between countries. It uses cluster-robust standard errors at the country level due to economic shocks or policies having an effect over multiple years. The components of the EGDI provide unexpected results. All three variables display a negative coefficient and are not significant at either 1%, 5% or 10% significance levels, in contrast to their positive coefficients in Model 3. Both the Human Capital Index and Telecommunications Infrastructure Index variables lose their statistical significance and the Online Service Index variable remained statistically insignificant in Model 4. The control variables: Trade Openness, Urbanisation Rate and Government Size display negative coefficients and are not statistically

significant, whereas in Model 3 they demonstrated positive and statistically significant relationships. On the other hand, the Pandemic variable maintains its negative relationship and statistical significance at the 5% significance level in Model 4. The Federalist System variable was omitted due to multicollinearity. All the coefficients in Model 4 are smaller than those in Model 3, which highlights how the POLS model likely picks up between-country differences. Model 4 explains 7.7% of variation of government effectiveness within countries. The adjusted R-squared value was calculated using the within R-squared value.

Model 5 includes a lagged dependent variable to capture persistence over time because previous levels of government effectiveness likely explain its current level. For example, government effectiveness is shaped by many factors such as past policies, good governance and culture, which can be difficult to measure, and the lagged dependent variable indirectly stores these influences. Since the lagged dependent variable may be correlated with the error term and this leads to dynamic panel bias, the two-step System GMM is employed to mitigate this endogeneity. The coefficient of the lagged dependent variable is estimated at 1.005, which is the largest among the independent variables, and is statistically significant at the 1% level. A 1 standard deviation increase in past government effectiveness leads to a 1.005 standard deviation increase in government effectiveness in the current period, holding all other variables constant. This finding highlights that countries with higher government effectiveness in the last period tend to have higher government effectiveness this period, which indicates persistence over time. The three components of the EGDI are not statistically significant at the 1%, 5% or 10% significance levels, but they all maintain their positive coefficients as in Model 3. Both the Trade Openness and Urbanisation Rate variables lose their statistical significance and now display negative signs compared to Model 3. The estimated coefficient of the Government Size variable maintains its statistical significance. However, the coefficient changed from 0.313 in Model 3 to -0.084 in Model 5, which suggests a 1% increase in the variable Government Size leads to a 0.00084 standard deviation decrease in government effectiveness, holding all other variables constant. Given the small coefficient and standard error of 0.038 being close to 0, the relationship is likely small. The estimated coefficient of the Pandemic variable remains negative, but it is not

statistically significant. The Federalist System variable remains statistically significant but illustrates a negative relationship. Its coefficient, which is estimated at -0.031, suggests a country with a federalist governance system may decrease government effectiveness by 0.031 standard deviations, holding all other variables constant. Federal systems may hinder government effectiveness because the different layers of government may slow decision making and increase coordination problems.

In summary, Model 1, 2 and 3 employed POLS. Model 1 established a positive and significant relationship between the composite EGDI variable and government effectiveness. Model 2 split the composite EGDI variable into its three components and Model 3 expanded it by including control and dummy variables. Model 3 demonstrates a positive and statistically significant relationship between the Human Capital Index and Telecommunications Infrastructure Index variables and government effectiveness. The Human Capital Index had the largest estimated coefficient, suggesting it has the strongest association with government effectiveness. The control and dummy variables display the appropriate signs and statistical significance at the 1% significance level. Model 3 has the largest adjusted R-squared value, explaining 65.3% of variation in government effectiveness, therefore adding control variables improves the model's explanatory power. However, the baseline relationships established in Model 3 do not hold under the robustness checks. Model 4, employing a FEM, demonstrated a drop in statistical significance for all variables except the Pandemic variable. Model 5 included a lagged dependent variable and employed a System GMM. The main finding is that the estimated coefficient of the lagged government effectiveness variable was the largest in the model and is statistically significant, highlighting the persistence of previous levels of government effectiveness on current levels. Government Size and the Federalist System variables were statistically significant, but their signs were unexpected, therefore lacking economic significance.

4.5 Evaluation

Model 5 is the preferred model because it properly accounts for persistence over time and utilises System GMM to address the problem of endogeneity by using internal

instruments. Model 3 establishes the baseline relationships. All the variables display the appropriate signs and all the variables, except the Online Service Index variable, are statistically significant at the 1% significance level. However, these relationships are not robust to controlling for unobserved heterogeneity and institutional persistence. The results in Model 3 may be primarily driven by cross country differences as wealthier countries may have a more skilled work force, established infrastructure, increased urbanisation, which may lead to improved government effectiveness. These relationships weaken once country fixed effects and dynamic persistence are accounted for. The GMM specification indicates that government effectiveness is highly persistent over time, while most independent variables do not exert statistically significant effects.

4.6 Hypothesis Test

My null hypothesis states that there is no relationship between the independent variables and the dependent variable, government effectiveness. Although the individual components of the EGDI do not exhibit statistically significant effects in Model 5, the hypothesis is nevertheless rejected. The lagged dependent variable displays statistical significance at the 1% significance level. The variables Government Size and Federalist System illustrate statistical significance at the 5% and 10% significance levels, respectively, which provides sufficient evidence to reject the null hypothesis. This finding may indicate that digitalisation alone is insufficient to improve government effectiveness and that its benefits depend on the broader institutional environment.

4.7 Additional Implications of the Estimation

4.7.1 The Pandemic

This study examines the effects of the pandemic on government effectiveness. First, the direct effect of the pandemic will be examined. Second, the indirect effects of the pandemic on government effectiveness such as through increased pressure on online public systems and fiscal resources will be discussed. Thirdly, the role of institutional

persistence will be analysed, specifically in understanding how exogenous shocks such as the pandemic are transmitted and managed over time. Table 4.5 displays the direct and indirect effects of the pandemic on government effectiveness and the role of institutional persistence in shaping these relationships.

Table 4.5: The effects of the pandemic

Variables	Direct	Indirect	Institutional persistence	Total	Contribution
ZGE_{it-1}			-0.0859	-0.0859	74.14%
$HumanCapital_{it}$		0.0008		0.0008	-0.68%
$OnlineServices_{it}$		-0.0003		-0.0003	0.26%
$Telecommunications_{it}$		0.0014		0.0014	-1.23%
$TradeOpenness_{it}$		0.0002		0.0002	-0.21%
$UrbanisationRate_{it}$		-0.0001		-0.0001	0.08%
$Governmentsize_{it}$		-0.0010		-0.0010	0.88%
$Pandemic_{it}$	-0.031			-0.031	26.75%
Total		-0.0859	0.0010	-0.1159	100%

Source: Author's own computations based on Model 5

I analyse the effects of the pandemic on government effectiveness through the independent variables, excluding the Federalist System variable because it is a time-invariant characteristic. The direct effect of the pandemic is the Pandemic variable's coefficient in Model 5, which demonstrates a 0.031 standard deviation decrease in government effectiveness each year of the pandemic, holding all other variables constant. The direct effect contributes 26.75% of the overall effect of the pandemic on government effectiveness. The indirect effects are calculated by identifying the lowest values of the independent variables during the pandemic years and subtracting their value in 2019, before the pandemic. These differences are multiplied by their coefficients from Model 5. The indirect effect column demonstrates how changes in the independent variables during the pandemic impacted government effectiveness. The indirect effects are negligible as some variables contribute to the worsening of government effectiveness, as

shown through positive contribution scores, whereas other variables offset these effects as demonstrated by negative contribution scores. The Online Service Index variable negatively impacted government effectiveness during the pandemic. The quality and accessibility of online public services declined during the pandemic and since there is a positive relationship with government effectiveness, as shown in Table 4.1, the decline in the Online Service Index negatively impacted government effectiveness. The Urbanisation Rate increased during the pandemic and since there is a negative relationship with government effectiveness, this had a negative impact perhaps due to increased pressure on public services in urban areas. Government size expanded during the pandemic, likely due to increased expenditure, and since there is a negative relationship with government effectiveness, this expansion negatively impacted government effectiveness. However, these are offset by improvements in the Human Capital Index and Telecommunications Infrastructure Index over the pandemic, which improve government effectiveness due to their positive relationships. Trade openness likely declined due to major lockdowns and disrupted supply chains but the negative relationship with government effectiveness leads to this decline improving government effectiveness. However, these variables do not have statistical significance in Model 5, except the variable Government Size, therefore these interpretations must be taken with caution. The role of institutional persistence provides an important point of analysis. It is represented by the lagged dependent variable, which is statistically significant at the 1% level in Model 5. The institutional persistence accounts for approximately 74% of the pandemic's effects. This suggests the pandemic's effects are largely mediated by pre-existing institutional conditions rather than by short-run changes induced by the shock itself. Institutions play an important role in determining the outcome of these exogenous shocks, therefore highlighting the necessity of building strong institutions before exogenous shocks occur.

4.7.2 AI Insights

This analysis on the relationship between digitalisation and government effectiveness provides recommendations for AI adoption in the public sector. Policymakers must prioritise institutional quality to create a conducive environment for AI adoption since

strong institutions are more likely to implement and regulate AI more successfully. Although digitalisation appears significant in Model 3, that effect disappears once between-country differences and institutional persistence are accounted for. In Model 5, the lagged dependent variable is statistically significant and has the largest coefficient, which emphasises that government effectiveness is highly persistent over time as current levels depend heavily on past institutional performance. Policymakers should focus on strengthening institutional quality before expecting substantial gains from AI adoption as pre-existing institutional quality plays a larger role in determining government effectiveness than digitalisation. The finding suggests that the benefits of AI adoption is conditional on institutional quality, therefore policymakers should invest in AI adoption alongside investments into regulatory quality and anti-corruption reforms.

4.8 Summary and Conclusions

I conducted the multicollinearity test on my independent variables and found low levels of collinearity among the independent variables. The Hausman test concluded that the FEM is more appropriate than a REM for my dataset. Although the Sargan test does not support the validity of the instruments, the Hansen test fails to reject the null hypothesis of instrument validity. Given the Hansen test is robust to heteroscedasticity, it is preferred and supports the suitability of the System GMM specification. I compared the regression results of three models using POLS. Model 1 contained the EGDI variable, Model 2 broke it down into its three components and Model 3 included the control and dummy variables. I employed FEM and System GMM models as robustness checks. I conclude that the established relationships in Model 3 do not hold when accounting for time invariant cross-country differences or institutional persistence. Model 5 highlights the importance of past levels of government effectiveness in current levels. The analysis of the pandemic on government effectiveness revealed how the quality of institutions helps determine how severe the consequences of an exogenous shock such as the pandemic are.

Chapter 5: Conclusion

This thesis aimed to investigate the relationship between digitalisation and government effectiveness. Understanding the role of digitalisation in the public sector is crucial because of the rapid development of digital technologies. Digitalisation improves government effectiveness through expanding administrative capacity, enhancing the transparency and accountability of operations, and by improving the quality of public services. Digital technologies are constantly evolving. For example, AI has progressed from large language models designed to handle general requests to agentic AI systems composed of autonomous, specialised agents capable of solving complex problems and responding to real-time information (Mucci, 2024). Emerging technologies have the potential to transform the public sector significantly. Consequently, understanding the baseline relationship between digitalisation and government effectiveness is essential for informing future technology adoption.

To understand this relationship, I defined the key concepts of government effectiveness and digitalisation. Government effectiveness reflects a government's ability to make a meaningful impact on society through the provision of high-quality public services and the formulation and implementation of policies that address citizens' needs and concerns. Digitalisation in government refers to the use of digital technologies to improve interactions between governments, citizens, and businesses, and to enhance public services. The existing literature establishes a positive and significant relationship between digitalisation and government effectiveness, at the macroeconomic level. However, some studies argue that strong institutions are a prerequisite for realising the benefits of digitalisation, raising questions about whether digitalisation improves government effectiveness or simply reflects it. This highlights the complexity of this relationship, which this thesis aims to address by using more recent data and a robust methodology.

This study empirically investigated the relationship using panel data analysis, allowing for a comprehensive analysis of digitalisation and government effectiveness across time and countries. The dependent variable, government effectiveness, was measured by the Government Effectiveness indicator from the World Bank’s Worldwide Governance

Indicators (World Bank, 2025). Digitalisation, the explanatory variable, was measured through the E-Government Development Index obtained from the UN E-Government Development Knowledgebase (2026). This indicator was chosen over the Digital Government Index because it captures the main channels through which digitalisation may affect government effectiveness: online service provision, telecommunications infrastructure, and human capital. The DGI evaluates the quality of digital governance practices, therefore the EGDI provides a more direct measure of digital development, making it more suitable for assessing its relationship with government effectiveness. The analysis incorporated a range of control variables such as Trade Openness, Government Size and Urbanisation Rate, which encompass economic, fiscal and sociodemographic factors. Additionally, dummy variables for the pandemic and federalist systems were included to assess the impact of an exogenous shock and account for time-invariant institutional characteristics across countries. This panel data analysis covered two decades, from 2003 to 2023, enabling the study to capture both improvements and deteriorations in government effectiveness, which typically occur gradually. The sample of OECD countries comprises 38 relatively wealthy and developed economies, which are more likely to have undergone digital development within the public sector. This makes them a suitable choice for examining the relationship between digitalisation and government effectiveness. I employed three POLS models, gradually including control and dummy variables, and as a robustness check, I used a FEM and a System GMM estimator.

The empirical findings revealed mixed evidence regarding the relationship between digitalisation and government effectiveness. The initial model, which considered only the composite EGDI variable as the determinant, demonstrated a positive and significant relationship. Model 1 explained around 35% of the variation in government effectiveness, highlighting the potential importance of digitalisation in influencing governance performance. Model 3, which incorporates the control and dummy variables, employed POLS and revealed statistically significant relationships with the appropriate signs between the explanatory variables and the dependent variable. The explanatory power of the model increased to around 65%, demonstrating that government effectiveness is influenced by a range of factors beyond digitalisation. However, these relationships did

not hold in the robustness checks. After controlling for unobserved country-specific effects, all variables except the Pandemic dummy variable lost statistical significance, indicating that the observed relationships were primarily driven by cross-country differences. The second robustness check introduced a lagged dependent variable to account for institutional persistence and the dynamic nature of government effectiveness. Since a lagged dependent variable can lead to dynamic panel bias, I employ the System GMM, which addressed the potential endogeneity through the use of internal instruments. The main finding was that past institutional performance had a positive and statistically significant relationship with current levels of government effectiveness, indicating that higher levels of government effectiveness in the past tend to exhibit higher levels of government effectiveness in the present. Policymakers ought to focus on strengthening institutions and maintaining policy consistency.

A key contribution of this analysis is the focus on the impact of the pandemic. I assessed the direct and indirect effects of the pandemic on government effectiveness, as well as the role of institutional persistence in mediating these effects. The direct effect of the pandemic accounted for 26.75% of the overall impact, while the indirect effects transmitted through the independent variables largely offset one another. The institutional persistence, represented by the lagged dependent variable, accounted for 74.14% of the overall impact, suggesting that pre-existing institutional capacity mediated most of the pandemic's effects rather than short-term changes in the independent variables. Regarding recommendations for AI adoption, the findings imply that the benefits of AI adoption may be contingent upon institutional capacity. Given the strong persistence observed in government effectiveness, policymakers should prioritise reforms that strengthen institutions, including anti-corruption measures and adherence to the rule of law. Stronger institutions are likely to enhance governments' ability to implement and realise the benefits of emerging technologies such as AI.

There are limitations to my analysis that must be considered. Firstly, there may be endogeneity bias due to omitted variable bias and reverse causality. The model includes control variables to account for observable time-varying factors and employs a FEM to control for unobserved time-invariant country characteristics, however, endogeneity may

still occur from unobserved time-varying factors. Endogeneity may arise from reverse causality, which is addressed through the inclusion of a lagged dependent variable and a two-step System GMM estimator. However, these methods cannot fully establish causality and the results should be interpreted as evidence of association. Secondly, the study's external validity may be limited due to the sample selection. The analysis focuses on OECD countries, which represent developed economies, therefore the results are not generalisable to developing countries. Future research should employ more robust methods to fully address endogeneity and establish causal relationships and should also include a broader range of countries to improve generalisability.

In conclusion, my analysis of the impact of digitalisation on government effectiveness in OECD countries between 2003 and 2023 highlights the importance of institutional quality as a prerequisite for successful e-government implementation. This finding is supported by the preferred model, a System GMM model, which helps address endogeneity concerns. While the direct and indirect effects of the pandemic accounted for around a quarter of the overall impact, the analysis illustrated the role of institutional persistence in mediating the consequences of an exogenous shock. Policymakers must prioritise strengthening institutions to minimise disruption from exogenous shocks and to create a conducive environment for successful AI implementation. Future research could employ more robust methodologies to fully mitigate endogeneity and make causal inference. Moreover, a sample selection including developing economies would enhance the external validity and policy relevance of the findings.

List of Acronyms

AI	Artificial Intelligence
EGDI	E-Government Development Index
EU	European Union
FEM	Fixed Effects Model
GMM	Generalised Method of Moments
H_0	Null Hypothesis
MENA	Middle East and North Africa
OECD	Organisation for Economic Co-operation and Development
POLS	Pooled Ordinary Least Squares
p-value	Probability Value
REM	Random Effects Model
RPA	Robotics Process Automation
VIF	Variance Inflation Factors

List of Tables

Bibliography

Alabi, O. and Bukola, T. 2023. Introduction to Descriptive Statistics *In*: *Recent Advances in Biostatistics* [Online]. IntechOpen. [Accessed 21 April 2026]. Available from: https://www.intechopen.com/chapters/1141192.

Andrade, C. 2021. A Student's Guide to the Classification and Operationalization of Variables in the Conceptualization and Design of a Clinical Study: Part 1. *Indian Journal of Psychological Medicine*. **43**(2), pp.177–179.

Androniceanu, A. and Georgescu, I. 2023. Public Administration Digitalization and Government Effectiveness in the EU Countries. *Central European Public Administration Review (CEPAR)*. **21**(1), pp.7–30.

Antonakis, J., Bendahan, S., Jacquart, P. and Lalive, R. 2010. On making causal claims: A review and recommendations. *The Leadership Quarterly*. **21**(6), pp.1086–1120.

Antonakis, J., Bendahan, S., Jacquart, P. and Lalive, R. 2014. Causality and endogeneity: Problems and solutions *In*: *The Oxford Handbook of Leadership and Organizations*.

Arellano, M. and Bover, O. 1995. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*. **68**(1), pp.29–51.

Arntz, M., Gregory, T. and Zierahn, U. 2019. Digitalization and the Future of Work: Macroeconomic Consequences.

Baltagi, B. 2014. Panel Data and Difference-in-Differences Estimation., pp.425–433.

Benedikt, L., Joshi, C., Nolan, L., Henstra-Hill, R., Shaw, L. and Hook, S. 2020. Human-in-the-loop AI in government: a case study *In*: *Proceedings of the 25th International Conference on Intelligent User Interfaces* [Online]. IUI '20. New York, NY, USA: Association for Computing Machinery, pp.488–497. [Accessed 7 March 2026]. Available from: https://dl.acm.org/doi/10.1145/3377325.3377489.

Bhatnagar, S. 2003. Global Corruption Report 2003: Access to Information. [Online]. [Accessed 28 February 2026]. Available from: https://issuu.com/transparencyinternational/docs/2003_gcr_accessinfo_en/40.

Blundell, R. and Bond, S. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*. **87**(1), pp.115–143.

Cameron, A.C. and Miller, D.L. 2015. A Practitioner's Guide to Cluster-Robust Inference. *The Journal of Human Resources*. **50**(2), pp.317–372.

Carlson, T. 2020. Cloud technology is transforming public services. This is how. *World Economic Forum*. [Online]. [Accessed 18 March 2026]. Available from: https://www.weforum.org/stories/2020/08/cloud-technology-is-transforming-public-services-this-is-how/.

CFI. 2020. Variance Inflation Factor (VIF). *Corporate Finance Institute*. [Online]. [Accessed 21 April 2026]. Available from: https://corporatefinanceinstitute.com/resources/data-science/variance-inflation-factor-vif/.

Chen, L. and Aklikokou, A.K. 2021. Relating e-government development to government effectiveness and control of corruption: a cluster analysis. *Journal of Chinese Governance*. **6**(1), pp.155–173.

Corrêa, N.K., Galvão, C., Santos, J.W., Del Pino, C., Pinto, E.P., Barbosa, C., Massmann, D., Mambrini, R., Galvão, L., Terem, E. and De Oliveira, N. 2023.

Worldwide AI ethics: A review of 200 guidelines and recommendations for AI governance. *Patterns*. **4**(10), p.100857.

Dhaoui, I. 2022. E-Government for Sustainable Development: Evidence from MENA Countries. *Journal of the Knowledge Economy*. **13**(3), pp.2070–2099.

Dobrolyubova, E., Klochkova, E. and Alexandrov, O. 2019. Digitalization and Effective Government: What Is the Cause and What Is the Effect? *In*: D. A. Alexandrov, A. V. Boukhanovsky, A. V. Chugunov, Y. Kabanov, O. Koltsova and I. Musabirov, eds. *Digital Transformation and Global Society*. Cham: Springer International Publishing, pp.55–67.

Durkiewicz, J. and Janowski, T. 2018. Is Digitalization Improving Governance Quality? Correlating Analog and Digital Benchmarks. *Bridge of Knowledge - your knowledge portal*. [Online], pp.48–56. [Accessed 26 January 2026]. Available from: https://mostwiedzy.pl/en/publication/is-digitalization-improving-governance-quality-correlating-analog-and-digital-benchmarks,146659-1.

Estonian Business and Innovation Agency. 2020. E-governance saves money and working hours. *e-Estonia*. [Online]. [Accessed 3 June 2026]. Available from: https://e-estonia.com/e-governance-saves-money-and-working-hours/.

Eurofound. 2026. Digitalisation. *Eurofound*. [Online]. [Accessed 24 January 2026]. Available from: https://www.eurofound.europa.eu/en/topics/digitalisation.

European Commission. 2024. eGovernment and digital public services | Shaping Europe's digital future. [Accessed 3 June 2026]. Available from: https://digital-strategy.ec.europa.eu/en/policies/egovernment.

Forum of Federations. 2026. Federal Countries. [Accessed 22 April 2026]. Available from: https://www.forumfed.org/countries/.

Gemstone. 2024. Big Data in the Public Sector: Improving Services through Analytics. *Gemstone*. [Online]. [Accessed 4 March 2026]. Available from: https://www.gemstoneit.co.uk/data-engineering/big-data-in-the-public-sector-improving-services-through-analytics/.

Goldenfein, J. 2024. Lost in the Loop: Who is the 'Human' of the Human in the Loop.

Hanck, C., Arnold, M., Gerber, A. and Schmelzer, M. 2026. *10.4 Regression with Time Fixed Effects | Introduction to Econometrics with R* [Online]. [Accessed 22 April 2026]. Available from: https://www.econometrics-with-r.org/10.4-regression-with-time-fixed-effects.html.

Humboldt Institute. 2025. Human in the Loop? *HIIG*. [Online]. [Accessed 8 March 2026]. Available from: https://www.hiig.de/en/project/human-in-the-loop/.

IMF. 2025. Public Finances in Modern History. [Accessed 22 April 2026]. Available from: https://www.imf.org/external/datamapper/exp@FPP/USA/FRA/JPN/GBR/SWE/ESP/ITA/ZAF/IND?year=2024

Kochanova, A., Hasnain, Z. and Larson, B. 2016. *Does E-Government Improve Government Capacity? Evidence from Tax Administration and Public Procurement* [Online]. World Bank, Washington, DC. [Accessed 17 December 2025]. Available from: https://hdl.handle.net/10986/24231.

Ngari, J. 2019. Time Series vs. Cross-Sectional Data | CFA Level 1. *AnalystPrep | CFA® Exam Study Notes*. [Online]. [Accessed 29 April 2026]. Available from:

https://analystprep.com/cfa-level-1-exam/quantitative-methods/time-series-data-vs-cross-sectional-data/.

Nickell, S. 1981. Biases in Dynamic Models with Fixed Effects. *Econometrica*. **49**(6), pp.1417–1426.

Noor, M. 2022. The effect of e-service quality on user satisfaction and loyalty in accessing e-government information. *International Journal of Data and Network Science*. **6**(3), pp.945–952.

Nurlinah, Ansar, M.C. and Chowdhury, K. 2025. Impact of government digital transformation on citizen trust and participation: evidence from Gowa Regency, Indonesia. *Frontiers in Human Dynamics*. **7**.

OECD. 2026. AI principles. *OECD*. [Online]. [Accessed 18 March 2026]. Available from: https://www.oecd.org/en/topics/ai-principles.html.

OECD. 2025. Digital government index: Government at a Glance 2025. *OECD*. [Online]. [Accessed 27 April 2026]. Available from: https://www.oecd.org/en/publications/government-at-a-glance-2025_0efd0bcd-en/full-report/digital-government-index_1edec44e.html.

Okunogbe, O. and Pouliquen, V. 2022. Technology, Taxation, and Corruption: Evidence from the Introduction of Electronic Tax Filing. *American Economic Journal: Economic Policy*. **14**(1), pp.341–372.

Omar, S.S., Nayef, J.M., Qasim, N.H., Kawad, R.T. and Kalenychenko, R. 2024. THE ROLE OF DIGITALIZATION IN IMPROVING ACCOUNTABILITY AND

EFFICIENCY IN PUBLIC SERVICES. *Journal of Operational Research*. **45**(2), pp.203–224.

Park, C.H. and Kim, K. 2020. E-government as an anti-corruption tool: panel data analysis across countries. *International Review of Administrative Sciences*. **86**(4), pp.691–707.

Reddick, C.G. and Turner, M. 2012. Channel choice and public service delivery in Canada: Comparing e-government to traditional service delivery. *Government Information Quarterly*. **29**(1), pp.1–11.

Riso, S., Adăscăliței, D. and Rodriguez Contreras, R. 2023. *Ethical digitalisation at work: From theory to practice* [Online]. Eurofound. [Accessed 24 January 2026]. Available from: https://www.eurofound.europa.eu/en/publications/all/ethical-digitalisation-work-theory-practice.

Roodman, D. 2009. How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*. **9**(1), pp.86–136.

Santos, H. and Pessoa, E.G. 2024. Impacts of digitalization on the efficiency and quality of public services: A comprehensive analysis. *LUMEN ET VIRTUS*. **15**(40), pp.4409–4414.

SAP. 2025. What Is Robotic Process Automation (RPA)? *SAP*. [Online]. [Accessed 3 March 2026]. Available from: https://www.sap.com/products/technology-platform/process-automation/what-is-rpa.html.

Shim, D.C. and Eom, T.H. 2008. E-Government and Anti-Corruption: Empirical Analysis of International Data. *International Journal of Public Administration*. **31**(3), pp.298–316.

Smith, B. 2025. How Cloud-Based E-Governance Platforms Improve Public Services. *Centurion*. [Online]. [Accessed 4 March 2026]. Available from: https://centurioncg.com/how-cloud-based-e-governance-platforms-improve-public-services/.

Spataru, C. and Popescu, C. 2025. *POST-BUHARINOMICS AGRICULTURE IN NIGERIA: WHAT NEXT FOR POLICY, PRACTICE, AND PRODUCTIVITY?*

StepUp StartUps Consortium. 2025. AI adoption in the EU's Public Sector: an opportunity to better serve citizens and support startups | Shaping Europe's digital future. [Accessed 4 March 2026]. Available from: https://digital-strategy.ec.europa.eu/en/library/ai-adoption-eus-public-sector-opportunity-better-serve-citizens-and-support-startups.

UN E-Government Knowledgebase. 2026. EGOVKB | United Nations > About > Overview > E-Government Development Index. [Accessed 22 April 2026]. Available from: https://publicadministration.un.org/egovkb/en-us/About/Overview/-E-Government-Development-Index.

UNCTAD. 2025. Facts & figures: The digital economy | UN Trade and Development (UNCTAD). [Accessed 22 April 2026]. Available from: https://unctad.org/press-material/facts-figures-digital-economy.

UNESCO. 2026. Ethics of Artificial Intelligence - AI | UNESCO. [Accessed 18 March 2026]. Available from: https://www.unesco.org/en/artificial-intelligence/recommendation-ethics.

Vossen, V. 2023. Dynamic Panel Data Estimation with System-GMM. [Accessed 30 April 2026]. Available from: https://www.tilburgsciencehub.com/topics/analyze/causal-inference/panel-data/system-gmm/.

Wahyudi, S., Yusup, A. and Perdana, M.R. 2025. Analysis of digital transformation of public administration in improving the effectiveness of government services in Indonesia. *Jurnal Konseling dan Pendidikan*. **13**(3), pp.574–585.

Wandaogo, A. 2022. Does digitalization improve government effectiveness? Evidence from developing and developed countries. *Applied Economics*. **54**(33), pp.3840–3860.

Webb, N.G. 2017. Variables, Control *In*: *The SAGE Encyclopedia of Communication Research Methods* [Online]. SAGE Publications, Inc, pp.1842–1842. [Accessed 12 May 2026]. Available from: https://methods.sagepub.com/ency/edvol/the-sage-encyclopedia-of-communication-research-methods/chpt/variables-control.

World Bank. 2024. World Development Indicators. Washington, DC: World Bank. **https://datatopics.worldbank.org/world-development-indicators/**

World Bank. 2025. "The Worldwide Governance Indicators: Revised Methodology for Measuring Governance Using Perception Data." Washington, DC: World Bank Group.

World Bank. 2026. Glossary | DataBank. [Accessed 3 June 2026]. Available from: https://databank.worldbank.org/metadataglossary/africa-development-indicators/series/GV.GOVT.EF.ES.

World Health Organisation. 2020. *WHO Director-General's Opening Remarks at the Media Briefing on COVID-19 - 11 March 2020*. [Accessed 28 January 2026]. Available from: https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

World Health Organisation. 2023. *WHO chief declares end to COVID-19 as a global health emergency | UN News*. [Accessed 27 January 2026]. Available from: https://news.un.org/en/story/2023/05/1136367.