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Essay title: The impact of government digital transformation programs on government effectiveness

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1. Background

The digital revolution has fundamentally altered global work dynamics, social interactions, and various life aspects. Concurrently, digital technologies are transforming the approach to designing and delivering public services, creating new ways for governments, businesses, and citizens to interact and generate value. Understanding the implications of these transformations on government effectiveness has become imperative as governments around the world are increasingly becoming digital governments.

Although various definitions of digital government exist, this study adopts the following framework: "Digital government encompasses the strategic utilization of information and communication technologies (ICTs), including web-based Internet applications, artificial intelligence, blockchain, Internet of Things (IoT), and other emerging technologies, to transform governance processes, enhance service delivery, engage citizens, and promote transparency and accountability in public administration. It involves the integration of digital tools across government functions and channels, facilitating seamless interactions between governments, citizens, businesses, and other stakeholders to achieve efficient, responsive, and inclusive governance outcomes" (Fountain, 2020, p. 15).

In 1993, the government of the United States was the first to present a vision of a digital government where citizens would be provided with "24/7 access to public information and services regardless of their location" (Lips, 2020, p. 6). Since then, many countries have developed digital government strategies at local and national levels. In fact, the latest available United Nations (UN) e-government survey noted an overall "persistent positive global trend towards higher levels of e-government development" (UN, 2022, p. 84). The survey included a ranking of the 193 member states and placed Denmark, Finland, and the Republic of Korea in the top three positions. While Europe remains the highest-performing region, the largest improvement since 2016 has been in the Americas, followed closely by Asia and Africa (UN, 2022, p. 148).

Furthermore, intergovernmental organisations such as the European Union (EU), the Organisation for Economic Co-operation and Development (OECD), the UN, and the World Bank, have all made digital government a core issue on their agenda (Amoretti, 2007, p. 3). The UN, for example, claims that digital governments are a powerful tool to help support the implementation of the 2030 agenda and its 17 sustainable development goals, "by promoting accountable and transparent institutions through open data and e-participation and

participatory decision-making, as well as by advancing online services to bridge the digital divides” (UN, 2016).

Notwithstanding the global improvements in the provision of electronic public services, the digital divide (the gap between individuals who have access to the internet and those who do not), has been identified as one of the biggest impediments to the effective deployment of digital government (OECD, 2003; Reddick, 2005). In fact, half of the world’s population does not have the possibility of benefiting from digital public services. The causes of the digital divide are multiple and include age, education, gender, race, IT literacy, geographical location, and income. In these cases, governments must aim for inclusiveness and, “ought to deliver their public services through traditional channels, including, front office operations or via toll-free telephone numbers” (Camilleri, 2019).

2. Research goal, data, and hypotheses

2.1. Research goal

This study seeks to examine the influence of digital transformation initiatives on government effectiveness, emphasizing the correlation between specific indicators of digital government maturity (independent variables) and levels of government effectiveness across countries (dependent variable).

2.2. Independent variables

Drawing data from the 2023 OECD Digital Government Index (DGI), this study employs six indicators of digital government maturity and its composite score as independent variables. The DGI, compiled from 2022 data, focuses on thirty-two OECD member countries, excluding Germany, Greece, Slovakia, Sweden, Switzerland, and the United States where data is unavailable. Described by the OECD as a benchmark for governmental efforts in establishing coherent and human-centered digital public sector transformations (OECD, 2024, p. 3), the DGI serves as a comprehensive metric for assessing digital government maturity.

Below is a description of these dimensions as defined by the OECD (OECD, 2024, p.8):

- Dimension 1 - *Digital by design*: measures how digital government policies are designed to enable the public sector to use digital tools and data in a coherent way when formulating policies or transforming public services.
- Dimension 2 - *Data-driven*: measures government's advancements in developing the enablers needed for data access, sharing and re-use across the public sector.
- Dimension 3 – *Government as a platform*: measures the deployment of common building blocks such as guidelines, tools, data, digital identity and software to equip teams to advance a coherent transformation of government processes and services across the public sector.
- Dimension 4 - *Open by default*: measures openness beyond the release of open data, including efforts to foster the use of technologies and data to communicate and engage with different actors.
- Dimension 5 - *User-driven*: measures governments' capacity to place user needs at the core of the design and delivery of public policies and services.
- Dimension 6 - *Proactiveness*: measures governments' capacity to anticipate the needs of users and service providers to deliver government services proactively.

2.3. Dependent variable

The dependent variable in this study is *Government Effectiveness*, which is derived from the World Bank's 2023 Worldwide Governance Indicators (WGI). The WGI dataset spans the years 1996-2022, with annual updates released each September. For the purposes of this research, the dataset from the year 2022 is specifically utilized. The WGI serves as a comprehensive compilation of data encompassing household, business, and citizen perceptions regarding the quality of governance across more than 200 countries and territories (Kaufmann and Kraay, 2023). Among several other governance indicators, *Government Effectiveness* “captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies” (Kaufmann and Kraay, 2023).

2.4. Hypotheses

The following hypotheses were derived from the datasets and variables mentioned in the previous section:

Research Question: To what extent do specific indicators of digital government maturity correlate with levels of government effectiveness across countries?	Hypothesis 1:	Countries with a higher score in the indicator <i>Digital by design</i> experience higher government effectiveness.
	Hypothesis 2:	Countries with a higher score in the indicator <i>Data-driven</i> experience higher government effectiveness.
	Hypothesis 3:	Countries with a higher score in the indicator <i>Government as a platform</i> experience higher economic growth.
	Hypothesis 4:	Countries with a higher score in the indicator <i>Open by default</i> experience higher government effectiveness.
	Hypothesis 5:	Countries with a higher score in the indicator <i>User-driven</i> experience higher government effectiveness.
	Hypothesis 6:	Countries with a higher score in the indicator <i>Proactiveness</i> experience higher government effectiveness.

Table 1. Research Questions and Hypotheses 1 to 6

3. Empirical analysis and findings

In this chapter, an empirical analysis is conducted to assess the effects of government digital transformation programs and economic prosperity on government performance. The chapter starts by presenting descriptive statistics, followed by an examination of the relationship between different variables, and concludes by presenting the results of a multivariate regression analysis.

3.1. Descriptive statistics

The first step of the data analysis consists of analysing descriptive statistics and deriving some insights regarding the study variables: the six dimensions of the Digital Government Index, its composite score (*Digital Government Index*), and *Government effectiveness*.

Descriptive Statistics	Dimension 1: Digital by design	Dimension 2: Data driven public sector	Dimension 3: Gov. as a platform	Dimension 4: Open by default	Dimension 5: User-driven	Dimension 6: Proactiveness	Composite score: Digital Gov. Index	Government Effectiveness
Obs	33	33	33	33	33	33	33	33
Mean	0.672	0.611	0.597	0.507	0.579	0.537	0.584	79.626
Median	0.677	0.555	0.631	0.502	0.595	0.547	0.586	83.020
Std. Deviation	0.151	0.171	0.174	0.161	0.191	0.226	0.153	16.714
Min	0.283	0.280	0.118	0.235	0.038	0.019	0.198	42.450
Max	0.973	1.000	0.913	0.882	0.925	0.934	0.935	98.580

Table 2. Descriptive statistics

3.1.1. Government Effectiveness

The Mean (79.626) is slightly lower than the Median (83.020), which indicates a slight left-skewness in the distribution, though the difference isn't substantial. The Standard Deviation is 16.714, indicating moderate variability in Government Effectiveness scores among the countries. The range between the Minimum (42.45) and Maximum (98.58) is quite wide (56.13), indicating that government effectiveness is characterised by a significant level of variation.

3.1.2. Digital Government Index (Composite score)

The Mean (0.584) is very close to the Median (0.586), suggesting that the distribution of Digital Government Index scores is approximately symmetrical. The Standard Deviation (0.153) is relatively moderate, indicating some variability in Digital Government Index scores among the countries. The range between the Minimum (0.198) and Maximum (0.935) is considerable (0.737), indicating a notable spread of Digital Government Index scores across countries.

3.1.3. The six dimensions of the Digital Government Index

Of these six indicators, the ones performing least effectively are those specifically designed to cater to user needs: Mean is higher in *Digital by design* (0.672), *Data-driven public sector* (0.611), and *Government as a platform* (0.597), and lower in *Open by default* (0.507), *User-driven* (0.579), and *Proactiveness* (0.537). According to the OECD, these results “may

be indicative of how the rapid digitalisation of government services to respond to the extended [COVID-19 pandemic] lockdown is not indicative of an increased capacity to understand user needs to maximise impact and solve end problems” (OECD, 2024, p. 15). In fact, putting people first and embracing a user-centered approach, is widely recognised by many governments and intergovernmental organisations, as a fundamental driver for the development of electronic public services. However, over the last twenty years, many critics claim that the users’ perspective has been overlooked, and that the decision-making process has been primarily guided by supply-side factors and technology developments (Bertot and Jaeger, 2006; Ebbers et al., 2008; Kunstelj et al., 2004).

3.2. Relation between variables

In this section, this study presents scatter plots to examine the relationship between *Government Effectiveness* (the dependent variable) and the six indicators of digital government maturity, including its composite score (the independent variables). It also presents the coefficient of determination (R^2) calculated to understand the percentage variation in *Government Effectiveness* that can be predicted by each one of the digital government indicators.

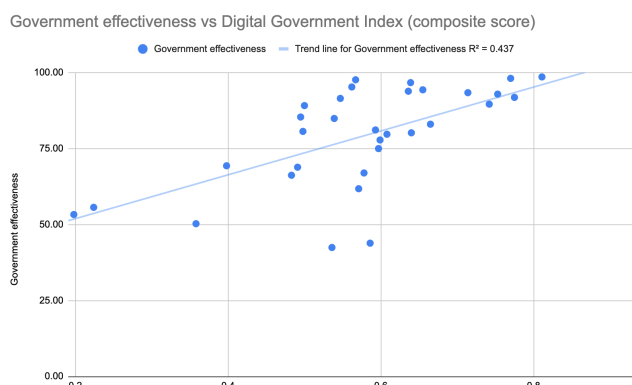


Fig. 1. Gov. Effectiveness vs DGI (Composite Score)

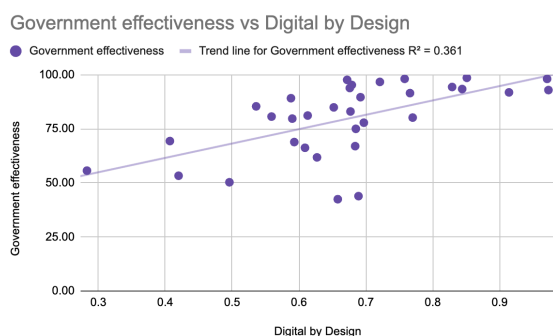


Fig. 2. Gov. Effectiveness vs Digital by Design

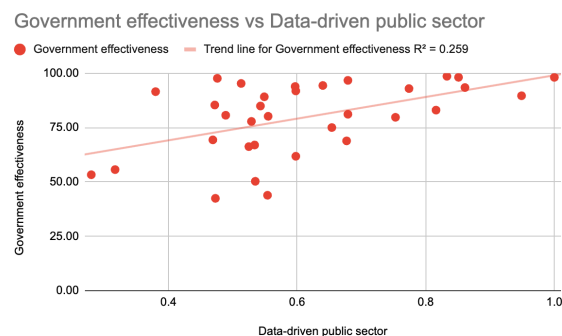


Fig. 3. Gov. Effectiveness vs Data-driven public sector

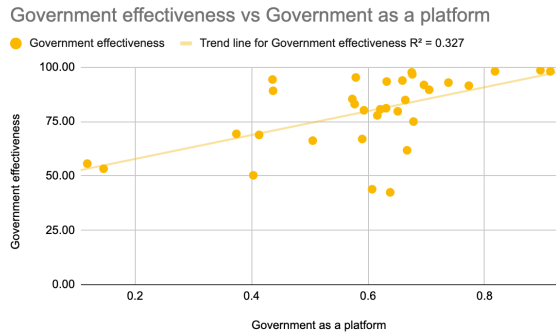


Fig. 4. Gov. Effectiveness vs Gov. as a platform

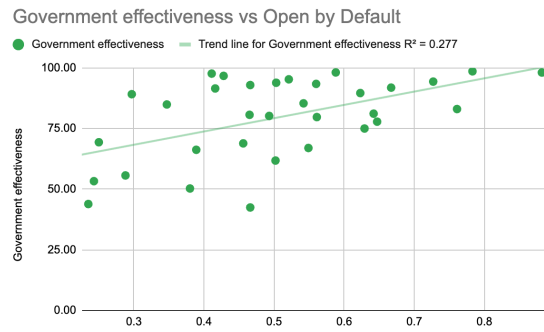


Fig. 5. Gov. Effectiveness vs Open by default

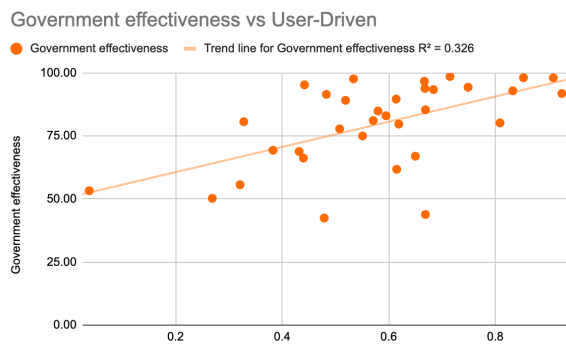


Fig. 6. Gov. Effectiveness vs User-driven

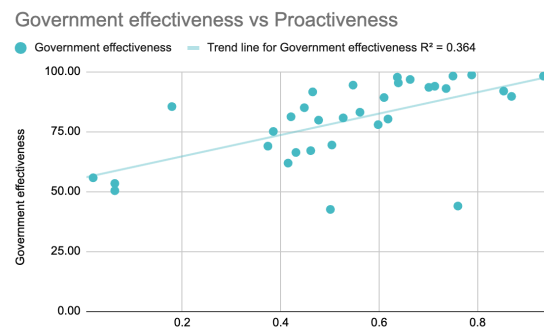


Fig. 7. Gov. Effectiveness vs Proactiveness

Based on the presented results, the following conclusions can be drawn:

- Scatter plots indicate that the relationship between *Government Effectiveness* and all the digital government maturity indicators is positive, suggesting that as the level of digital government maturity increases, government effectiveness also tends to increase.
- The results suggest that all hypotheses 1 to 6 are correct: countries with higher scores in digital government maturity indicators, tend to have a more effective government.
- Values of the Coefficient of Determination (R^2) suggest a stronger correlation between *Government Effectiveness* and *Proactiveness* ($R^2 = 0.364$), *Digital by design* ($R^2 = 0.361$), *Government as a platform* ($R^2 = 0.327$), and *User-driven* ($R^2 = 0.326$).
- Values of the Coefficient of Determination (R^2) suggest a weaker correlation between *Government Effectiveness* and *Open by default* ($R^2 = 0.277$) and *Data-driven public sector* ($R^2 = 0.259$).

3.3. Multivariate Regression Analysis

While the primary goal of this study is to analyse the impact of government digital transformation programs on government effectiveness, it became evident that a comprehensive understanding of this complex phenomenon necessitated a broader analytical scope. Hence, the inclusion of an additional independent variable, *Per-capita Income* (PCI), was considered essential to analyse governmental performance.

This section presents the results of the regression analysis conducted to examine the impact of digital government maturity and economic prosperity on government performance. Various models were developed, with a simpler structured model selected for analysis due to its fewer predictors while retaining comparable predictive performance:

$$\text{GovEff}_i = \beta_0 + \beta_4 D4_i + \beta_6 D6_i + \beta_7 \text{PCI}_i + \varepsilon_i$$

Where $i = 1, \dots, 34$ countries

Multiple R	R Square	Adjusted R Square	Standard Error	Observations
0.8363130718	0.699419554	0.6683250251	9.625544397	33

	df	SS	MS	F	Significance F
Regression	3	6252.09612	2084.03204	22.49333175	0.0000001
Residual	29	2686.882043	92.65110494		
Total	32	8938.978164			

	Coefficients	Standard Error	T Stat	P-value	Lower 95%	Upper 95%
Intercept	39.41	5.99	6.58	0.0000003	27.17	51.66
Dimension 4: Open by default	32.35	11.98	2.69	0.011467	7.84	56.86
Dimension 6: Proactiveness	17.20	9.14	1.88	0.069805	-1.49	35.89
Per capita income	0.32	0.07	4.99	0.000025	0.19	0.45

Table 3. Summary Output

The equation derived from the regression analysis is as follows:

$$\text{GovEff}_i = 39.41 + 32.35 \text{ D4}_i + 17.21 \text{ D6}_i + 0.32 \text{ PCI}_i + \varepsilon_i$$

Based on the regression results provided, here are some conclusions drawn:

- Overall Model Fit: The model has a reasonably good fit, as indicated by the adjusted R2 value of 0.668, indicating that approximately 66.8% of the variance in *Government Effectiveness* is explained by the predictors in the model.
- Average size of the error: The standard error of 9.626 suggests that the model's predictions are, on average, about 9.626 units away from the actual values of *Government Effectiveness*.
- *Per Capita Income* (PCI) significance: The positive coefficient for PCI (0.322) suggests that an increase in per capita income is associated with higher *Government Effectiveness*. This implies that economic prosperity might lead to better government performance.
- Digital Government Maturity Indicators: The coefficient for D4 (*Open by default*) is significant (32.35), indicating that a government's openness in sharing data and information is positively associated with *Government Effectiveness*. The p-value for D6 (*Proactiveness*) is 0.0698, which is slightly above the 0.05 threshold. Therefore, D6 is marginally significant, but not statistically significant at the conventional 0.05 threshold.
- Interpretation of the Intercept: The intercept of 39.41 represents the estimated *Government Effectiveness* when all predictors are zero. It suggests a baseline level of *Government Effectiveness* even in the absence of digital government maturity or per capita income.

4. Conclusion

Understanding the relationship between digital government maturity indicators and government effectiveness requires careful consideration of the complex dynamics involved. While it's crucial to acknowledge the limitations and complexities inherent in studying such multifaceted phenomena, this study focused on exploring potential associations and trends:

- Descriptive statistics reveal notable disparities in *Government Effectiveness* and digital government maturity indicators among various countries. These differences underscore the diverse landscape of government performance and digital implementation across nations.
- Descriptive statistics also highlight that the digital government indicators aimed at catering to user needs are the ones performing less effectively. This suggests a potential gap in prioritizing user perspectives in decision-making processes.
- Scatter plots illustrate a positive correlation between *Government Effectiveness* and all digital government maturity indicators, suggesting that higher digital maturity tends to coincide with greater government effectiveness. This supports the hypothesis that countries with higher scores in digital government maturity indicators generally demonstrate more effective governance.
- Despite these findings, determining the direction of causality between digital transformation programs and government effectiveness is a complex task. On the one hand, investing in digital initiatives can improve service delivery, potentially boosting government effectiveness. On the other hand, effective governments may be more capable of implementing successful digital programs due to their existing governance strengths and resources.

Additionally, the Multivariate regression analysis reveals that *Per Capita Income*, *Openness by default*, and *Proactiveness* significantly impact *Government Effectiveness*. Higher-income levels correlate with better government performance, while transparent data sharing positively affects effectiveness. However, while *Proactiveness* shows promise, its influence is less pronounced. Other dimensions of Digital Government maturity have a limited impact within this model.

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