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Digital Transformation and Democratic Governance: Empirical Evidence from Open Government and Internet Access Data

Herman
Doctor of Sociology, University of Muhammadiyah Malang

*Correspondence: sancakanaru10 @gmail.com

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Abstract: Digital transformation has emerged as a key factor reshaping governance structures and democratic dynamics, particularly in developing countries. In the ASEAN region, increased internet access, the utilization of big data, and the implementation of open government data have created new opportunities for transparency, accountability, and public participation, while simultaneously generating uneven structural challenges across countries. This study aims to analyze the role of digital transformation in shaping the quality of democratic governance in ASEAN countries by examining the relationship between digital access, government data openness, and democratic indicators. The research adopts a qualitative–descriptive approach with a cross-national analysis of big data derived from international databases and public policy documents. The data are analyzed comparatively to identify patterns, trends, and cross-country variations in the use of digital technologies to strengthen democratic governance. The findings indicate that digital transformation has contributed positively to improving transparency and the effectiveness of public service delivery, particularly in countries with strong institutional capacity and a firm commitment to information openness. However, the results also reveal that increased digital access does not automatically lead to substantive political participation in countries characterized by more closed political systems. This study contributes to the literature on digital democracy by positioning big data as an analytical instrument for examining democratic governance in the ASEAN region. The main limitation of this study lies in its reliance on aggregated national-level data, which is unable to capture the dynamics of individual-level participation. Future research is therefore encouraged to integrate micro-level data and quantitative approaches to strengthen causal analysis of the relationship between digital transformation and the quality of democracy.

Keywords: Digital transformation, Digital democracy, Big data, Open government data, ASEAN

Introduction

Digital transformation has reshaped the ways in which states around the world perceive governance, deliver public services, and manage relationships between governments and citizens (Sharmin & Chowdhury, 2025). In a rapidly evolving digital era, information and communication technologies particularly the internet and open data play a significant role in promoting transparency, public participation, and governmental accountability. Digital transformation not only reduces administrative inefficiencies but also affects all dimensions of democratic governance and the relationship between citizens and state institutions (Yang et al., 2024). Within the ASEAN region a context characterized by diverse levels of digital development, political cultures, and institutional capacities the relationship between digital transformation and democratic governance presents a compelling research opportunity to understand how internet access and open government initiatives can both strengthen and challenge democratic practices. This includes examining how digital technologies enable open government, facilitate access to public information disclosure, and create participatory spaces that allow citizens to contribute more directly to public policymaking processes.

Consequently, digital transformation in governance constitutes a strategic pathway for expanding democratic space in a region comprising ten member states with varied governmental structures (Asrijal et al., 2025). Despite its growing potential, challenges such as the digital divide, disparities in infrastructure quality, and varying degrees of political willingness to embrace openness mean that the impact of digital transformation on the quality of democracy is not uniform across ASEAN countries. The domain of open government data, as a cornerstone of effective digital governance, therefore constitutes a critical research agenda for empirically evaluating its relationship with democratic benchmarks such as citizen participation in policymaking processes, societal oversight capacity over public institutions, and the formation of public opinion that generates problem-solving outcomes. Rigorous empirical studies examining the linkages between internet access, open government initiatives, and democratic governance in ASEAN can deepen our understanding of how digital technologies contribute to enhancing democratic quality and good governance (Ruijer & Martinius, 2017).

A growing body of literature has examined the dimensions of digital transformation in the context of governance and democracy in ASEAN and other regions. For example, the study "Comparative Analysis of the E-Government Development Status of ASEAN Member States" highlights sustained improvements in the E-Government Development Index (EGDI) across several ASEAN countries such as Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam over the past decade. These trends indicate positive outcomes in the adoption of digital government technologies to enhance public service delivery, administrative efficiency, and information transparency. However, other ASEAN countries, including Cambodia, Lao PDR, and Myanmar, have demonstrated only moderate progress, reflecting persistent disparities in the level and pace of digital transformation across the region. Such variations are closely linked to differences in institutional capacity, infrastructure readiness, human capital, and political commitment to digital reform. The uneven development of e-government underscores that technological adoption alone is insufficient to produce uniform democratic gains. Instead, the effectiveness of digital governance initiatives depends on their integration with broader institutional reforms, inclusive policy frameworks, and mechanisms that actively promote citizen participation and accountability.

Taken together, these findings suggest that while digital transformation has the potential to strengthen democratic governance in ASEAN, its impacts remain contingent upon national contexts. This reinforces the need for comparative and context-sensitive analyses that move beyond aggregate indicators to examine how digital technologies interact with political institutions, social structures, and governance practices in shaping democratic outcomes across the region (Tissayakorn, 2025). Furthermore, research presented in the book *Democratization in the Digital Era: Experiences from Southeast Asia* highlights how digital spaces can play a dual role in democratization processes: on the one hand, they create opportunities for citizen political engagement and more inclusive political communication; on the other hand, in several countries they function as instruments of political repression when used to suppress freedom of expression or to criminalize criticism of the government. The outcomes vary across countries; while some have experienced increased discursive participation, others continue to face serious challenges to digital freedoms (Alami et al., 2022).

Empirical approaches to open government data (OGD) have been widely discussed in the literature, particularly in reviews that examine how OGD contributes to transparency, accountability, and public policy innovation. Systematic analyses of OGD studies indicate that this body of literature possesses significant theoretical and practical potential; however, it often lacks explicit linkages between the use of open data and democratic outcomes such as public participation or societal oversight of government institutions (Wirtz et al., 2022). In this context, the literature on digital transformation emphasizes that this phenomenon is not limited to technological implementation alone, but also encompasses social, political, and economic dimensions of governance environments. Other studies demonstrate that higher levels of internet penetration and the use of digital public services are associated with greater citizen engagement in governance processes, increased public trust in institutions, and more responsive policymaking. Research in the ASEAN context shows a positive relationship between the adoption of e-government and public trust; nevertheless, it also highlights that the quality of digital services, citizen participation, and institutional capacity remain critical in translating technological transformation into broader democratic outcomes (Ramadhani, 2025).

Despite significant progress in the literature, several important gaps remain, particularly within the ASEAN context. First, most existing studies tend to analyze digital transformation primarily through e-government indicators such as the E-Government Development Index (EGDI), without holistically linking internet access, open government data initiatives, and democratic outcomes such as public participation or overall democratic quality. Much of the previous research remains descriptive or relies on narrative case studies, offering limited support for comparative empirical analysis across ASEAN countries based on comprehensive quantitative data (Widhiasthini et al., 2024).

Second, although the literature identifies various factors influencing the adoption of open government data and its governance impacts, there is still limited explanation of how open government data and internet access jointly interact to shape democratization processes in ASEAN countries. More specifically, empirical evidence that simultaneously links national internet access, government data openness, and democratic dimensions such as digital political participation or citizen involvement in public decision-making within a single, integrated analytical framework remains scarce (Apriliyanti, B. Kusumasari, Agus Pramusinto, 2020). Third, only a small number of studies explicitly assess the impact of the digital divide on democratic dimensions of digital governance in ASEAN.

This gap is critical, as disparities in internet access often reflect broader social inequalities, which in turn may constrain the democratic benefits of digital transformation. This study contributes uniquely to the literature by integrating three key domains that are rarely examined together in previous research, namely: National Internet Access, as a structural variable reflecting the extent to which citizens possess the capacity to participate in digital spaces; Open Government Data Initiatives, representing institutional openness in the provision of public information and the facilitation of citizen engagement; and Indicators of Democratic Quality and Digital Political Participation, used to empirically assess the substantive effects of digital transformation on democratic governance.

By combining national-level big data, digital governance indices, and measurable democracy indicators, this study provides empirical evidence that has not been fully explored in prior research. Accordingly, the findings offer new insights into the causal relationships between the expansion of internet access, government data transparency, and the quality of democratic governance in ASEAN a region characterized by diverse digital challenges and opportunities (Hendratmoko, 2023). This research focuses on an empirical analysis of the relationship between digital transformation measured through internet access and open government data and democratic governance in ASEAN countries over the past decade. Digital transformation is conceptualized not merely as technological advancement, but as a structural mechanism for institutional openness and political participation (Nurdiana et al., 2023).

The objectives of this study are threefold. First, to measure the relationship between national levels of internet access and indicators of democracy and digital political participation in ASEAN. Second, to evaluate the extent to which open government data initiatives contribute to democratic quality in ASEAN countries. Third, to compare cross-national differences among ASEAN members in terms of the democratic outcomes of digital transformation. The main research questions addressed in this study are: How does the level of internet access in an ASEAN country influence democratic quality and digital political participation? To what extent does open government data correlate with democratic indicators such as transparency, societal oversight, and public engagement? What cross-country differences emerge among ASEAN states regarding the relationship between internet access, open government data, and democratic outcomes?

Literature Review

The first strand of the literature addresses the types of data that form the empirical foundation of studies on digital transformation and democratic governance, particularly open government data (OGD) and internet access within the context of governance and democracy. Open government data refer to government datasets that are publicly released and can be accessed, reused, and redistributed by citizens without significant restrictions, and are widely regarded as a key element in strengthening transparency and public participation in contemporary governance (Gao et al., 2023). National internet access, in turn, provides the foundational digital infrastructure that enables citizens to connect online, obtain information, and engage in political processes through digital media or civic engagement platforms (Boulianne, 2020). In empirical research, datasets such as the E-Government Development Index (EGDI), internet penetration statistics, and democracy indicators from institutions such as V-Dem or Polity are frequently used to examine the relationship between digital transformation and democratic quality.

These datasets encompass variables related to technical access (infrastructure-level access), government openness policies, and democratic indicators such as online political participation, accountability, and citizen involvement in public policymaking. Collectively, such data provide an empirical basis for testing the hypothesis that digital advancement enhances democratic quality through open government and expanded access to information. Moreover, empirical data must also address the digital divide inequalities in internet access within and across countries which has profound implications for citizens' capacity to benefit from digital participation opportunities. Studies that integrate OGD and internet access data contribute to a more holistic understanding of the relationship and causal direction between digitalization and democratic governance (Rasool et al., 2022).

Global research on the relationship between digital transformation and democratic governance has expanded rapidly over the past two decades, revealing complex and multidimensional dynamics. Comprehensive literature reviews on OGD research indicate that open government data

play a strategic role in promoting bureaucratic transparency, enhancing societal oversight of government, and potentially expanding public participation in governance processes. For example, a systematic review of 169 empirical studies on OGD found that, despite the heterogeneity of theoretical debates surrounding OGD, its implementation is frequently associated with outcomes such as increased administrative transparency and public service innovation although its democratic implications are often insufficiently articulated within formal information systems research (PMC). Early literature further suggests that publishing government data in open formats can reduce corruption, strengthen government accountability, and improve equitable access to information, while also acknowledging persistent challenges related to technical capacity, data quality, and effective reuse. These studies form an important empirical foundation for understanding how OGD can function as a driver of democratic governance at both national and cross-national levels (Ali Hassan & Twinomurinzi, 2018).

Consistent with research on Open Digital Democracy (ODD), international empirical evidence on the impact of internet access on democracy also demonstrates a significant relationship between digital network penetration and indicators of democratic quality across diverse contexts. An empirical cross national study examining internet penetration and democratic outcomes found that social media use which cannot function without internet access exerts positive effects on multiple dimensions of democracy, including egalitarian, participatory, liberal, electoral, and deliberative democracy, across all countries analyzed, provided that internet penetration reaches medium to high levels. In this study, the positive effects of internet penetration were more pronounced when combined with widespread social media participation, which in turn strengthened public deliberation, political mobilization, and even societal monitoring of government institutions. These findings support the view that the internet is not merely a technical infrastructure but also a medium that expands democratic space through information flows, interactive communication, and online political mobilization. Similarly, other strands of the literature examining the role of the internet in citizen participation suggest that digital access can act as a catalyst for political mobilization, although it may also reinforce existing offline participation patterns and highlights the importance of social and structural factors such as education and economic resources in fully explaining political engagement (Jha & Kodila-Tedika, 2020).

Within more specific global research on the relationship between open government data and democracy, empirical studies tend to examine OGD outcomes from both micro- and macro-level perspectives. A recent experimental study focusing on the impact of OGD on political self-efficacy defined as individuals' perceived ability to participate in public affairs produced findings that challenge optimistic assumptions. Using survey experiments, the study found that exposure to publicly released government data was associated with a decline in perceived self-efficacy in public participation, suggesting that not all forms of transparency automatically enhance citizen engagement (ScienceDirect). These findings underscore the complexity of OGD's democratic effects and highlight how outcomes depend on data presentation, interpretability, and citizens' capacity to use information effectively. The study further emphasizes the importance of developing value-added applications that simplify data interpretation and enhance relevance for diverse user groups. This critical perspective suggests that the mere availability of OGD is insufficient; cognitive and social factors such as information overload, perceptual bias, and interpretive capacity play a decisive role in determining whether OGD contributes to democratic governance in practice (Martin, 2014).

Beyond the global literature, a growing body of research explores digital transformation and democracy within specific regional and national contexts. In ASEAN, for instance, comparative studies indicate that the adoption of digital government services is positively correlated with public trust in government institutions, with variables such as digital service quality and user engagement playing a crucial role in reinforcing trust in several member states. Other studies in Southeast Asia, including research conducted by JMI Stikom, examine the relationship between digital transparency and citizen engagement, finding that digital initiatives aimed at increasing transparency significantly contribute to higher levels of citizen participation in governmental activities in countries such as Indonesia, Malaysia, and Thailand. These findings deepen the understanding that, despite cross-country variation, a general trend points toward a positive relationship between digital governance and certain dimensions of democracy.

Despite the growing evidence of positive associations between digital transformation and democratic quality, significant research gaps remain. First, most empirical studies tend to analyze digital transformation dimensions such as OGD or internet access in isolation, without integrating these key variables into a comprehensive analytical framework. This limits our understanding of how their interaction shapes democratic outcomes. Moreover, many OGD studies focus primarily on administrative or economic outcomes, while democratic effects such as digital political participation, freedom of expression, and societal oversight are not examined simultaneously. Second, the majority of studies emphasize macro level indicators (e.g., aggregate democracy indices or national internet penetration rates) without adequately considering micro-level factors such as citizen perceptions, political self-efficacy, and data literacy, which may moderate the relationship between digitalization and democratic governance. This highlights the need for multilevel approaches that link structural data with citizen-level perceptions and capacities.

To address these gaps, the novelty of this study lies in its comprehensive integration of open government data, internet access, and indicators of democratic quality within a single empirical model. The study not only examines correlations between each of these variables and democratic governance, but also seeks to identify causal mechanisms through which internet access may amplify the democratic value of OGD for

example, by enhancing digital citizen engagement and public oversight of government institutions. Furthermore, this research extends the existing literature by explicitly accounting for cross country differences within ASEAN, allowing for the mapping of variation in social, economic, and political contexts that moderate the digitalization democracy relationship. The approach combines cross-national comparative analysis with multivariate methods to examine simultaneity and interaction among key variables, while incorporating the digital divide as a critical moderating dimension that has often been overlooked in prior studies.

Based on the preceding findings and identified gaps, the analytical framework of this study is built around three core components: (1) national internet access as a digital infrastructure enabling digital political participation and information acquisition; (2) open government data as an indicator of institutional openness; and (3) the quality of democratic governance, encompassing indicators such as digital political participation, government accountability, and public oversight. The framework also incorporates the digital divide and citizens' capacities such as digital literacy as moderating variables influencing the relationship between internet access and citizens' ability to use OGD effectively. Through this approach, the study examines not only linear relationships among variables, but also interaction mechanisms that generate divergent democratic outcomes at both national and regional levels within ASEAN. This conceptual model enriches the literature by integrating structural-level (macro) indicators and behavioral-level (micro) indicators of citizen engagement within a single, integrated empirical analysis.

Method

Based on prior findings and the identified research gaps, this study develops an analytical framework built around three core components: (1) national internet access as digital infrastructure enabling digital political participation and information acquisition; (2) Open Government Data (OGD) as an indicator of institutional openness; and (3) the quality of democratic governance, encompassing indicators such as digital political participation, government accountability, and public oversight. The framework also incorporates the digital divide and citizens' capabilities (e.g., digital literacy) as moderating variables that influence the relationship between internet access and citizens' ability to use OGD effectively. Through this approach, the study examines not only linear relationships among variables but also interaction mechanisms that produce divergent democratic outcomes at national and regional levels within ASEAN. This conceptual model enriches the literature by integrating structural-level (macro) indicators and behavioral-level (micro) indicators of citizen engagement within a single, integrated empirical analysis (Rifda Khaerani & Kafrawi Al-Kafiah Samsu, 2025).

Within this framework, qualitative content analysis is employed as the primary methodological technique to describe and interpret digital data drawn from multiple primary sources (e.g., national internet statistics, open government data indices) and secondary sources (e.g., international literature on open government and democracy). Qualitative content analysis is a systematic method for extracting meaningful themes, patterns, and relationships from large volumes of textual or digital documents and for explaining their relevance to the research phenomenon (Schöggl et al., 2020). More broadly, this method places interpretation at the core of the analytical process, aiming to understand how statistical indicators and digital governance narratives reflect or influence the quality of democratic governance in ASEAN. Rather than merely identifying statistical associations among variables, this approach provides a contextual and holistic explanation of complex social phenomena by incorporating social interpretation and institutional context. Accordingly, the study not only identifies empirical patterns but also explains how and why digitalization is linked to democratic governance outcomes.

Although the study adopts a qualitative approach, big data elements are integrated into the analytical framework through qualitative big data content analysis. In this study, big data refer to large and heterogeneous datasets such as internet access rates, numbers of internet users, government data transparency policies, and democracy indicators across multiple countries and time periods. To manage and analyze these large datasets qualitatively, the study applies several key analytical strategies: Data Reduction, this stage involves filtering and simplifying large volumes of data into more focused conceptual blocks. For example, data on internet access and open government indicators are classified into key thematic categories such as digital infrastructure, public information accessibility, and digital citizen engagement. Data reduction is essential for processing large datasets systematically without losing contextual meaning (Arlina et al., 2023).

Coding at this stage, large datasets comprising textual, narrative, and numerical data are transformed into analytical coding units relevant to the research focus, such as keywords representing democratic quality, transparency, or citizen participation (Cantador et al., 2020). This technique enables the identification of emerging thematic patterns by assigning codes that represent specific phenomena within the data (Kholif, 2025). Thematization and Interpretation Following coding, the researchers group codes into broader themes that explain the relationship between digital transformation and democratic governance. This stage constitutes the core of qualitative analysis, as it incorporates social, historical, and cultural contexts of individual ASEAN countries to interpret how thematic findings relate to democratic quality across different national settings (Arlina et al., 2023).

This approach requires the application of robust validation strategies, including data triangulation across multiple sources, contextual analysis, and where appropriate the use of qualitative analysis software to assist in mapping patterns within very large datasets. The primary data source for this study is Our World in Data (OWID), a global data repository and publication platform managed by the Global Change Data Lab at the University of Oxford, United Kingdom. OWID provides thousands of openly accessible datasets

covering a wide range of global indicators, including internet penetration rates, digital media usage, and other variables relevant to digital transformation and digital governance.

The stages of data collection and analysis from the Our World in Data platform follow several systematic steps. First, variable identification is conducted, whereby researchers determine relevant variables such as internet usage, internet access and network coverage, and social, economic, or governance indicators provided by OWID. These data are typically available through an interactive data explorer that allows mapping by country and time period. Second, dataset retrieval involves downloading structured data formats (e.g., CSV, Excel, or API-based datasets) that support cross-national and longitudinal analysis. All datasets used are openly licensed, allowing unrestricted academic use.

Third, data categorization and validation are performed by organizing the datasets into major thematic categories (e.g., digital infrastructure, internet penetration, digital inclusion) and validating them against supplementary sources such as international organization reports and academic literature to ensure consistency and reliability in line with qualitative research standards. Fourth, integration with policy documents and academic literature is undertaken by combining OWID's numerical data with policy narratives, scholarly articles, government reports, and other empirical sources to support textual interpretation. This integration enables the mapping of relationships between large-scale structural data and narrative content that explains democratic and digital governance contexts. Finally, advanced content analysis and thematization are applied to the reduced and coded datasets to uncover contextual meanings, patterns, and relationships between digital variables and democratic governance outcomes across ASEAN countries. This phase includes examining linkages between internet access, open government data, and democratic outcomes such as public participation and transparency (Jha & Kodila-Tedika, 2020).

Results

This section presents the main empirical findings of the study concerning the dynamics of global digital transformation, as reflected in the growth of active mobile money accounts during the period 2010–2023, and their implications for democratic governance, with a particular analytical focus on ASEAN countries. The data analyzed are sourced from the Global System for Mobile Communications Association (GSMA) and disseminated through Our World in Data. The dataset captures the number of active mobile money accounts across global regions. An account is classified as active if it has been used for at least one transaction within the previous 90 days in a given year. Although the data are global in scope, the observed patterns and trends provide an important contextual basis for understanding ASEAN's position in the broader process of digital transformation and its relevance to government openness and citizen participation.

Global Growth of Mobile Money Accounts as an Indicator of Digital Transformation

Based on the available data, there has been a highly significant increase in the number of active mobile money accounts globally between 2010 and 2023. In 2010, the number of active accounts remained relatively low, at fewer than 20 million worldwide. Over the subsequent decade, however, this figure grew exponentially, surpassing 650 million active accounts by 2023. This surge reflects an accelerated pace of digital transformation in the financial sector, particularly in regions with limited access to conventional banking systems. This sharp increase signifies a substantial shift in how individuals interact with digital financial services, with broader implications for information access, economic inclusion, and citizens' capacity to participate in digital governance ecosystems. Within the context of this study, the growth of mobile money accounts can be understood as a key indicator of expanding digital access an essential prerequisite for open government initiatives and democratic governance practices. Digital transformation thus occurs not only within public administration but also across the socio-economic infrastructures that support wider citizen participation.

Regional Distribution and Inequalities in Digital Transformation

The data analysis reveals that the growth of mobile money accounts is uneven across regions. Sub-Saharan Africa occupies the most dominant position, contributing the largest share of active accounts globally. By 2023, the region accounted for more than 330 million active accounts, making it the global epicenter of mobile money growth. This dominance reflects the high demand for alternative financial services in areas with limited access to formal banking institutions. By contrast, East Asia and the Pacific covering most ASEAN countries exhibit a steady and significant upward trend. The number of active accounts in this region increased from nearly zero in the early 2010s to approximately 130–140 million accounts by 2023. Although this level remains below that of Sub-Saharan Africa, the trend indicates a growing penetration of internet- and mobile-based digital financial services across East Asia and the Pacific, including ASEAN member states.

South Asia also demonstrates consistent growth, reaching more than 110 million active accounts by the end of the observation period. Meanwhile, Latin America and the Caribbean, Europe and Central Asia, and the Middle East and North Africa show more moderate growth, though all regions display an overall upward trajectory. These variations underscore the contextual nature of digital transformation, which is strongly shaped by institutional arrangements, regulatory frameworks, and socio-economic conditions specific to each region.

Relevance of the Findings for Internet Access and Digital Infrastructure in ASEAN

Although the figure does not explicitly disaggregate ASEAN as a separate category, the East Asia and Pacific region serves as a useful proxy for understanding digital dynamics within ASEAN countries. The substantial increase in mobile money accounts in this region indicates that internet access and the use of mobile-based digital technologies are becoming increasingly widespread. This finding is consistent with prior research highlighting internet penetration as a critical prerequisite for the adoption of e-government initiatives and open government data. In the ASEAN context, the rising number of mobile money accounts suggests that an increasing share of the population has access to basic digital technologies, including mobile devices and internet connectivity. Such access not only facilitates digital financial transactions but also creates opportunities for citizen engagement with digital public services, policy monitoring, and interaction with government institutions through online platforms. Accordingly, the data provide empirical evidence that digital transformation in ASEAN is progressing along a positive trajectory, albeit with varying levels of maturity across countries.

Mobile Money as Supporting Infrastructure for Open Government

The findings indicate that the growth of active mobile money accounts can be understood as part of a broader open government ecosystem. Mobile-based digital financial infrastructure enables governments to distribute social assistance more transparently, reduce budgetary leakages, and enhance accountability in public fund management. In several ASEAN countries, digital wallets have been integrated into social assistance programs and public service delivery, indirectly reinforcing principles of openness and efficiency in governance. Moreover, the expanding use of mobile money has the potential to broaden citizens' access to public data and information, as digital financial services are often interconnected with other digital platforms, including government portals. In this sense, the findings support the argument that digital transformation as reflected in the expansion of mobile money accounts is positively associated with efforts to build more open and responsive government systems.

Implications for Democratic Governance and Citizen Participation

In addressing the research question concerning the relationship between digital transformation and democratic governance, the data suggest that the expansion of digital access through mobile money has the potential to strengthen citizen participation. As more individuals become digitally connected, barriers to accessing public information, expressing concerns, and engaging in policy processes are reduced. This dynamic is particularly relevant for ASEAN countries, which are characterized by diverse geographical conditions and varying levels of development. Overall, the findings indicate that mobile money growth represents not only a financial innovation but also a broader digital infrastructure that can support democratic governance by enhancing inclusiveness, transparency, and citizen engagement across the ASEAN region.

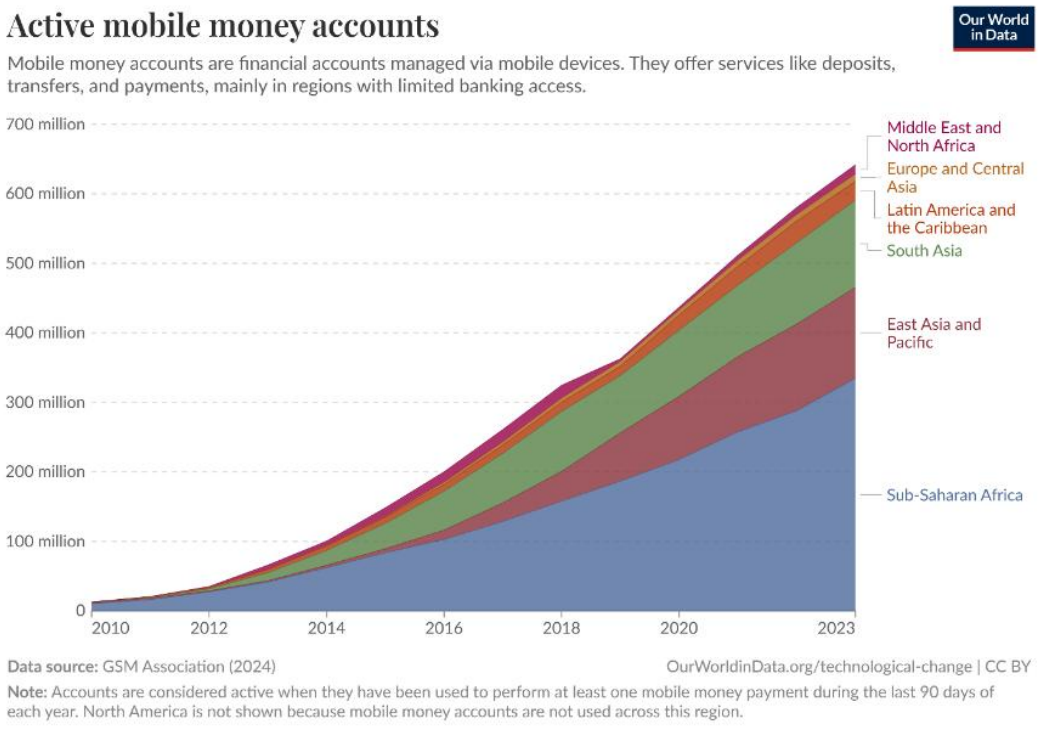

Figure 1. Global Trends in Mobile Money Accounts as an Indicator of Digital Transformation

General Trends in Government Transparency in Southeast Asia (1980–2010)

Overall, the data indicate that most Southeast Asian countries experienced improvements in government transparency over the period under observation. However, these improvements were neither linear nor uniform across countries or over time. Pronounced fluctuations are evident, particularly around the 1997–1998 Asian financial crisis and throughout the 2000s. Cross-country differences in transparency levels reflect variations in bureaucratic capacity, political stability, governance systems, and commitments to public data transparency. Countries with stronger institutional capacity tend to exhibit higher and more stable transparency scores than those affected by political conflict or limited administrative capacity.

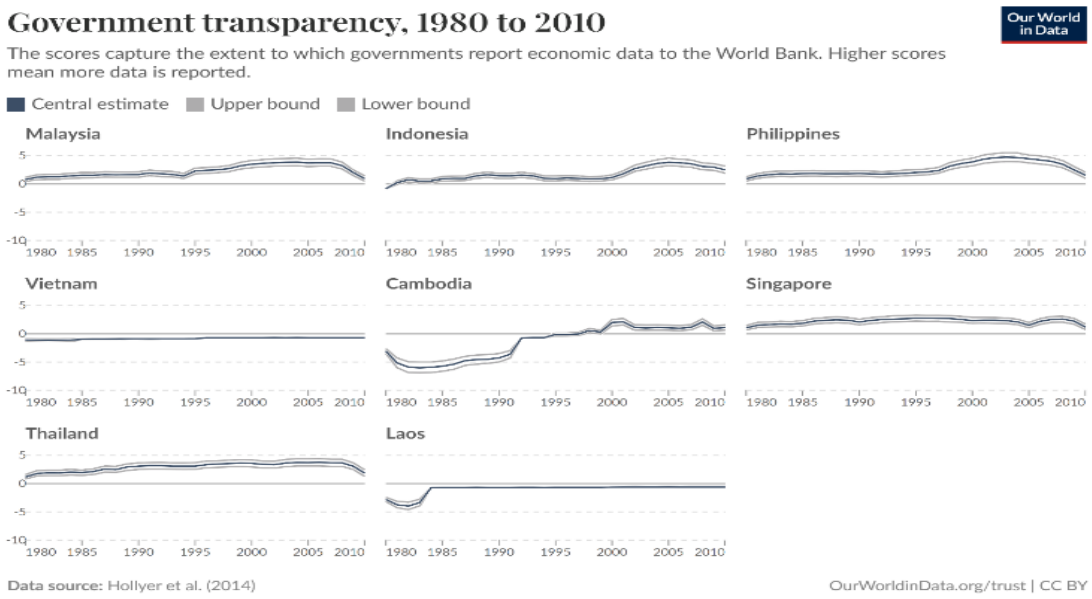

Figure 2. General Trends in Government Transparency in Southeast Asia (1980–2010)

Singapore

Singapore demonstrates relatively high and stable levels of transparency throughout the study period. Since the early 1980s, its transparency scores have remained above the regional average and gradually increased until the late 1990s. Although a slight decline is observed after 2005, fluctuations remain minimal. This stability reflects consistent state capacity, a strong bureaucracy, and a centralized and efficient public administration system. Transparency in Singapore has not been significantly affected by political regime changes, given the high degree of governmental continuity.

Malaysia

Malaysia shows moderate but steady improvements in transparency from the early 1980s to the mid-2000s. Transparency scores peaked around 2005 before declining toward 2010. This pattern suggests that, despite relatively strong administrative capacity, transparency in Malaysia remains sensitive to domestic political dynamics and government priorities regarding the disclosure of economic information.

Thailand

Thailand also exhibits a fairly consistent upward trend in transparency, particularly from the mid-1980s to the early 2000s. Transparency scores increased steadily and reached relatively high levels in the early 2000s. However, after 2006, a decline is observed. This downturn can be associated with political instability, including military coups and domestic political conflict, which negatively affected data reporting practices and governance performance.

Indonesia

Indonesia exhibits substantial fluctuations in transparency levels. From 1980 to 1997, transparency scores were relatively low and largely stagnant. Following the 1998 economic crisis and political reform, transparency increased sharply in the early 2000s, peaking around 2005 before declining slightly toward 2010. These findings indicate that democratic transition and institutional reforms played a crucial role in enhancing data transparency, although sustaining these gains remains a challenge.

Philippines

The Philippines records a clear upward trend in transparency from the early 1980s to the mid-2000s. Transparency scores increased gradually and reached relatively high levels around 2005. However, a decline is evident toward 2010. This pattern suggests that, despite a relatively democratic political system, leadership changes and policy instability can undermine the consistency of government transparency.

Vietnam

Vietnam demonstrates persistently low and largely stagnant transparency throughout the study period. Transparency scores show little significant change from 1980 to 2010. This stagnation reflects the country's political characteristics, including a single-party system and strong state control over economic information. Limited transparency in Vietnam indicates that economic growth does not necessarily coincide with increased public data disclosure.

Laos

Laos also exhibits low transparency levels, particularly in the early 1980s, with significantly negative scores. Although a slight improvement is observed in the mid-1980s, transparency levels subsequently stagnate and show no substantial increase through 2010. This situation reflects limited bureaucratic capacity and the low priority given to international economic data reporting.

Cambodia

In contrast to Vietnam and Laos, Cambodia shows a notable improvement in transparency, despite starting from very low levels. In the early 1980s, Cambodia recorded the lowest transparency scores among the countries studied. However, from the early 1990s to the early 2000s, transparency increased sharply. This improvement correlates with post-conflict reconstruction, engagement with international institutions, and governance reforms. Nevertheless, after reaching its peak, Cambodia's transparency scores fluctuated and failed to demonstrate long-term consistency. Overall, cross-country comparisons reveal clear transparency gaps in Southeast Asia.

Countries with high political stability and strong institutional capacity (such as Singapore and Malaysia) tend to exhibit higher and more stable transparency levels. In contrast, countries experiencing political conflict, authoritarian governance structures, or weak administrative capacity display lower or stagnant transparency. Overall, the data indicate that political participation in Southeast Asia ranges from moderate to low, with substantial variation across countries. No country in the region consistently achieves the maximum score, although several countries exhibit relatively higher levels of participation than others. These variations reflect differences in political systems, levels of democratization, civil liberties, and state–society relations. Countries with more open and competitive political systems tend to record higher political participation scores than those characterized by authoritarian or semi-authoritarian governance.

Discussion

Findings study this show that connection between adoption digital technology, growth economy, consumption energy, and CO_2 emissions in ASEAN countries are complex and not uniform between countries. Increase in GDP per capita in a way general walk along with increasing consumption energy per capita, especially in countries with level income tall such as Singapore and Brunei Darussalam. This pattern in line with view classic in economy energy that places energy as the main input in the production and improvement process welfare economy (Wang *et al.* , 2019) . In context this, the result study confirm that growth the economy in ASEAN is still very dependent on consumption energy, some of which big sourced from energy fossil.

However thus, the results research also shows variation significant cross- country differences, even among countries with level relative income similar. Difference level consumption energy per capita between Malaysia, Thailand, and Vietnam indicates that structure economy, level efficiency energy, as well as policy national play role important in form connection between growth economy and use energy. Findings This strengthen argument that growth economy No in a way automatic produce pressure the same environment in each country , as also found in studies cross- country by the IEA (2023) and OECD (2022) . With thus, the context institutions and policies become factor determinant in direction development sustainable.

From the side digital transformation, improvement penetration telephone the very rapid use of mobile and internet in all ASEAN countries shows that digitalization has become phenomenon cross level development. Income countries medium such as Indonesia, Vietnam, and the Philippines experienced growth fast digital access although GDP per capita level they Still relatively low. Findings This in line with draft *digital leapfrogging* , where developing countries can adopt digital technology in direct without must through stages industrialization long technology (Delera *et al.* , 2022) . Literature previously also confirmed that technology information and communication potential increase productivity, expanding market access, and accelerate growth economy (Kurniawati, 2022) .

Although thus, the results study This show that improvement digitalization No always followed by an increase quality environment. In some large ASEAN countries, growth use digital technology in fact walk side by side with increasing consumption energy and CO_2 emissions. Findings This support arguments that state that digitalization own side

paradox , where technology can increase efficiency in one side, but also adds request energy through improvement use device electronics, networks telecommunications, and data centers on the other hand (Steffen Lange, Pohl and Santarius, 2020) . In other words, digital transformation has not yet fully functioning as driving green growth in this region.

In this regard with CO_2 emissions, results study show that countries with consumption energy high and dependency big on material burn fossil tend own higher per capita emissions high. This pattern consistent with IPAT framework that explains that improvement prosperity and technology based fossil increase pressure to environment (Hunjra *et al.* , 2024) . However, the case of Singapore shows a little dynamic different, where the level relative CO_2 emissions more under control compared to with level his income. This is indicates existence role policy environment, efficiency energy, and adoption more technology clean, as also emphasized in literature about developed country capacity in manage impact environment from growth economy (OECD, 2022) .

In a way overall, discussion results This confirm that adoption digital technology in ASEAN is not yet fully functioning as drivers of green growth, but rather Still is at in dilemma between push growth economy and enlarge pressure environment. Digital transformation is indeed open opportunity big for improvement productivity and inclusion economy, but without policy energy clean, efficient, and reduced digital divide, digitalization precisely potential strengthen pattern development that is not sustainable. Therefore that, the findings study This strengthen argument that digitalization need integrated in a way strategic with policy energy and the environment to truly contribute to development sustainable development in the ASEAN region.

Conclusion

This Study conclude that connection between adoption digital technology, growth economy, consumption energy, and CO_2 emissions in ASEAN countries are complex, non-linear, and highly heterogeneous between countries. Increase penetration digital technology is reflected from increasing internet and telephone usage mobile no in a way automatic lower emission carbon or strengthen development sustainable. In many ASEAN countries, digital transformation is actually walk along with increasing consumption energy and CO_2 emissions, especially Because structure energy that is still dominated material burn fossils and increasing request energy from the digital infrastructure alone. Income country tall as Singapore shows that emission can relatively controlled through efficiency energy and policy strong environment, while developing countries still is in phase improvement emission along growth economy. With thus, adoption technology in ASEAN today This more represent dilemma between green growth and digital divide than become driver automatic development sustainable.

Contribution main study This lies in integration the concept of green growth and digital divide in One framework analysis for understand dynamics development sustainable development in ASEAN. This study show that digitalization is not variables neutral, but rather the impact is largely determined by the context structural like policy energy, capacity institutional level development economy and inequality digital access. With positioning the digital divide as moderating factors effectiveness technology, research This enrich literature that has been This tend look at technology as universal solution for problem environment. In general empirical, research This give description comparative across ASEAN countries which shows that the country with digital infrastructure and better policies ripe more capable utilise technology for efficiency, while countries with limitations precisely risky experience improvement pressure environment without benefit commensurate sustainability. With thus, research This give base conceptual and policy that digitalization must accompanied by transition energy clean and reduction strategies digital divide to truly support development sustainable.

Study This own a number of limitations. First, the approach qualitative based analysis content and interpretation of secondary data limit ability for identify connection causal in a way statistics. Second, the indicators technology used Still nature general (internet and mobile penetration) and not yet reflect quality use technology or adoption technology green in a way specific. Third, variation policy national and dynamics political Not yet analyzed in a way deep. Therefore that, research furthermore recommended for combine approach qualitative and quantitative through dynamic panel model or non-linear approach to test connection causal and threshold effects digitalization to emissions. In addition, research advanced can expand analysis with enter variables energy renewable, quality institutions, as well as innovation green for understanding about How digitalization can directed towards inclusive green growth become more comprehensive and operational for formulation policy.

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