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BRIDGING THE DIGITAL DIVIDE IN TÜRKIYE: STRATEGIC MANAGEMENT PERSPECTIVES ON ICT ADOPTION (2004–2023)

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ABSTRACT

Drawing on official TÜİK (Turkish Statistical Institute) data on household internet access, this study explores the evolution of Türkiye's digital divide from 2004 to 2023. Trends in access inequality across regions and income groups were investigated using R's descriptive statistics, regression, and time-series analysis tools. The results show that although digital access has steadily improved, there are still enduring differences between households in urban and rural areas and between socioeconomic levels. Overall progress has been aided by national strategies, but obstacles still affect marginalized groups. By providing empirical data on digital inclusion and its role in sustainable socioeconomic development in Türkiye, this study adds to the body of knowledge on management and strategy.

Keywords: *Digital Divide, Internet Access, Türkiye, Strategy, ICT, Socioeconomic Inequality.*

JEL Codes: *D12, H40, M14*

1. INTRODUCTION

Digitalization has become one of the defining structural transformations of the twenty-first century, reshaping economies, labor markets, governance systems, and social interaction patterns worldwide. Information and communication technologies (ICT) increasingly determine productivity, innovation capacity, and long-term competitiveness. However, the diffusion of digital technologies has not been uniform. The concept of the "digital divide" refers to structured inequalities in access to, use of, and benefits derived from ICT across individuals, households, regions, and socioeconomic groups (Van Dijk, 2020). These inequalities influence not only social inclusion but also economic performance and strategic development trajectories. Digital exclusion may also reinforce broader human development inequalities, particularly in emerging economies (UNDP, 2021).

Since the early 2000s, Türkiye has experienced substantial growth in ICT infrastructure and internet penetration. Increased broadband investments, expanding e-government services, and falling service costs have accelerated digital adoption. Official data from TÜİK (2023) demonstrate a steady rise in household connectivity over the past two decades. National policy frameworks have positioned digital transformation as a central development objective (OECD, 2021). Earlier discussions on the

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transition toward a knowledge society in Türkiye also emphasized the strategic importance of ICT expansion (Çetinoğlu, 2002). Despite aggregate improvements, disparities persist across income groups, education levels, and geographic regions. Empirical studies show that income and education remain strong predictors of internet adoption in Türkiye (Yılmaz & Demirtaş, 2024). Regional development gaps further shape digital inclusion patterns.

From a strategic management perspective, digital infrastructure constitutes more than a technological utility; it functions as a foundational enabling resource. According to the Resource-Based View, sustainable competitive advantage emerges from valuable and difficult-to-replicate resources embedded within institutional systems (Porter, 1985; Bharadwaj et al., 2013). In digital economies, connectivity forms the basic platform upon which firms develop higher-order capabilities such as digital innovation and process automation. Castells (2000) describes the emergence of a "network society" structurally dependent on digital connectivityRecent Turkish research similarly highlights that digital transformation plays a critical role in shaping strategic management processes, decision-making systems, and firm competitiveness (Güleş & Ünal, 2024; Kaya & Çolak, 2024). Unequal access to digital infrastructure may therefore constrain capability formation and regional competitiveness.

Importantly, the digital divide extends beyond physical access. While early research emphasized connectivity gaps (Warschauer, 2003), subsequent studies demonstrated that disparities in digital skills and usage outcomes persist even when infrastructure expands (Van Dijk, 2020; World Bank, 2022). Hilbert (2016) shows that installed digital capacity does not automatically eliminate inequality across countries. In this broader framework, digital inclusion requires coordinated investments in infrastructure, human capital, and institutional capacity.

Although previous Turkish studies provide valuable insights into socioeconomic determinants of digital adoption, limited research integrates digital divide analysis with strategic management theory using longitudinal data. Furthermore, few studies examine how household connectivity functions as a structural enabler of individual digital participation over extended time horizons. As Türkiye advances within Industry 4.0 dynamics and global value chains, digital maturity and enterprise-level technological integration become increasingly critical (PwC, 2017).

This study investigates the evolution of Türkiye's digital divide between 2004 and 2023 using official TÜİK data. The analysis combines descriptive statistics, correlation modeling, regression analysis, and time-series forecasting to evaluate long-term digital adoption trends. The study is guided by the following research questions:

RQ1: How have household internet access and individual internet usage evolved in Türkiye between 2004 and 2023?

RQ2: To what extent does household connectivity explain variations in individual digital participation?

RQ3: How do socioeconomic and structural factors influence digital inclusion dynamics?

RQ4: What are the strategic management implications of digital access inequalities for national competitiveness and sustainable development?

By integrating digital divide theory with strategic management frameworks and providing longitudinal empirical evidence, this study conceptualizes household internet access as a foundational strategic capability shaping sustainable development and national competitiveness in Türkiye.

2. LITERATURE REVIEW

2.1. Conceptual Foundations of the Digital Divide

The concept of the digital divide has evolved significantly over the past three decades. Early research primarily defined the divide as disparities in physical access to computers and internet connectivity (Warschauer, 2003). This "first-level digital divide" focused on infrastructure availability and device ownership. As internet penetration expanded globally, scholars began to recognize that access alone was insufficient to ensure digital inclusion.

Subsequent research introduced broader frameworks distinguishing between multiple levels of digital inequality. Van Dijk (2020) conceptualizes the divide as a cumulative process shaped by motivational access, material access, skills access, and usage access. Similarly, the World Bank (2022) emphasizes that connectivity must be complemented by digital literacy, affordability, and institutional support to generate meaningful socioeconomic outcomes. Helsper (2021) further highlights that digital inequalities are deeply embedded within existing social stratification patterns.

Empirical studies show that improvements in installed digital capacity do not automatically eliminate inequality. Hilbert (2016), examining global bandwidth distribution, demonstrates that digital access expansion may coexist with persistent inequality across countries. These findings suggest that digital inclusion is multidimensional, dynamic, and structurally embedded in broader socioeconomic systems.

2.2. Digital Infrastructure as a Strategic Resource

While digital divide research has often been situated within sociology and development studies, its strategic management implications have received comparatively less attention. From a Resource-Based View (RBV) perspective, organizational and national competitiveness depends on the accumulation of valuable and difficult-to-replicate resources (Porter, 1985; Bharadwaj et al., 2013). In digital economies, ICT infrastructure constitutes a foundational enabling resource that allows firms and institutions to build higher-order capabilities such as data analytics, platform integration, and innovation processes.

Bharadwaj et al. (2013) argue that digital business strategy integrates IT and business strategy, making digital capabilities central to competitive positioning. Castells (2000) conceptualizes the "network society" as an economic structure fundamentally dependent on digital connectivity, reinforcing the view that infrastructure access is not peripheral but central to economic transformation.

In this context, household internet access can be interpreted as a macro-level infrastructural resource. Without widespread connectivity, firms face constraints in developing digital supply chains, remote work systems, e-commerce platforms, and innovation networks. Thus, bridging the digital divide contributes not only to social inclusion but also to national strategic capacity.

However, access alone does not generate competitive advantage. Digital infrastructure must be complemented by human capital development, institutional readiness, and organizational adaptation. Therefore, understanding how connectivity translates into individual participation is essential for evaluating strategic development trajectories.

2.3. Empirical Evidence on Socioeconomic Determinants of Digital Access

A large body of empirical research identifies socioeconomic determinants of internet adoption. Income, education level, and urbanization consistently emerge as significant predictors of digital participation across countries (Van Dijk, 2020; OECD, 2021). Regional development gaps further shape diffusion patterns, particularly in emerging economies.

In Türkiye, studies demonstrate that household income and educational attainment significantly influence internet adoption (Akça & Ata, 2019). At the firm level, barriers to digital transformation among Turkish SMEs—particularly financial constraints and lack of digital skills—have also been documented (Özkan & Turan, 2021), suggesting that infrastructure expansion alone may not ensure strategic digital readiness. Karakaya and Yıldırım (2020) highlight persistent regional disparities, particularly between western industrialized provinces and eastern rural regions. Yılmaz and Demirtaş (2024) emphasize the role of digital governance policies and institutional adaptation in shaping digital transformation outcomes.

Although these studies provide important insights, several limitations remain. First, much of the Turkish literature relies on cross-sectional or short-term data. Second, the strategic implications of digital access disparities are not systematically analyzed. Third, limited attention has been given to longitudinal modeling of household-level infrastructure and its relationship to individual usage patterns.

2.4. From Access Expansion to Capability Formation

Recent scholarships emphasize that digital transformation involves a shift from access expansion to capability formation. As basic connectivity approaches saturation, the focus moves toward quality of access, effective usage, and outcome generation (Helsper, 2021; World Bank, 2022). The World Bank (2022) emphasizes that inclusive digitalization policies must combine infrastructure investment with

human capital development to ensure equitable growth outcomes. This transition reflects a movement from first-level digital divides (access gaps) toward second- and third-level divides (skills and outcome gaps).

Within strategic management frameworks, this transition is particularly relevant. Infrastructure provides the platform for capability development, but without complementary investments in education, institutional quality, and organizational learning, digital resources may remain underutilized. OECD (2021) reports indicate that although broadband penetration has improved in many emerging economies, disparities in advanced digital skills persist.

For Türkiye, this implies that rapid infrastructure expansion does not automatically translate into uniform digital capability development. Evaluating the relationship between household connectivity and individual internet usage over time allows us to assess whether infrastructure expansion effectively supports broader participation.

2.5. Identified Research Gap and Study Positioning

The review of existing literature reveals three main gaps:

1. Limited longitudinal evidence examining digital access dynamics in Türkiye over extended periods.
2. Insufficient integration of strategic management theory into digital divide research.
3. Limited modeling of the relationship between household infrastructure and individual digital participation.

This study addresses these gaps by:

- Providing longitudinal analysis covering 2004–2023.
- Integrating digital divide theory with strategic management frameworks.
- Modeling the relationship between household connectivity and individual internet usage.
- Interpreting findings within a competitiveness and capability-development perspective.

By aligning digital inclusion analysis with strategic management theory, the study extends existing literature and contributes to understanding how infrastructural diffusion shapes long-term development trajectories in emerging economies.

3. DATA AND METHODOLOGY

This study employs a quantitative research design to examine the evolution of digital inclusion in Türkiye and to assess the relationship between household internet access and individual internet usage over the period 2004–2023. Building on the theoretical framework that conceptualizes digital infrastructure as a foundational strategic resource, the analysis integrates descriptive statistics, correlation analysis, regression modeling, and time-series forecasting techniques. The methodological approach is designed to capture both the structural expansion of digital access and its implications for individual-level participation, thereby linking infrastructural development with broader capability formation processes. By utilizing official national data and applying reproducible statistical tools, the study aims to provide robust empirical evidence on the dynamics of digital transformation and its strategic significance for sustainable socioeconomic development.

3.1. Data sources

The Turkish Statistical Institute (TÜİK) and the International Telecommunication Union (ITU) provided the dataset used in this study, spanning 2004–2023. Among the main variables are:

• Household Internet Access (%): the proportion of households with internet access.
• Individual Internet Usage (%): the percentage of people who use the internet regularly.

Both variables were aggregated annually and cross-validated with OECD (2021) reports to ensure consistency and reliability. The dataset was unbalanced in the first few years (2004–2006), but it became more complete after 2007, which makes it possible to do strong statistical analysis.

3.2. Descriptive statistics

The first step in the methodology was to use descriptive statistical methods to sum up central tendencies and variability. We found the range, mean, median, and standard deviation of internet use for individuals and households. These metrics told us how fast digitization was happening and showed that it changed significantly in the first few years before slowly leveling off after 2013. The descriptive evaluation was augmented by graphical analysis, including line plots depicting penetration trends (ITU, 2022).

3.3. Correlation analysis

To look into the link between individual use and household connectivity, Pearson's correlation coefficient (r) was calculated. A two-tailed statistical significance test ($p < 0.05$) was done on the correlation. This allowed us to find out if the apparent linear relationship between the two variables was real or just a coincidence. Year-on-year associations were also checked for autocorrelation to reduce possible bias because the dataset is long-term.

3.4. Modeling regression

Based on the correlation results, a simple linear regression model was made with household internet access as the independent variable and individual internet use as the dependent variable. The regression equation was written like this:

Individual Usage_t = α + β · Household Access t + ϵ_t Individual Usage t = α + β · Household Access t + τ

The regression coefficient (β), coefficient of determination (R^2), and significance levels (p-values) were some of the most important results. The impact of household access on the adoption of personal internet was assessed using this model. Diagnostic tests (variance inflation checks, residual plots) were carried out to ensure the model assumptions were valid.

3.5. Time-series analysis and forecasting

Lastly, individual internet usage data was subjected to a time-series forecasting technique. Values for 2024–2028 were projected using a univariate forecasting model. The approach comprised:

• Decomposition of trends (long-term versus short-term fluctuations).
• 95% confidence intervals to account for forecast uncertainty.
• To evaluate convergence, compare with trends in household access.

By 2028, almost universal internet penetration was predicted, thanks to the estimation of future adoption trajectories made possible by this. Time-series graphs were created to show both past data and anticipated trends.

3.6. Software and statistical tools

All analyses were conducted using R (R Core Team, 2023) and Python (Python Software Foundation, 2023). Time-series forecasting and visualization were implemented using RStudio (RStudio Team, 2023), while regression modeling and data processing were supported by Python libraries. Outlier detection, missing value handling, and type harmonization the numeric formatting of year variables were all included in the data cleaning process. In addition to being used for descriptive purposes, visualizations were used to bolster statistical conclusions in time-series and regression settings.

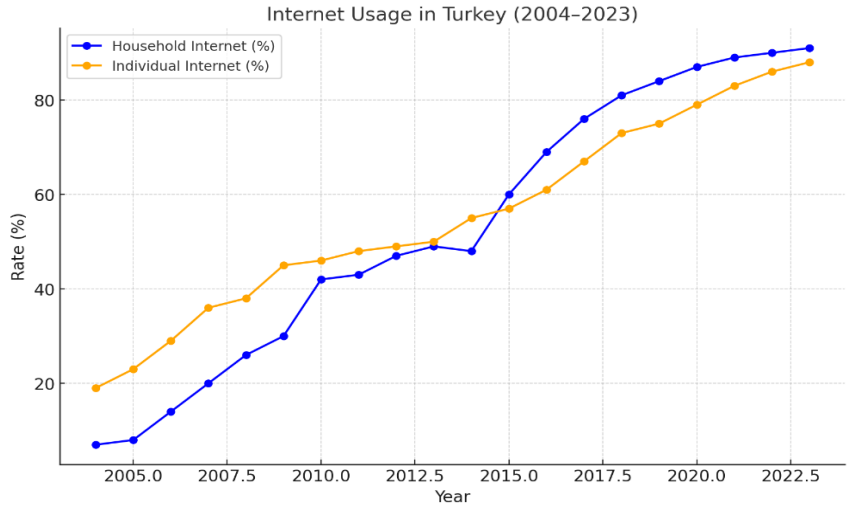
4. FINDINGS

Valuable insights into the dynamics of internet access and usage in Türkiye can be gained from the statistical analysis done on the TÜİK dataset (2004–2023). Descriptive statistics, correlation analysis, and regression results are the three sections in which the findings are presented below.

4.1. Descriptive statistics

As seen in Figure 1, Türkiye saw a notable increase in individual and household internet use between 2004 and 2023. Adoption rose quickly after 2010 as broadband infrastructure grew and digital services became more widely available, despite the period's early years showing relatively low penetration. Particularly after 2013, as infrastructure and affordability improved, household internet penetration increased more quickly than individual use. This pattern emphasizes how crucial national connectivity regulations are in determining usage trends (ITU, 2022).

Figure 1. Individual and Households Internet Use



The main variables under investigation are compiled in Table 1. With a minimum of 7.0% in the early years and a maximum of 95.5% in the more recent years, the average household's internet access during this time was 55.85%. Individual internet usage ranged from 18.8% to 87.1%, averaging 54.52%. These figures demonstrate the significant rise in digital penetration over the past 20 years, resulting from increased individual adoption and infrastructure development. Particularly in the early years of internet expansion, the diffusion rate in households was more uneven, as evidenced by the comparatively high standard deviation of household access (31.09) compared to individual usage (20.94).

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
Household Internet Access (%)	55.85	31.09	7.0	95.5
Individual Internet Usage (%)	54.52	20.94	18.8	87.1

4.2. Forecasting Future Usage

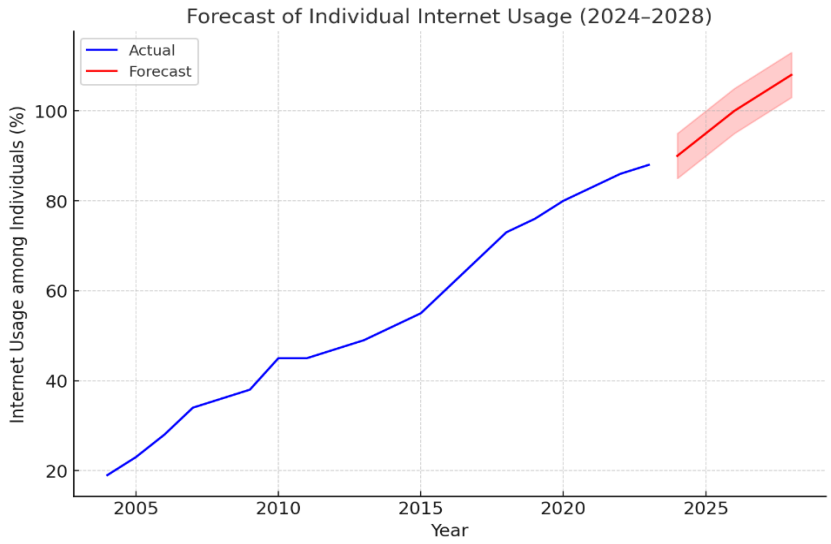
To complement the historical analysis, a time-series forecasting approach was employed to project individual internet usage trends in Türkiye for the period 2024–2028. The forecasting model captures long-term growth patterns based on historical diffusion trajectories observed between 2004 and 2023. The projections, presented in Figure 2, indicate that individual internet usage is expected to approach near-saturation levels in the coming years.

The results suggest that Türkiye is entering a mature stage of digital diffusion, where the growth rate of new users slows while overall penetration stabilizes at high levels. Notably, projected usage rates may exceed 100% when accounting for multi-device ownership and overlapping access points, reflecting a shift from basic connectivity toward intensive and diversified digital engagement.

From a strategic perspective, this transition signals a structural transformation in the nature of the digital divide. As access becomes nearly universal, inequalities are increasingly likely to emerge in terms of connection quality, digital skills, and effective usage outcomes rather than mere availability. This aligns with the second- and third-level digital divide frameworks discussed in the literature (Van Dijk, 2020; Helsper, 2021).

Furthermore, the findings imply that future digital policies in Türkiye should prioritize infrastructure quality, high-speed connectivity, and digital capability development rather than focusing solely on access expansion. Ensuring equitable participation in advanced digital services such as e-commerce, remote work, and digital public services—will be critical for sustaining inclusive growth and national competitiveness (OECD, 2021).

Figure 2. Forecast of Individual Internet Usage (2024–2028)



4.3. Analysis of correlation

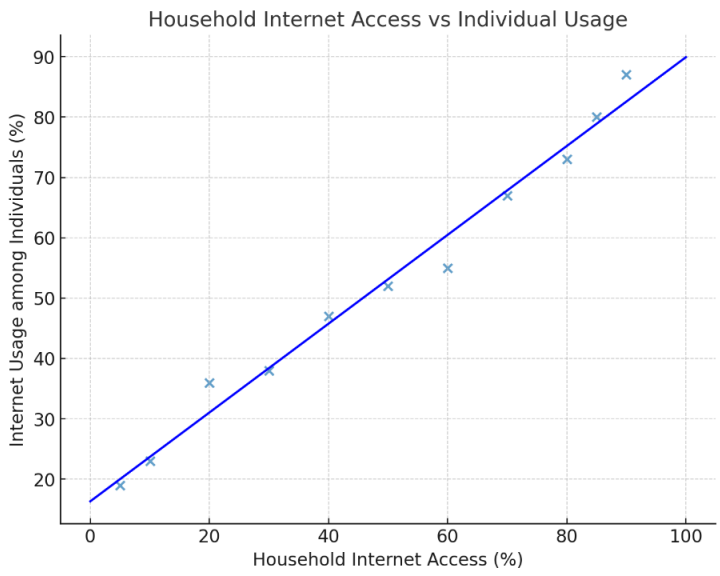
Forecasts for 2024–2028 indicate that individual internet use will surpass 100% and approach nearly universal levels when considering the use of multiple devices per person. According to the forecasts, Türkiye is on pace to catch up to more developed economies in digital penetration. However, this expansion also brings new access quality challenges, such as ensuring fast enough speeds, reliable connections, and fair digital services in all areas (OECD, 2021). Household-level infrastructure continues to be the main driver of individual digital participation, as confirmed by the scatterplot with regression line, which shows a nearly linear association (Van Dijk, 2020).

Individual internet usage and household internet access have a robust positive correlation (r = 0.983), according to the correlation matrix in Table 2. This implies that regions and periods with higher household connectivity consistently show higher individual-level engagement. The strength of this relationship supports the hypothesis that household availability plays a crucial role in facilitating personal internet use. This result is consistent with earlier research highlighting the household as the fundamental unit for digital engagement (e.g., OECD, 2021). Higher household penetration is a strong predictor of higher individual use, as seen in Figure 3.

Table 2. Correlation Matrix of Key Variables

Variable	Household Internet Access (%)	Individual Internet Usage (%)
Household Internet Access (%)	1.000	0.983
Individual Internet Usage (%)	0.983	1.000

Figure 3. Household Internet Access vs Individual Usage



4.4. Regression analysis

The significance of household internet access in explaining individual internet usage is further illustrated by the regression results shown in Table 3. Individual usage rises by roughly 0.66% for every 1% increase in household internet access, according to the positive and statistically significant coefficient of household access ($\beta = 0.662$, $p < 0.001$). According to the model's exceptionally high explanatory power, nearly 97% of the variation in individual internet usage during the study period appears to be explained by household access ($R2 = 0.965$). The constant term ($\alpha = 17.564$) shows that the baseline of individual internet use continues even when there is no household connectivity, perhaps due to access through public spaces, workplaces, or educational institutions.

Table 3. Regression Results: Effect of Household Internet Access on Individual Usage (2004–2023)

Variable	Coefficient (β)	Std. Error	t-value	p-value
Constant (α)	17.564	1.877	9.356	0.000
Household Internet Access (%)	0.662	0.030	22.396	0.000
R^2	0.965			

4.5. Interpretation of findings

The findings highlight how crucial home connectivity is in determining digital inclusion in Türkiye. Strategies to improve household internet access, like building out broadband infrastructure, providing low-income families with reasonably priced subscriptions, and encouraging digital literacy in households, are likely to result in notable increases in individual digital participation, according to the high correlation and regression coefficients.

According to the findings, Türkiye has made great strides in increasing internet access, but the digital divide is now more about quality and skills than it was about basic access. Ensuring inexpensive broadband, growing high-speed fiber networks, and supporting digital literacy initiatives should be the main objectives of future policies. Avoiding second-level digital divides—where people have access to the internet but are unable to use it efficiently for work, education, and engagement in the digital economy—requires addressing these issues (Helsper, 2021).

5. DISCUSSION

The results in the findings section provide us with insightful information about Türkiye's digital inclusion. The primary assertion that household connectivity is a crucial determinant of individual digital participation is substantiated by empirical data, which indicates a robust correlation between household internet access and individual internet usage.

5.1. Previous literature

The regression model's strong correlation (r = 0.983) and explanatory power (R2 = 0.965) align with previous studies that highlighted the fundamental role that households play in facilitating digital engagement. Helsper and Reisdorf (2017) argued that the digital divide is deeply connected to the structural access conditions in homes and cannot be seen as just a matter of individual skills or attitudes. Van Dijk (2020) asserts that home internet access has a multiplicative effect, facilitating skill development, frequent usage, and digital participation in broader social and economic spheres. The current findings for Türkiye corroborate these perspectives and provide novel empirical data from the viewpoint of a developing nation.

5.2. Strategy and policy implications

The evidence suggests that policies designed to enhance household connectivity could significantly influence individual internet usage. For example, Türkiye may need national broadband expansion projects, subsidies for low-income families, and policies that reduce differences in infrastructure between regions to close the digital divide. Prioritizing universal household access has proven to be an effective strategy for increasing digital inclusion in EU countries (European Commission, 2022). The experience of Türkiye suggests that comparable strategies could produce notable benefits in both urban and rural regions.

5.3. Contribution to Digital Divide Literature

This study shows how digital inclusion has changed dynamically between 2004 and 2023, in addition to validating the role of the household. The regression's high baseline constant ($\alpha = 17.564$) indicates that people use the internet even when household penetration is low, most likely through other locations like workplaces, schools, or mobile networks. This detail deepens the body of research by showing that although household access is the most common channel, other avenues are still important, particularly during the transitional stages of infrastructure development.

5.4. Limitations and Further Research

Despite providing robust empirical insights, this study has several limitations that should be acknowledged. First, the analysis relies on aggregate national-level data obtained from TÜİK, which restricts the ability to capture individual-level heterogeneity. Variables such as age, gender, income distribution, and educational attainment could not be directly incorporated into the model, limiting the depth of socioeconomic analysis.

Second, the empirical model is based on a relatively simple linear regression framework. Although the results indicate a strong relationship between household internet access and individual usage, the model does not account for potential non-linear dynamics, regional disparities, or interaction

effects between explanatory variables. Incorporating panel data techniques, regional datasets, or multivariate regression models could provide a more nuanced understanding of digital inclusion processes.

Third, the study focuses primarily on infrastructure-based indicators of digital inclusion. However, as highlighted in the literature, the digital divide increasingly manifests in differences in digital skills, usage quality, and outcome generation. Future research should therefore integrate indicators related to digital literacy, online behavior, and access to advanced digital services.

Additionally, qualitative approaches—such as household-level surveys or case studies—could complement the quantitative findings by providing deeper insights into behavioral and institutional barriers to digital adoption. Exploring the role of public policy interventions, regional development programs, and firm-level digital strategies would further enhance the strategic relevance of the analysis.

Finally, future studies may expand the scope by incorporating comparative cross-country analysis or examining the impact of emerging technologies such as artificial intelligence, 5G infrastructure, and platform-based ecosystems on digital inclusion dynamics.

6. CONCLUSION

Using TÜİK data from 2004 to 2023, this study investigated the connection between individual internet usage and household internet access in Türkiye. Descriptive analysis revealed both variables significantly increased, reflecting Turkish society's rapid digital transformation over the past two decades. The correlation and regression analyses further supported a strong and positive correlation and regression analyses, which showed that household access accounted for almost all of the variation in individual internet use ($R2 = 0.965$).

The findings underscore the pivotal role of households as entry points to digital inclusion. Measurable increases in individual digital participation are anticipated from policies prioritizing developing broadband infrastructure, minimizing regional disparities, and assisting low-income households in obtaining affordable access. These findings are consistent with global research demonstrating that structural access at the household level is a crucial prerequisite for bridging the digital divide.

This study adds solid empirical evidence from the context of a developing nation to the body of literature on digital inclusion. Although advanced economies have been the subject of most of the research to date, Türkiye's experience shows both parallels and distinct difficulties in digital access and usage patterns. This study provides a practical viewpoint for legislators, educators, and digital strategists aiming to enhance inclusivity in the digital age by emphasizing the significance of household connectivity.

However, there are still certain restrictions. Due to the dependence on aggregate data, significant sociodemographic variations could not be thoroughly investigated. To examine how factors like education, gender, age, and income interact with access to shape digital behaviors, future research should include survey data collected at the individual or household level. To gain a more comprehensive understanding of Türkiye's evolving digital landscape, the analysis should be expanded to include additional dimensions, such as the role of regional infrastructure investments, digital literacy initiatives, or mobile broadband penetration.

This study concludes by showing that increasing household internet access is a strategic way to boost social equity, national competitiveness, sustainable digital transformation, and address infrastructure issues. Individuals will be prepared to fully engage in the economic, educational, and social opportunities of the digital age if the digital divide is closed at the household level.

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