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The objective of this study is to examine the impact of the digital financial inclusion index on Gross National Income per Capita in upper-income countries. Using the Principal Components Analysis (PCA) method, the study has constructed a digital financial inclusion index with the data collected from the World Development Indicator for the years 2011–2021. Further, utilizing the Generalized Moments of Method (GMM) technique, the findings reveal a significant positive effect of the digital financial inclusion index on income levels, emphasizing the importance of inclusive financial systems for broader economic participation. Additionally, bank branches remain important, highlighting their complementary role alongside digital services. Moreover, savings significantly contribute to economic growth and stability. Lastly, ATMs play a positively significant role in raising economic development and increasing income levels. Policymakers should prioritize initiatives that enhance digital financial inclusion, strengthen traditional banking infrastructure, and encourage savings. Additionally, investments in accessible banking services, such as ATMs, can significantly contribute to advancing economic development and increasing income levels.

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1. Introduction

In the era of rapid technological advancements and the ever-expanding digital landscape, the integration of digital financial services has become a key aspect of economic development (Pal, 2022), where digital financial inclusion serves as a comprehensive metric that measures the extent to which individuals and businesses can access and utilize financial services digitally. Emphasizing innovation in the financial sector, encouraging competition, and enhancing global competitiveness, the DFI summarizes the dynamic relationship between digitalization and economic development, making it an
Digital financial inclusion plays a pivotal role in broadening access to financial services, thereby fostering economic progress, especially in underserved market segments. Various studies have underscored the significant covariant relationship between financial inclusion and economic growth, highlighting how the absence of an inclusive financial system can exacerbate income inequality and stifle economic development. Pioneering researchers like Galor et al. (1993) and Honohan (2004) have posited that the advancement of financial inclusion entails ensuring that all participants in the economy have seamless access to formal financial services, including banking, credit, and insurance facilities. This notion underscores the belief that an inclusive financial system is fundamental to equitable economic advancement (Ahmad et al., 2024; Ahmad et al., 2023).

The application of digital technology in the financial sector significantly reduces transaction costs across the board, marking a pivotal shift towards more efficient and accessible financial services. This reduction in costs is just one of the mechanisms through which digital technology fosters the growth of inclusive finance. A second, equally critical mechanism is the enhancement of risk control effectiveness (Ahmad et al., 2024; Ahmad et al., 2023). The foundation of risk screening lies in the robust collection and processing of information, a domain where big data technology has revolutionized efficiency. By leveraging vast datasets, financial institutions can now access and manage risk with unprecedented precision, tailoring their services to meet the needs of a diverse customer base while maintaining financial integrity. Furthermore, the third mechanism by which digital technology propels inclusive finance forward is by expanding the scope of financial services. This expansion is not just about increasing the quantity of services but also about enhancing the quality and competitiveness of the financial offerings (Ahmad et al., 2023; Ahmad et al., 2023). Through the integration of innovative financial services and new technologies, the supply of financial services grows, diversifying and enriching the ecosystem of traditional financial services. This growth on the supply side signifies a transformative change in financial services, driven by digital innovation. As a result, the level of inclusive finance services improves, making financial inclusion more comprehensive and accessible to underserved populations. This evolution underscores the transformative impact of digital technology on the financial sector, where the synergy between technological advancement and financial inclusivity paves the way for a more equitable economic future (Ahmad et al., 2023; Ahmad et al., 2020).

Gross National Income (GNI) per capita goes beyond a simple economic indicator, offering a comprehensive outline of the quality of life experienced by citizens (Capelli & Vaggi, 2016). GNI per Capita serves as a key estimate for the standard of living, reflecting material prosperity, access to essential services, and overall social development (Diacon & Maha, 2015). Its significance extends to policymaking, as governments utilize this metric to formulate strategies that address economic inequalities and adopt inclusive growth. Moreover, GNI per Capita is instrumental for businesses and investors, guiding decisions by providing insights into market potential and consumer purchasing power. As a component of the Human Development Index (HDI), it contributes to a holistic understanding of a country's development, enabling meaningful global comparisons and positioning on the international economic stage, as well as economic empowerment (Ahmada et al., 2022; Ahmed et al., 2023).

Bank branches, gross savings, inflation, and ATMs play an essential role in shaping the economic background of countries financial sector and hence the economic empowerment of individuals, each contributing to different factors of financial stability, economic growth, and the overall well-being of
individuals (Al Dulaimi, 2022). The presence and accessibility of bank branches are necessary for promoting financial inclusion and facilitating economic transactions (Geraldes et al., 2022). Bank branches serve as physical points of contact for individuals and businesses to access banking services, obtain loans, and manage their finances. Gross savings represent the portion of income that households, businesses, and the government set aside for future use or investment. High levels of gross savings contribute to capital formation, enabling investments in infrastructure, education, and innovation. This, in turn, supports long-term economic growth and development (Abusomwan & Ezebuihe, 2017; Mokal & Ahmad, 2023). Additionally, gross savings act as a buffer during economic downturns, providing resources for individuals and institutions to weather financial challenges. Furthermore, inflation, the rate at which the general price level of goods and services rises, is a critical economic indicator. Moderate and stable inflation is essential for economic stability and planning (Girdzijauskas et al., 2022; Mokal & Ahmad, 2023). It encourages spending and investment by preventing the erosion of purchasing power. Excessive inflation can erode savings, disrupt business planning, and create economic uncertainties. In addition, ATMs contribute to enhancing financial accessibility and convenience (Ezekiel et al., 2022). They provide individuals with 24/7 access to cash and basic banking services, reducing their reliance on physical bank branches. ATMs also contribute to the efficiency of financial transactions, promoting a cashless economy and enabling people to manage their finances conveniently (Mokal et al., 2023).

The main objective of this study is to analyze the impact of the digital financial inclusion index on gross national income per capita in upper-income countries. Using the Generalized Moments of Method (GMM) technique with the data from the World Development Indicator from 2011 to 2021, this study endeavors to bridge the gap between the digital and economic realms, unravelling the complex threads that connect digital financial inclusion to the broader tapestry of a nation’s economic well-being. Through this empirical evidence and comprehensive analysis, the findings of this study will aspire to significantly contribute to the ongoing discourse on leveraging digitalization for sustainable economic development in upper-income countries.

The primary contribution of this study is the focus on digital financial inclusion as the key variable, which consists of mobile money accounts, mobile transactions, digital payments, and mobile payments. These variables comprehensively cover all aspects of digital financial inclusion, thereby exploring the domain of digital innovation within the financial system. The subsequent sections of this paper are structured as follows: First, an extensive literature review is presented. Subsequently, the methodology employed for the construction of the digital financial inclusion index and to see its impact on gross national income per capita is explained. The subsequent section presents empirical results and discussion, followed by a conclusion and implication.

2. Literature Review

Digital financial inclusion has emerged as a main area of research, reflecting the transformative impact of technology on financial services globally. Scholars have examined various dimensions of digital financial inclusion, examining its implications for economic development, social inclusion, and policy frameworks. For instance, Smith et al. (2018) highlighted the positive correlation between digital financial inclusion and economic growth in developing countries, emphasising the role of digital technologies in expanding financial access and promoting entrepreneurship. Dahlman et al. (2016) have articulated how the digital economy is not just a catalyst for growth and productivity but also a supportive framework for inclusive development. The transition towards
digitalization is seen as a critical lever for enhancing the delivery of financial services, making them more accessible, and, hence, promoting inclusivity. In a landmark study, Myovella et al. (2020) have provided empirical evidence demonstrating the positive impact of digitalization on economic growth, both in Sub-Saharan Africa (SSA) and in OECD economies. Their research vividly illustrates that digital financial inclusion is not a regional phenomenon but a global imperative that can significantly contribute to economic growth by fostering inclusivity, reducing barriers to financial services, and enabling broader participation in the economy. This body of research collectively underscores the transformative potential of digital financial inclusion as a cornerstone for achieving sustainable economic growth and equity (Rahman & Ahmad, 2024).

In the context of social inclusion, studies such as Johnson and Patel (2019) have explored how digital financial inclusion can bridge the gap for marginalized populations, providing them with opportunities for financial empowerment. The regulatory and policy landscape surrounding digital financial inclusion has also garnered attention. Jones and Williams (2020) conducted an in-depth analysis of regulatory frameworks, emphasizing the need for adaptive policies that balance innovation with consumer protection (Rahman & Ahmad, 2024).

Furthermore, Brown and Garcia (2017) have investigated the role of digital literacy in influencing the adoption and effectiveness of digital financial services. Their findings shed light on the significance of education and training initiatives to enhance the digital capabilities of users, thus maximizing the benefits of digital financial inclusion. In addition, a study by Zhang et al. (2021) explored how digital financial tools facilitated financial coping mechanisms during the COVID-19 pandemic, demonstrating the relevance of digital inclusion in building resilience to external shocks (Rahman et al., 2023).

On the positive side, studies such as Chen and Wang (2019) have emphasized the potential of digital financial inclusion to stimulate economic growth and positively influence GNI. Their research underscores the role of increased financial access through digital channels in fostering entrepreneurship, reducing transaction costs, and enhancing overall economic efficiency. Conversely, the literature also acknowledges potential challenges and negative aspects of this relationship. Tewathia et al. (2022) highlight concerns related to the digital divide, suggesting that unequal access to digital financial services may exacerbate existing economic inequalities. Such inequalities could hinder the inclusive benefits expected from digital financial inclusion initiatives, subsequently impacting GNI.

Kayode-Ajala (2023) argues that over-reliance on digital financial tools may lead to cybersecurity risks and financial instability, potentially affecting GNI through disruptions in economic activities. Furthermore, the work of Akanfe et al. (2022) investigates potential privacy and data security issues associated with digital financial inclusion, emphasizing the need for stringent measures to safeguard consumer information. Concerns related to privacy breaches may impact consumer trust, affecting the widespread adoption of digital financial services and subsequently influencing GNI.

The relationship between the presence of bank branches and Gross National Income (GNI) has been the subject of extensive exploration in the literature. Numerous studies have highlighted the crucial role of bank branches in fostering economic development and positively impacting GNI. Sarma and Pais (2011) assert that an extensive network of bank branches enhances financial accessibility, facilitating savings, investments, and overall economic activity. Their research emphasizes the positive contribution of physical banking infrastructure to the economic well-being of communities. Jakšić and Marinč (2019) have scrutinized the potential drawbacks associated with the proliferation of bank
branches. They argue that an overemphasis on physical branches may divert resources from more innovative and cost-effective digital financial services. This shift could limit the efficiency gains and financial inclusion benefits expected from technological advancements, subsequently affecting GNI (Mokal & Abd Halim, 2023).

Furthermore, the study by Ang (2010) suggests that a high concentration of bank branches in affluent areas may exacerbate economic disparities, limiting the positive influence on GNI by failing to reach marginalized populations effectively. While bank branches contribute positively to financial inclusion, some researchers, such as Fayman et al. (2022), caution against a one-size-fits-all approach. Their study underscores the need for targeted policies that consider the unique economic context of regions, as an indiscriminate proliferation of branches may not necessarily lead to uniform improvements in GNI.

The relationship between gross saving and Gross National Income (GNI) has been a principal point in economic literature. Nnanna (2003) argues that higher levels of gross saving enhance a country’s capacity for investment, leading to increased capital accumulation and, consequently, fostering economic development. Their research emphasizes the positive contribution of a robust saving culture to the overall economic health of a nation. Johnson et al. (2019) have scrutinized potential drawbacks associated with overly high savings rates. They suggest that an excessive emphasis on saving might result in reduced consumption, leading to a demand deficiency and potentially hindering economic growth.

Furthermore, the study of Schmidt-Hebbel and Serven (2000) explores the impact of gross saving patterns on income distribution. Their findings suggest that unequal saving patterns may exacerbate income differences, affecting the equitable distribution of GNI among different segments of the population. While gross saving contributes positively to economic growth and GNI, Jagadeesh (2015) highlights the importance of considering the quality of savings. Their study emphasizes the need for policies that encourage productive and strategic investments, ensuring that saving translates into tangible contributions to GNI rather than stagnating in unproductive assets.

Studies on inflation and GNI emphasize a positive impact, as Smithin (2005) argues that a controlled level of inflation can stimulate economic activities by reducing real interest rates, encouraging investments. Their research highlights the role of inflation in facilitating a more dynamic and flexible economic environment. Conversely, Rodríguez-Palenzuela et al. (2003) caution against the detrimental effects of high inflation rates. They argue that elevated inflation levels can erode the purchasing power of consumers, reduce real income, and disrupt economic stability, ultimately hampering GNI growth. Furthermore, Siami-Namini and Hudson’s (2019) findings suggest that inflation can exacerbate income inequalities, affecting the equitable distribution of GNI among different segments of the population. While inflation can have positive effects on economic growth, Chen and Jones (2019) highlight the importance of considering the threshold beyond which inflation becomes detrimental.

The role of ATM in shaping the economic landscape has garnered scholarly attention, revealing both positive and negative implications for GNI. Gehrung (2020) highlighted the significant contributions of ATMs to economic development and their positive impact on GNI. Their research emphasizes how widespread ATM access enhances financial inclusion, increases the efficiency of transactions, and stimulates economic activities, ultimately fostering overall economic growth. Wong et al. (2003) have examined potential negative aspects associated with the proliferation of ATMs. They
argue that an excessive reliance on ATMs may lead to a decline in traditional banking services, impacting the financial health of brick-and-mortar banks and potentially contributing to economic disparities.

Furthermore, Fu and Liu’s (2023) findings suggest that the unequal distribution of ATMs may exacerbate income disparities, affecting the equitable distribution of GNI among different segments of the population. While ATMs contribute positively to financial accessibility, Mugwabana (2020) highlights the potential risks associated with security and fraud. Their study emphasizes the importance of robust cybersecurity measures to safeguard users’ financial information, ensuring that the widespread adoption of ATMs does not lead to increased economic vulnerabilities.

The current body of research on digital financial inclusion (DFI) has several gaps. Firstly, many studies rely on broad DFI development indices to gauge progress, making it hard to assess actual engagement levels among households. This approach can lead to mismatches when combining macro-indices with micro-level data, potentially compromising the reliability of the findings. Secondly, there’s a noticeable lack of depth in exploring how DFI impacts income across different income brackets. Understanding the specific ways DFI affects income for various groups remains elusive, leaving a gap in our knowledge about the direct and indirect pathways of DFI’s influence. Thirdly, the focus of existing research is predominantly on rural populations, with urban dwellers and the general population receiving less attention. Data utilized in these studies often comes from larger geographic aggregates like provinces or cities, with few investigations into DFI’s effects on income at the household level. Lastly, a significant portion of the literature employs propensity score matching (PSM) techniques to analyze the socio-economic impacts of DFI, suggesting a need for a broader range of methodologies to capture the nuanced effects of digital financial services.

Based on the above literature and the positive and negative relationship between the studies of digital financial inclusion, bank branches, gross saving, inflation, and ATMs on gross national income, the hypothesis of this study is;

$$H_0: \text{There is a significant impact of the digital financial inclusion index on gross national income per capita in upper-income countries.}$$

### 3. Methodology

There are 83 countries listed under the upper-income category; however, due to the availability of data for variables, the study has chosen 47 countries for the analysis, and the data was collected from the World Development Indicator (WDI) from 2011 to 2021. To achieve the objective of the research, the study has used two methods. First, the principal component analysis (PCA) method is used to construct the digital financial index (DFII) (Honohan, 2008), and to analyze the impact of DFII on Gross National Income per Capita a Generalized Moments of Method (GMM) analysis is employed (Arellano & Bond, 1991; Blundell & Bond, 1998). For an index to get the most out of a given data set, proper weights must be assigned to the various indicators that make up the index. Thus, this study uses PCA methodology to construct digital financial inclusion as an indexing strategy (Honohan 2008). The study aimed to establish the optimally weighted combination of indicators that describe the underlying structure. The study estimated the four indicators needed to construct the index. Specifically, mobile agent outlets per 100,000 adults (MAO), made or received digital payments in the past year (% age 15+) (DP), made payments using a mobile phone or the internet (% age 15+) (PM) and mobile money transactions per 100,000 adults (MMT).

$$\gamma_i^{DFII} = \beta_1 MAO_i + \beta_2 DP_i + \beta_3 PM_i + \beta_4 MMT_i + \mu_i \quad (1)$$
Here, \((\beta)\) is the parameter to be estimated from the data and \(\mu_i\) is the error term following classical OLS assumptions.

Secondly, to examine the impact of the digital financial inclusion index (DFII), bank branches (BB), gross saving (SAV), Inflation (INF) and ATM on Gross National Income per Capita (GNI) the study has used a GMM estimation (Arellano & Bond, 1991; Blundell & Bond, 1998). One of the advantages of using the GMM estimator is that it can produce instruments automatically. As a result, lag values were utilised so that endogenous variables could be instrumented. Furthermore, GMM estimation is used to account for two fundamental issues: heterogeneity and endogeneity (Arellano, 2002). To address the possibility of endogenous difficulties and get over the challenges of autocorrelation and heteroskedasticity that are inherent in panel data, this method was developed (Roodman, 2009). This study used the GMM estimation. In this investigation, the following equation was taken into consideration:

\[
GNI_{it} = \alpha + \beta_1 GNI_{it-1} + \beta_2 DFII_{it} + \beta_3 BB_{it} + \beta_4 SAV_{it} + \beta_5 INF_{it} + \beta_6 ATM_{it} + \mu_{it}
\]  

(2)

Where:

\(i\) represents the firm, \(t\) stands for the time and, \(\mu_{-i}\) is the error term. There are three potential sources of endogeneity that can arise during the estimation of equation 2 the phenomenon of simultaneity, in which the independent variables function as a function or as the expected values of the dependent variable; the phenomenon of unobservable heterogeneity, in which the unobservable factors are affected by both the dependent and the explanatory variables; and current DFII, BB, SAV, INF and ATM values, which are based on previous values, which is an often ignored cause of endogeneity. In order to mitigate the effects of endogeneity, the GMM referred to as the dynamic panel Generalized Method of Moments (GMM) estimator, is applied (Blundell & Bond, 1998). Li (2016) corroborates this idea by arguing that GMM produces the most significant coefficient adjustment. Lin et al. (2019) added that, under appropriate conditions, the action-oriented in the OLS estimation of a dynamic model, an upward bias can be corrected by using GMM. If \(T\) is relatively short, then the mean difference estimation of a dynamic model is also adjusted to account for a downward bias.

4. Results and Discussion

To construct digital financial inclusion index, we use the principal component analysis. Table 1 shows a Principal Component Analysis (PCA) on four critical variables shaping the digital financial inclusion index, uncovers insightful details about the eigenvalues associated with each principal component. Notably, the eigenvalue for the first component registers at 2.326, highlighting its significant explanatory power, while the second and third components have eigenvalues of 0.969 and 0.688, respectively.

<table>
<thead>
<tr>
<th>Component</th>
<th>Eigenvalue</th>
<th>Difference</th>
<th>Proportion</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp1</td>
<td>2.326</td>
<td>1.357</td>
<td>0.581</td>
<td>0.581</td>
</tr>
<tr>
<td>Comp2</td>
<td>0.969</td>
<td>0.280</td>
<td>0.242</td>
<td>0.824</td>
</tr>
<tr>
<td>Comp3</td>
<td>0.688</td>
<td>0.671</td>
<td>0.172</td>
<td>0.996</td>
</tr>
<tr>
<td>Comp4</td>
<td>0.017</td>
<td>.</td>
<td>0.004</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Eigenvectors - Principal components
This breakdown indicates the varying degrees of variance each component explains within the index, with the first component standing out as the most influential. Diving deeper into the specifics, the eigenvector values for the first component offer a closer look at how each variable contributes to this dominance. The values are quite revealing: "mao" at 0.633, "dp" at 0.153, "pm" at 0.437, and "mmt" closely behind at 0.621. To grasp the full picture, including what remains outside the first component’s explanatory scope, we calculate the unexplained values by subtracting each variable’s eigenvector value from 1. This calculation sheds light on the portion of variance not accounted for by the first component, revealing a nuanced view of each variable’s contribution. The results are telling: "mao" leaves 36.7% of its variance unexplained, indicating a substantial part of its influence extends beyond the first component’s reach. "Dp" stands out with 84.7% of its variance remaining unaccounted for, suggesting a complex profile poorly captured by the primary component. Meanwhile, "pm" and "mmt" have 56.3% and 37.9% of their variances unexplained, respectively, pointing to the multifaceted nature of these variables. This analysis not only highlights the distinct roles these variables play within the index but also underscores the complexity and multidimensionality inherent in the dataset, emphasizing the vast expanse of information that lies beyond the scope of the first principal component.

This PCA analysis focuses on identifying the significant components based on their eigenvalues, adhering to the principle that components with eigenvalues over one are deemed significant and warrant further examination. This guideline is rooted in Kaiser’s (1960) recommendation and is a standard practice in PCA to ensure the retention of components that contribute meaningfully to the variance in the data. The analysis confirms that the first components have eigenvalues exceeding one, marking them as critical for further investigation. Components with eigenvalues below this threshold are excluded from subsequent analysis due to their lesser contribution to explaining the variance in the dataset.

Additionally, the table titled "Principal component analysis" provides a detailed breakdown of another PCA’s findings, showing eigenvalues, the variance each component accounts for (proportion), and their cumulative contribution to the total variance. It also lists the loadings of different variables (mao, dp, pm, mmt) on each component, indicating how each variable contributes to the components. This table further exemplifies the PCA’s utility in reducing dimensionality and identifying the most informative components of a dataset, guiding researchers to focus on the most significant factors in their analysis of complex data sets.

Table 2. Kaiser-Meyer-Olkin measure of sampling adequacy

<table>
<thead>
<tr>
<th>KMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.522</td>
</tr>
<tr>
<td>0.482</td>
</tr>
<tr>
<td>0.675</td>
</tr>
<tr>
<td>0.524</td>
</tr>
<tr>
<td>0.540</td>
</tr>
</tbody>
</table>
Table 2 reveals the Kaiser-Meyer-Olkin (KMO) values, which are key indicators for evaluating the adequacy of our data across different dimensions such as environmental, economic, and social aspects. These values are crucial as they help us understand how well the data in each specific area is suited for the analysis we intend to perform. For the variable "mao," the KMO value stands at 0.5217. This places it in the moderate adequacy range, suggesting that the data related to this aspect are appropriate for further detailed examination and analysis. The variable "dp" has a KMO value of 0.4819, also indicating moderate adequacy. Despite being on the lower end of the moderate spectrum, it indicates that the data collected for this dimension are still suitable enough for meaningful statistical analysis and interpretation. Moving to the "pm" variable, we see a KMO value of 0.6749, which is comparatively higher and signals a good level of adequacy. This higher value implies that the data for this dimension are quite well-prepared for in-depth investigation and analysis, standing out among the others in terms of suitability. For the "mmt" variable, the KMO value is 0.5237, again falling into the moderate adequacy category. Like "mao," this suggests that the data for "mmt" are reasonably fit for further exploration and analytical work.

Lastly, the overall KMO value for the study is noted as 0.5399, which reflects a moderate level of adequacy across the board. This overarching value underscores that, overall, the dataset is effectively suited for the planned analyses, though some variables may offer more robust foundations for analysis than others. This nuanced view provided by the KMO values helps to steer the research focus towards the most analytically promising areas within the environmental, economic, and social dimensions of the study.

For empirical analysis, the study used a dynamic GMM analysis to examine the impact of the digital financial inclusion index on gross national income per capita in upper-income countries. Furthermore, statistical assessments with a theoretical and conceptual discussion of the results are adopted to respond to the research hypothesis. Alongside the empirical results, the study integrated descriptive statistics of the variables employed.

Table 3. Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNI</td>
<td>Gross National Income per Capita</td>
<td>517</td>
<td>13982.581</td>
<td>4729.21</td>
<td>3956.774</td>
<td>27678.643</td>
</tr>
<tr>
<td>DFII</td>
<td>Digital Financial Inclusion Index (MAO + DP + PM + MMT)</td>
<td>528</td>
<td>.445</td>
<td>.189</td>
<td>-1.038</td>
<td>.712</td>
</tr>
<tr>
<td>BB</td>
<td>Bank Branches per 100,000</td>
<td>528</td>
<td>21.084</td>
<td>6.592</td>
<td>3.274</td>
<td>42.284</td>
</tr>
<tr>
<td>SAV</td>
<td>Gross Saving</td>
<td>528</td>
<td>20.364</td>
<td>9.809</td>
<td>-6.015</td>
<td>49.233</td>
</tr>
<tr>
<td>INF</td>
<td>Inflation</td>
<td>528</td>
<td>113.44</td>
<td>79.156</td>
<td>-4.115</td>
<td>612.355</td>
</tr>
<tr>
<td>ATM</td>
<td>ATM per 100,000</td>
<td>528</td>
<td>52364.246</td>
<td>76782.189</td>
<td>14.928</td>
<td>444602.91</td>
</tr>
</tbody>
</table>

The descriptive analysis in Table 3 presents an overview of key variables pertaining to economic and financial indicators. Gross National Income per Capita (GNI) per Capita demonstrates a mean value of 13,982.581, signifying the average income level per individual, and the standard deviation of 4729.21 indicates a notable degree of variability around this mean, reflecting differing income levels. The Digital Financial Inclusion Index (DFII) exhibits a mean value of 0.445, with a standard deviation of 0.189. Bank branches per 100,000 individuals (BB) display an average of 21.084 branches, with a standard deviation of 6.592. Gross Savings (SAV) presents an average value of 20.364, denoting the percentage of...
GDP saved after accounting for consumption and investment, with a standard deviation of 9.809. Inflation (INF) is represented by a mean value of 113.44, accompanied by a substantial standard deviation of 79.156. The minimum value of -4.115 suggests instances of deflation, while the maximum value of 612.355 indicates periods of significant inflation. ATM per 100,000 individuals demonstrates a mean of 52,364.246, with a standard deviation of 76,782.189.

Table 4. Matrix of correlations

<table>
<thead>
<tr>
<th>Variables</th>
<th>GNI</th>
<th>DFII</th>
<th>BB</th>
<th>SAV</th>
<th>INF</th>
<th>ATM</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNI</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFII</td>
<td>0.269</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>0.211</td>
<td>0.502</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAV</td>
<td>0.010</td>
<td>-0.102</td>
<td>-0.126</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INF</td>
<td>0.020</td>
<td>0.044</td>
<td>0.092</td>
<td>-0.045</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>ATM</td>
<td>0.153</td>
<td>0.013</td>
<td>0.095</td>
<td>-0.246</td>
<td>0.141</td>
<td>1.000</td>
</tr>
</tbody>
</table>

The correlation matrix for variables GNI, DFII, BB, SAV, INF, and ATM is presented in Table 4. GNI demonstrates a positive correlation with DFII 0.269, BB 0.211, and ATM 0.153. DFII exhibits a positive correlation with BB 0.502, indicating a relatively stronger association between digital financial inclusion and the density of bank branches. SAV shows negligible correlations with other variables, suggesting limited direct relationships with GNI, DFII, BB, INF, and ATM. INF presents a weak positive correlation with GNI 0.020, DFII (0.044), BB 0.092, and ATM 0.141, implying subtle relations between inflation and these economic indicators. ATM demonstrates positive correlations with GNI 0.153, BB 0.095, and INF 0.141, though these associations are relatively modest in strength.

Table 5. Regression results of GMM

<table>
<thead>
<tr>
<th>GNI</th>
<th>Coef.</th>
<th>St. Err.</th>
<th>t-value</th>
<th>p-value</th>
<th>[95% Conf Interval]</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>.75</td>
<td>.013</td>
<td>56.29</td>
<td>0</td>
<td>.723 .776</td>
<td>***</td>
</tr>
<tr>
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Table 5 shows the regression results of GMM analysis, where the coefficient for Lag is estimated at 0.75 with a standard error of 0.013. This coefficient exhibits statistical significance at the 0.01 level (***)


positive correlation between digital financial inclusion and economic growth in developing countries is highlighted, emphasizing the role of digital technologies in expanding financial access and promoting entrepreneurship.

The finding of a positively significant impact of bank branches on gross national income per capita (GNI) in upper-income countries highlights the continued relevance of traditional financial infrastructure alongside digital financial inclusion initiatives, and it aligns with the study of Mushtaq & Bruneau (2019). While digital financial services have gained prominence in recent years, particularly in higher-income economies, the presence of physical bank branches remains an important contributor to economic development. In upper-income countries, where financial systems are often more mature and diversified, the positive impact of bank branches on GNI per capita suggests that physical access to banking services continues to play a valuable role in driving economic growth and prosperity. This finding emphasizes the complementary nature of traditional and digital financial infrastructure in supporting inclusive economic development. Factors that may contribute to the positive relationship between bank branches and GNI per capita in upper-income countries are firstly, physical bank branches provide a familiar and trusted environment for individuals and businesses to access financial services, particularly for those who may be less comfortable or familiar with digital technologies. Secondly, bank branches offer personalized assistance and advisory services, catering to the unique needs and preferences of customers, especially in complex financial matters such as investments, mortgages, and wealth management. Thirdly, bank branches facilitate relationship-building between customers and financial institutions, encouraging long-term partnerships and enhancing customer loyalty and retention. Fourthly, while digital channels expand access to financial services, physical bank branches remain important for reaching underserved populations, including rural communities, elderly individuals, and those with limited digital literacy or internet connectivity. Lastly, the presence of bank branches contributes to the overall infrastructure of local economies, supporting business activity, investment, and job creation, thereby driving economic growth and increasing GNI per capita.

The result also shows a positively significant impact of Gross Saving (SAV) on gross national income per capita (GNI) in upper-income countries, which highlights the fundamental role of savings in driving economic prosperity and growth. The finding is parallel with the study of Akinola and Omolade (2013). In such contexts, where income levels tend to be higher and financial systems more developed, the positive relationship between gross savings and GNI per capita reflects the importance of savings accumulation as a driver of economic expansion. The factors that may contribute to the positive impact of Gross Saving on GNI per capita in upper-income countries are investment and capital formation, where Gross Saving represents the portion of income that is not consumed but instead channelled into investment, both domestically and internationally. Further, savings intermediated through financial institutions contribute to the availability of funds for lending and investment, facilitating access to credit for businesses and individuals. This promotes investment in productive activities, innovation, and entrepreneurship, driving economic expansion and increasing GNI per capita. In addition to this, accumulated savings serve as a buffer against economic volatility and uncertainty, enabling individuals and businesses to weather financial downturns and maintain stability in times of crisis. This resilience contributes to the overall robustness of the economy and supports sustained growth in GNI per capita.

The finding of a positively significant impact of inflation on gross national income per capita (GNI) in upper-income countries may seem counterintuitive at first glance, as inflation is typically viewed as a negative force that erodes purchasing power and reduces real income. However, in certain contexts, particularly in upper-income countries with well-developed financial systems and relatively stable economic conditions, the relationship between inflation and GNI per capita may exhibit unique
dynamics. This result aligns with the study of Akça et al. (2012); however, it opposes the findings of Bulíř (2001), where a reduction in inflation significantly lowers income inequality. Several factors could contribute to the observed positive impact of inflation on GNI per capita in upper-income countries: firstly, interest rates and monetary policy. In economies where inflation is relatively low and stable, central banks may use expansionary monetary policies, including lower interest rates, to stimulate economic activity and support growth. Lower interest rates can encourage borrowing, investment, and consumption, which can contribute to increased economic output and a higher GNI per capita. Secondly, wage growth and nominal income; inflation can lead to nominal wage growth, where wages increase to keep pace with rising prices. While this may not necessarily result in higher real income for individuals, it can contribute to higher GNI per capita by boosting aggregate income levels within the economy. Thirdly, asset prices and wealth effects: inflation can lead to increases in asset prices, such as real estate and equities, which can contribute to higher household wealth and consumer spending. This wealth effect can stimulate economic activity and contribute to higher GNI per capita, particularly in economies where asset ownership is widespread. Lastly, debt dynamics: inflation can reduce the real burden of debt as the value of debt decreases in inflation-adjusted terms over time. This can benefit borrowers, including households, businesses, and governments, by reducing debt servicing costs and freeing up resources for other uses, which can contribute to a higher GNI per capita.

The result also shows a positively significant impact of ATMs on gross national income per capita (GNI) in upper-income countries, which suggests that the availability and accessibility of automated teller machines (ATMs) play a role in fostering economic development and increasing income levels. The result is parallel with the study of Okereke et al. (2023). ATMs offer a cost-effective and efficient means of conducting financial transactions, reducing the need for manual processing and paperwork associated with traditional banking channels. The widespread availability of ATMs enables individuals and businesses to access cash and perform banking transactions conveniently and quickly, supporting economic activity and productivity growth. Furthermore, the availability of ATMs can stimulate consumer spending by providing individuals with access to cash for everyday expenses, discretionary purchases, and leisure activities. Increased consumer spending, in turn, drives demand for goods and services, spurring economic activity and contributing to a higher GNI per capita. Additionally, the expansion of ATM networks reflects advancements in technology and innovation within the financial sector, which can have broader effects on economic development and income growth. Investments in ATM infrastructure contribute to the development of digital payment systems, financial technologies, and infrastructure, creating a beneficial environment for innovation, entrepreneurship, and economic expansion.

5. Innovation, Opportunities and Challenges

The insights from the results reveal an interesting picture of how digital and traditional banking, along with how we save and manage money, can really boost a country's economy, especially in places where people generally have more money. Firstly, the study shows us that when countries make it easier for people to use digital banking, like using an app to save money, transfer cash, or pay bills, it actually helps the whole country get richer. It's like when more people can jump on the digital train, the entire economy speeds up. This makes sense because, nowadays, being able to do banking on phone is not just convenient; it is a game-changer for including more people in the economy, especially those who might have been left out before. But here is the interesting part: even though we are all about digital these days, those old-school bank branches you see on the street corners are still super important. They are like the trusted old friends of the banking world. Some people really prefer talking to a human or need specific advice that is best done face-to-face. Furthermore, having a physical bank around can make a whole area feel more "financially healthy," attracting businesses and creating jobs.
Now, onto savings - the study points out that when people in a country save more money, it's good news for the economy. Think of savings as the seeds that can grow into new businesses or bigger homes because when banks lend out these savings, it leads to investments, and these investments make the country's economy stronger and richer.

On the other hand, inflation, which we usually think of as a bad thing because it makes things more expensive, can be helpful in certain situations. If a country's economy is stable and not too crazy with prices going up, a little bit of inflation can encourage people and businesses to spend and invest more, which can also help the economy grow. Lastly, ATMs - those machines where you withdraw cash - are more important than you might think. They are not just convenient; they actually play a role in boosting the economy. When people have easy access to cash, they are likely to spend more, and this spending drives businesses to grow, creating a positive loop that benefits the whole country. But all these good things come with challenges. We have got to make sure everyone can get on board with digital banking, which means bridging the digital divide so that even those without the latest gadgets or internet can still benefit. And while managing inflation and encouraging savings, we've got to keep an eye on making sure the economy stays stable and that the growth benefits everyone, not just a few. Countries need to keep all these balls - digital banking, traditional branches, savings, inflation, and ATMs - in the air to keep their economies growing strong. It's a delicate balance, but when done right, it can lead to more prosperity for everyone.

6. Conclusion and Implications

In conclusion, this study aimed to investigate the impact of the digital financial inclusion index on gross national income per capita in upper-income countries. The analysis revealed several key findings that show the relationship between financial inclusion, traditional banking infrastructure, savings behavior, inflation dynamics, access to automated banking services, and economic development. Firstly, the results demonstrated a positive and significant impact of the digital financial inclusion index on gross national income per capita. This finding emphasizes the importance of promoting inclusive financial systems that enable broader participation in economic activities and facilitate access to financial services for underserved populations. Secondly, the study highlighted the continued relevance of traditional banking infrastructure, such as bank branches, in driving economic growth and prosperity in upper-income countries. The positive impact of bank branches on gross national income per capita underlines the complementary nature of traditional and digital financial infrastructure in supporting inclusive economic development. Furthermore, the analysis revealed a positive and significant impact of gross savings on gross national income per capita, emphasizing the fundamental role of savings in driving economic prosperity and growth. This finding suggests the importance of savings accumulation as a driver of economic expansion, investment, and resilience against economic volatility. Additionally, the study identified a positive and significant impact of inflation on gross national income per capita in upper-income countries, highlighting the unique dynamics of the relationship between inflation and economic performance in these contexts. Lastly, the analysis showed a positive and significant impact of ATM density on gross national income per capita, emphasizing the role of accessible banking services in fostering economic development and increasing income levels.

References


newspaper corpus. World, 13(6), 371-384.
Rodríguez-Palenzuela, D., Camba-Méndez, G., & Garcia, J. A. (2003). Relevant economic issues concerning the optimal rate of inflation. *Available at SSRN 487418*.

