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The Effect of Economic Digitalization and Startup Investment on Informal Sector Employment Absorption in Five Metropolitan Cities of Indonesia (Jakarta, Surabaya, Bandung, Medan, and Makassar) 2020–2024: An Islamic Economic Perspective

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Abstract

The development of digital technology has significantly transformed economic and employment structures in Indonesia, particularly through economic digitalization and the growth of startup ecosystems. This study aims to analyze the effect of economic digitalization and startup investment on informal sector employment absorption in five Indonesian metropolitan cities during 2020–2024. A quantitative approach was applied using secondary data from the Central Statistics Agency (BPS) and the Financial Services Authority (OJK), analyzed with panel data regression in EViews 13. Model selection was conducted using the Chow Test, Hausman Test, and Lagrange Multiplier Test. The results show that economic digitalization and startup investment have a positive and significant impact on informal sector labor absorption, both individually and simultaneously. Digital technology expansion has increased business efficiency, created new job opportunities, and broadened market access for MSMEs. From an Islamic economic perspective, these findings reflect the principles of maslahah, social justice ('adl), and economic inclusivity, emphasizing equitable distribution of economic benefits.

Keywords: Informal Sector Labor Absorption, Economic Digitalization, Startup Investment, Islamic Economics.

A. INTRODUCTION

The global economic transformation in the era of the Industrial Revolution 4.0 has fundamentally changed the paradigm of the world economic system. Economic digitalization has become a disruptive force that drives structural changes in the mechanisms of production, distribution, and consumption of goods and services (Abrar, 2008). This phenomenon has not only reshaped conventional business models but has also created a new economic ecosystem based on digital technology, online platforms, and information and communication technology (ICT) innovation. According to the World Economic Forum (2024), digital technology is projected to create 69 million new jobs while replacing 83 million existing jobs worldwide. The impact of economic digitalization on employment has therefore become a critical issue that requires in-depth study, particularly in developing countries with unique labor market characteristics. From the perspective of Islamic economics, economic transformation must also be

aligned with the principles of welfare (Ansori, 2018), ensuring that technological progress contributes to social justice and equitable prosperity.

Indonesia, as the largest economy in Southeast Asia and home to the world's largest Muslim population, faces both opportunities and challenges in adapting to economic digitalization. Data from the United Nations Development Programme indicate that the informal sector plays a crucial role in Indonesia's economic growth and rural employment structure (UNDP, 2024). The informal sector, dominated by micro, small, and medium enterprises (MSMEs), street vendors, freelancers, and self-employed workers, has a strategic role in job creation and poverty alleviation.

However, it also encounters structural problems such as low productivity, limited access to capital, and vulnerability to economic shocks. Empirical studies show that informal workers, such as street vendors, often make location and business decisions based on accessibility and economic survival considerations (Yulistiani, 2020). Digitalization brings ambivalent impacts to this sector; on the one hand, digital platforms such as e-commerce and fintech provide broader market access and operational efficiency, while on the other hand, automation and technological advancements may create displacement effects for low-skilled workers (Li et al., 2025). Moreover, digital finance has been proven to encourage consumption and economic activity, particularly in developing regions (Li & Yu, 2025).

The rapid growth of Indonesia's startup ecosystem over the past decade has positioned the country as one of the largest digital innovation hubs in Southeast Asia. The increasing flow of venture capital and private equity investment into technology startups has the potential to generate significant multiplier effects on the economy, including job creation. Previous research confirms that the digital economy has a significant impact on employment patterns and workforce structure in Indonesia, creating new flexible job opportunities while simultaneously reshaping labor relations (Lianingsih, Irman, & Nurnisaa, 2025). Nevertheless, the capital-intensive and skill-intensive nature of startups raises questions regarding their contribution to informal sector employment, which is largely characterized by low education and limited digital skills. Furthermore, ICT development has been found to moderate the relationship between informality and aggregate labor productivity growth (Erumban, 2024). The dynamics of digitalization and startup investment also vary significantly across major metropolitan cities such as Jakarta, Surabaya, Bandung, Medan, and Makassar, which have different levels of digital infrastructure, startup ecosystem maturity, and informal labor market structures. These regional variations make the relationship between economic digitalization, startup investment, and informal sector labor absorption an important subject for further empirical investigation.

Table 1. E-Commerce Transaction Value in Five Metropolitan Cities of Indonesia, 2020–2024

No	City	2020 (Rp T)	2021 (Rp T)	2022 (Rp T)	2023 (Rp T)	2024 (Rp T)
1	Jakarta	79,89	31,96	21,30	38,96	17,99
2	Surabaya	20,33	31,96	32,09	16,04	12,03
3	Bandung	42,89	48,13	38,10	19,05	14,29
4	Medan	36,14	54,45	36,30	18,15	13,61
5	Makassar	46,10	58,44	38,96	19,48	14,61

Source: Statistics Indonesia, 2020–2024 (Data Processed by the Author)

The data in Table 1 show high volatility in e-commerce transaction values across the five metropolitan cities. The surge in e-commerce transactions during the pandemic period was mainly driven by mobility restrictions, shifts in consumer behavior toward online shopping, and digitalization stimulus. Meanwhile, the sharp decline in transaction values during the 2020–2024 period indicates market consolidation and normalization following the transaction boom in the early phase of the COVID-19 pandemic. Jakarta, as the capital city and national economic center, experienced a decrease in e-commerce transaction value from IDR 79.89 trillion in 2020 to IDR 17.99 trillion in 2024.

A similar pattern also occurred in Surabaya, Bandung, Medan, and Makassar, all of which recorded significant declines in e-commerce transaction values. Startup investment as a driving force of the digital economic ecosystem also demonstrates varying dynamics in the five metropolitan cities, as shown in Table 1.2.

Table 2. Startup Investment Values in Five Metropolitan Cities of Indonesia, 2020–2024

No	City	2020	2021	2022	2023	2024
1	Jakarta	USD 2.3 million	USD 4.8 million	USD 2.9 billion	USD 2.1 billion	USD 1.7 billion
2	Surabaya	USD 136 million	USD 276 million	USD 168 million	USD 120 million	USD 100 million
3	Bandung	USD 102 million	USD 207 million	USD 126 million	USD 90 million	USD 75 million
4	Medan	USD 51 million	USD 103 million	USD 63 million	USD 45 million	USD 38 million
5	Makassar	USD 10.2 million	USD 20.7 million	USD 12.6 million	USD 9 million	USD 7.5 million

Source: Indonesia Financial Services Authority (OJK), 2020–2024 (Data Processed by the Author)

Startup investment data indicate that Jakarta dominates with significantly higher investment values than other cities, peaking at USD 4.8 billion in 2021 before declining to USD 1.7 billion in 2024. The overall decrease in startup investment across metropolitan cities during 2021–2024 reflects market correction following the pandemic-driven technology investment boom, as well as the impact of global economic uncertainty and rising interest rates. Surabaya, Bandung, Medan, and Makassar exhibit similar patterns with much lower investment values, indicating that the startup ecosystem remains highly concentrated in Jakarta. Meanwhile, informal sector employment absorption in the five metropolitan cities shows a relatively stable trend with variations among cities, as presented in Table 1.3.

Table 3. Number of Informal Sector Workers in Five Metropolitan Cities of Indonesia, 2020–2024

No	Kota	2020	2021	2022	2023	2024
1	Jakarta	2.1 million	2.14 million	2 million	2.1 million	2.1 million
2	Surabaya	880 thousand	910 thousand	890 thousand	860 thousand	845 thousand
3	Bandung	970 thousand	1 million	980 thousand	950 thousand	930 thousand
4	Medan	760 thousand	780 thousand	770 thousand	745 thousand	730 thousand
5	Makassar	410 thousand	425 thousand	420 thousand	405 thousand	396 thousand

Source: Central Statistics Agency, 2020–2024

The data on informal sector employment indicate that Jakarta consistently has the largest number of informal workers, averaging around 2.1 million people during the 2020–2024 period. This stability reflects the relatively strong capacity of the informal sector to absorb labor despite fluctuations in e-commerce transaction values and startup investment. In contrast, Surabaya, Bandung, Medan, and Makassar experienced a gradual decline in informal employment during the same period. This trend may suggest an ongoing process of economic formalization, where workers begin to shift from traditional informal activities toward more structured and formal economic sectors. However, this decline also requires further examination to determine whether it is primarily driven by the displacement effect of digitalization or by positive structural transformation within the labor market.

The development of Indonesia's digital economy between 2020 and 2024 demonstrates a complex and dynamic pattern. During the early phase of the COVID-19 pandemic, digital economic activities increased sharply, marked by the rapid growth of e-commerce transactions, the expansion of digital payment systems, and a surge in startup investment. This situation encouraged many workers who lost formal employment to enter digitally-based informal jobs such as online sellers, delivery couriers, and gig-economy service providers. The expansion of digital platforms during the pandemic played a significant role in sustaining MSME income and enabling business continuity through online market

access (Nasution & Febriaty, 2022). However, entering the 2021–2023 period, e-commerce transaction values began to decline as market conditions normalized. At the same time, the number of informal workers gradually decreased, indicating that digitalization was beginning to reshape labor market structures and encourage greater efficiency and productivity within the economy.

By 2024, Indonesia's digital economy had reached a more mature stage. The decline in e-commerce transaction values no longer reflected a weakening of digital economic activity, but rather a process of consolidation and market adjustment following the extraordinary growth experienced during the pandemic. Alongside this process, informal sector employment continued to decrease across most metropolitan cities, signaling an important structural shift in which digitalization contributed to the gradual transition of workers from informal to more formal and productive sectors. The contextualization of digital platforms within the informal economy further explains how technology adoption influences labor dynamics and employment structures (Budiman & Giri, 2025). This phenomenon is consistent with the theory of structural transformation, which explains that technological progress and productivity growth tend to drive labor mobility from traditional sectors to modern economic activities over time. Empirical studies in Indonesia also confirm that various economic factors, including investment and government spending, significantly affect labor absorption in the informal sector (Jamaluddin, 2023; Suhada & Ridwan, 2024).

The five metropolitan cities examined in this study—Jakarta, Surabaya, Bandung, Medan, and Makassar—exhibit distinct characteristics in terms of digital infrastructure, economic structure, and labor market conditions. Jakarta serves as the primary hub of Indonesia's digital economy with the most advanced infrastructure, the largest startup ecosystem, and the highest concentration of venture capital investment. Surabaya benefits from a strong MSME base and active smart city initiatives that support digital transformation. Bandung is recognized as a creative and innovation-driven city with a large pool of educated talent, as reflected in efforts to strengthen digital creative ecosystems through collaborative innovation approaches (Novani et al., 2022). Meanwhile, Medan and Makassar still face challenges related to limited digital infrastructure, lower levels of digital literacy, and slower adoption of technology, although Makassar has begun to implement digital transformation strategies within its public services to support smart city development (Maldun et al., 2024). These regional differences lead to varying impacts of digitalization on informal sector employment across cities.

From the perspective of Islamic economics, digital economic transformation must be directed toward achieving social justice, equitable distribution of welfare, and the realization of maslahah (public benefit). Digitalization should not merely increase economic output but must also create decent employment opportunities, reduce inequality, and protect vulnerable workers in the informal sector. Islamic ethical principles emphasize that modern market development must be guided by fairness, responsibility, and inclusivity (Sikki et al., 2025). Furthermore, the convergence between maqasid al-shariah and sustainable development goals provides a normative framework to ensure that technological advancement contributes to holistic human welfare (Kasri, Bouheraoua, & Radzi, 2023). Previous studies also highlight that Islamic financial development can positively influence economic growth and productivity, which are essential components in supporting inclusive digital transformation (Rofik et al., 2025). This research is therefore highly relevant, as it empirically analyzes the influence of economic digitalization and startup investment on informal sector labor absorption in five Indonesian metropolitan cities during 2020–2024. The findings are further examined through the framework of maqasid al-shariah to provide normative and ethical evaluations, as well as constructive policy recommendations aimed at ensuring that Indonesia's digital transformation process remains inclusive, sustainable, and aligned with Islamic economic principles.

B. LITERATURE REVIEW

Endogenous Growth Theory

Endogenous Growth Theory emerged in the 1980s as a critique of the neoclassical Solow-Swan growth model, which was considered inadequate in explaining the sources of long-term economic growth. In the neoclassical model, economic growth is assumed to occur only through external factors,

particularly technology that is treated as an exogenous variable. This limitation led to the development of new ideas by Paul Romer (1986, 1990) and Robert Lucas (1988), who argued that economic growth can be explained endogenously through internal economic mechanisms such as investment in knowledge, technological innovation, and human capital development.[1]

This theory identifies that the main determinants of economic growth originate from within the economic system itself. Capital is understood in a broader sense, including not only physical capital but also human capital. According to Romer, the assumption of increasing returns to scale in capital investment is more realistic due to the mechanism of learning by doing in human resources. Through investment and specialization in human resources and knowledge, individuals are able to develop new methods of production that generate economic benefits. In the endogenous growth model, technology plays an important role, but it is not the sole determinant of long-term growth. Romer emphasizes that knowledge and human capital are also crucial elements for sustainable development.[3]

In the context of digitalization, Romer's perspective explains that digital transformation enables MSMEs and informal workers to increase productivity, expand market access, and create new income sources. Meanwhile, Lucas highlights that startup investment brings new training, skills, and work patterns that enhance labor quality and generate positive externalities for the informal sector. Thus, digitalization and startup investment function as endogenous factors that drive economic growth and job creation while helping informal workers improve their economic status through human capital development.

Digital Economy Theory

Digital Transformation Theory is a conceptual framework that explains how digital technology is not merely used to accelerate and optimize existing processes, but also to fundamentally change business models, organizational structures, and economic interactions. Digital transformation is not only about converting physical processes into digital form, but rather a comprehensive transformation that affects how organizations operate and create value.

According to Westerman, Bonnet, and McAfee (2014) in their book Leading Digital, digital transformation requires the integration of technologies such as big data, cloud computing, artificial intelligence, IoT, and blockchain, accompanied by changes in business processes and strategies to remain competitive in an increasingly digital era.

This theory highlights three main pillars of digital transformation:

a. Customer Experience – how digital technology enhances interaction and value for customers;
b. Operational Processes – how digital tools improve efficiency and automation; and
c. Business Models – how digital innovation enables the creation of new business models that were previously impossible.

This theoretical perspective is highly relevant to the Indonesian context, where digital companies such as Gojek, Tokopedia, and sharia-based fintech platforms demonstrate how digital adoption transforms not only corporate operations but also the broader economic landscape.

Digitalization and Technology in Islamic Economics

Islam views technology as a blessing from Allah that must be utilized for the benefit of humanity. The principle of istikhlaf teaches that humans are entrusted with intellect and capability to develop technology for improving quality of life. Digitalization supports the dissemination of knowledge and facilitates access to education and beneficial information. The development of digital technology has brought significant impacts on the growth of Islamic economics, particularly in sectors such as sharia fintech, halal e-commerce, and Islamic crowdfunding platforms. Digitalization enables faster, more efficient, and more accessible sharia-based transactions.

This is in line with the Qur'anic principle stated in Surah Al-Baqarah verse 185:

يُرِيدُ اللَّهُ بِكُمُ الْيُسْرَ وَلَا يُرِيدُ بِكُمُ الْعُسْرَ

This verse emphasizes that Islamic teachings aim to provide convenience and benefit for humankind. In the modern era, this value of ease (yusr) is reflected in the use of digital technology in Islamic finance and economics, such as digital zakat, waqf platforms, and halal blockchain systems.

However, the use of digital technology must comply with sharia principles. Technology must not be used for prohibited activities such as riba, gambling, or fraud. Digital platforms are required to ensure

transparency, fairness, and consumer protection in accordance with Islamic ethical standards. Islam encourages technological innovation that increases efficiency and productivity, but such development must consider social impacts and avoid creating harmful inequalities. The principle of la dharar wa la dhirar emphasizes that technology should not cause greater harm than benefit.

Keynesian Employment Theory

Keynesian employment theory emerged from John Maynard Keynes' critique of classical economic theory following the Great Depression (1929–1939). In his book The General Theory of Employment, Interest, and Money (1936), Keynes argued that employment levels are primarily determined by aggregate demand, and that investment plays a crucial role in stimulating production and absorbing labor.

According to Keynes, investment not only increases productive capacity but also creates new demand through the multiplier effect. Economic growth and employment opportunities can be achieved if there is sufficient investment to expand business activities. Therefore, investment is a key driver in job creation as it aligns production capacity with market demand.

In the context of startup investment, this theory is highly relevant to explain how investment in digital startups in Indonesian metropolitan cities contributes to labor absorption, including in the informal sector. Employment opportunities are created both directly—through recruitment by startups—and indirectly—through informal workers involved in digital supply chains and supporting services.

Dual Sector Development Theory (Economic Dualism)

The Dual Sector Development Theory was first introduced by W. Arthur Lewis in his article entitled "Economic Development with Unlimited Supplies of Labour" in 1954. In this work, Lewis explained that the economies of developing countries generally consist of two main sectors. The first is the traditional sector, usually in the form of agriculture or the informal sector, which is characterized by low productivity, surplus labor, and very low wages. The second is the modern sector, namely the industrial or urban sector, which has higher productivity, significant investment, and capital accumulation.

According to Lewis, economic growth occurs when surplus labor in the traditional sector gradually moves to the modern sector. This process allows the modern sector to grow rapidly due to continuous capital accumulation, while the traditional sector begins to operate with more efficient labor utilization. The core idea of this theory is that industrialization and investment in the modern sector will absorb excess labor from the traditional sector, leading to structural transformation in the economy.

Initially, when labor migrates from rural to urban areas, production in the traditional sector does not decline because labor supply is still abundant. However, after reaching a certain point, surplus labor begins to diminish, and wages in the modern sector start to rise.

Islamic Economics

Islamic Economics is built upon Islamic teachings, as economic activities are an inseparable part of Islamic religious principles. As a derivation of Islamic values, all economic aspects must follow sharia regulations in their implementation. Islam provides a comprehensive system of life guidance through the Qur'an and Hadith, offering complete rules for human welfare and socio-economic justice.

In the digital era, Islamic economics is not merely understood as production and exchange activities based on technology, but as an instrument to realize comprehensive human welfare (maslahah). The concept of Maqasid al-Shariah in Islamic economics aims to achieve goodness while preventing harm, often expressed in the principle dar'u al-mafasid wa jalb al-masalih (preventing harm and obtaining benefits). The essence of Maqasid al-Shariah is the realization of maslahah for all mankind.

Maqasid al-Shariah refers to the objectives and wisdom behind the establishment of sharia, which ultimately aim to bring benefits and welfare to humanity. Therefore, maslahah is the manifestation of Maqasid al-Shariah, ensuring that all economic activities are aligned with ethical and moral values prescribed by Islam.

Maslahah Theory

From an etymological perspective, the word maslahah is derived from the Arabic root word saluha, which means goodness, benefit, and appropriateness. Linguistically, maslahah refers to anything that brings goodness, usefulness, and advantage to human life. Terminologically, maslahah means

benefit, welfare, and goodness. Al-Buthi, in his book Dawabit al-Maslahah fi asy-Syari'ah al-Islamiyyah, defines maslahah as anything that brings benefit and happiness or prevents harm and evil. According to him, this benefit is in accordance with human nature (fitrah), as every human being naturally seeks goodness and avoids harm.

Thus, in Islamic economic thought, maslahah serves as the fundamental basis for evaluating whether an economic activity is permissible and beneficial. All economic policies and technological innovations, including digitalization, must be directed toward achieving public welfare while preventing harm and injustice.

Hypothesis

The Effect of E-commerce Transactions on Informal Sector Labor Absorption

Endogenous Growth Theory explains that economic digitalization contributes to job creation by promoting innovation, technology adoption, and human capital development. Digital platforms such as e-commerce, digital payments, and gig-economy applications reduce market barriers, expand business opportunities, and create new forms of employment. Digital Economy Theory further emphasizes that digital technology transforms economic interactions by integrating data, networks, and online platforms into production processes.

Empirical studies indicate that digitalization has significantly improved access to markets and services for informal workers, enabling greater economic participation and labor absorption. Therefore, it is assumed that higher levels of e-commerce transactions positively influence informal sector employment.

H1: E-commerce transactions have a positive and significant effect on labor absorption in the informal sector in five metropolitan cities in Indonesia

The Effect of Startup Investment on Informal Sector Labor Absorption

Endogenous Growth Theory states that investment in innovative sectors stimulates economic expansion and employment creation through technological development and productivity improvement. Startup investment, particularly in digital-based businesses, generates new business models and economic ecosystems that provide job opportunities, including for informal workers. Keynesian theory also supports this argument by explaining that investment increases aggregate demand through a multiplier effect, which in turn expands employment opportunities. Previous research has shown that investment growth, especially in MSMEs and startups, significantly contributes to labor absorption.

H2: Startup investment has a positive and significant effect on labor absorption in the informal sector in five metropolitan cities in Indonesia.

The Simultaneous Effect of E-commerce Transactions and Startup Investment on Informal Sector Labor Absorption

Digitalization and startup investment function synergistically in developing an inclusive digital economic ecosystem. E-commerce transactions expand market access, while startup investment strengthens digital infrastructure and innovation. Together, these factors enhance productivity, create new employment opportunities, and support the transformation of informal economic activities.

H3: E-commerce transactions and startup investment simultaneously have a positive and significant effect on labor absorption in the informal sector in five metropolitan cities in Indonesia.

C. RESEARCH METHOD

This study employs a quantitative method with an explanatory approach aimed at explaining the causal relationships among research variables. The quantitative approach was selected because it allows for objective measurement of the influence of economic digitalization and startup investment on informal sector labor absorption through structured statistical analysis. The research adopts a positivist paradigm that emphasizes hypothesis testing based on valid and reliable empirical data. In addition, the study integrates an Islamic economic perspective through the maqashid sharia framework as the basis for interpretation, so that the research findings are not only analyzed econometrically but also examined

in accordance with the values of justice, public welfare, and economic sustainability. The research design is longitudinal, utilizing panel data from the period 2020–2024 to capture dynamic changes in variables over time.

The research location focuses on five metropolitan cities in Indonesia, namely Jakarta, Surabaya, Bandung, Medan, and Makassar. The selection of these locations is based on their characteristics as national economic centers, major hubs of digitalization, and rapidly developing startup ecosystems. These cities exhibit high levels of digital technology penetration, significant concentrations of startup investment, and large and diverse informal sectors. The research period covers the years 2020–2024, which were chosen because they represent an era of accelerated digital transformation, particularly due to the impact of the COVID-19 pandemic that shifted economic activities toward digital platforms. This time frame is considered relevant for analyzing how economic digitalization and startup investment affect the dynamics of informal sector employment in the context of Indonesia's digital economy in the new normal era.

The population of this study consists of all macroeconomic data related to economic digitalization, startup investment, and informal sector labor absorption in five metropolitan cities in Indonesia during the period 2020–2024. The research data are obtained from official institutions such as the Central Statistics Agency (BPS) and the Financial Services Authority (OJK), which provide longitudinal data measured annually. The research sample comprises panel data from five cities over five years, resulting in 25 observation units. This sample size is considered adequate for panel data regression analysis, taking into account data availability and geographical representativeness. Each observation unit includes variables of economic digitalization, startup investment, and informal sector labor absorption that are measured consistently and comparably across cities and time periods, enabling a valid, reliable, and comprehensive analysis.

D. RESULTS AND DISCUSSION

Panel Data Regression Model

The first test conducted was the Common Effect Model (CEM). The CEM assumes that there are no differences in effects across sectors or time periods, so the model applies a single equation for all observations. The estimation technique used in the Common Effect Model is Ordinary Least Squares (OLS).

The following are the estimation results of the Common Effect Model in the panel data regression analysis:

Table. 4 CEM Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.218952	0.160834	-7.578939	0.0000
TE	**-0.078019**	0.046823	-1.666264	**0.1098**
IDS	**0.282827**	0.013197	21.43138	**0.0000**

Source: Output Eviews 13, 2025

The E-commerce Transaction variable (X1) obtained a coefficient value of -0.078019 with a probability value of 0.1098 > 0.05. Therefore, it can be concluded that the e-commerce transaction variable (X1) has a negative and statistically insignificant effect on informal sector employment in the five metropolitan cities of Indonesia.

Furthermore, the Startup Investment variable (X2) obtained a coefficient value of 0.282827 with a probability value of 0.0000 < 0.05. This indicates that the startup investment variable (X2) has a positive and statistically significant effect on informal sector employment in the five metropolitan cities of Indonesia.

Table. 5 FEM Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.336104	0.036033	-9.327651	0.0000
TE	**0.028767**	0.007439	3.867103	**0.0011**
IDS	**0.025054**	0.009492	2.639630	**0.0166**

Source: Output Eviews 13, 2025

The results of panel data regression using the Fixed Effect Model test show a constant value of -0.336104. This value means that if all independent variables (e-commerce transactions and startup investment funds) are equal to zero, assumed to be constant, or do not experience any change, the absorption of labor in the informal sector would be -0.336104.

The panel data regression results using the Fixed Effect Model also indicate that the e-commerce transaction variable (X1) obtained a coefficient value of 0.028767 with a probability value of 0.0011 < 0.05. Therefore, it can be concluded that the e-commerce transaction variable (X1) has a positive and statistically significant effect on informal sector labor absorption in the five metropolitan cities of Indonesia.

Furthermore, the startup investment variable (X2) obtained a coefficient value of 0.025054 with a probability value of 0.0166 < 0.05. This indicates that the startup investment variable (X2) has a positive and statistically significant effect on informal sector labor absorption in the five metropolitan cities of Indonesia.

Table. 6 REM Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.418750	0.061784	-6.777689	0.0000
TE	**0.016300**	0.007298	2.233398	**0.0360**
IDS	**0.050900**	0.009017	5.644749	**0.0000**

Source: Output Eviews 13, 2025

The panel data regression results using the Random Effect Model show a constant value of -0.418750, indicating that if all independent variables are assumed to be zero or constant, informal sector labor absorption would be -0.418750. This value represents the baseline condition of the dependent variable without the influence of e-commerce transactions and startup investment.

The regression results further indicate that the e-commerce transaction variable (X1) has a coefficient of 0.016300 with a probability value of 0.0360 < 0.05, meaning it has a positive and significant effect on informal sector labor absorption. Likewise, the startup investment variable (X2) obtains a coefficient of 0.050900 with a probability value of 0.0000 < 0.05, confirming a positive and significant influence on informal sector employment in the five metropolitan cities of Indonesia.

Tabel. 7 Chow Result

Effects Test	Statistic	d.f.	Prob.
Cross-section F	377.675418	(4,18)	0.0000
Cross-section Chi-square	111.045058	4	0.0000

Source: Output Eviews 13, 2025

Based on the results of the Chow test, the probability value of Cross F is 0.0000 and the Chi-square value is 0.0000. These results indicate that the probability value is less than 0.05, meaning that

H_0 is rejected and H_1 is accepted. This implies that the Fixed Effect Model is more appropriate than the Common Effect Model.

Tabel. 8 Hausman Result

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	76.457814	2	0.0000

Source: Output Eviews 13, diolah 2025

Based on the results of the Hausman test, the probability value obtained is 0.0000. This means that the probability value is less than 0.05, indicating that H_0 is rejected, which implies that the Fixed Effect Model is more appropriate than the Random Effect Model.

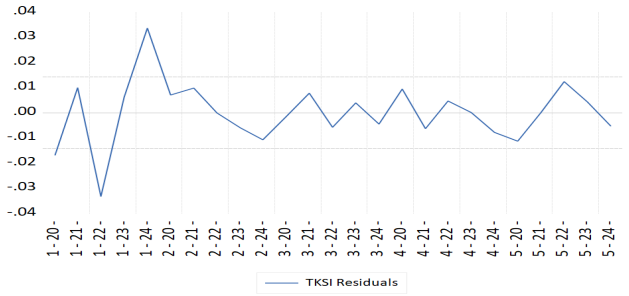
Table. 9 Multikolinearity Test

	TE	IDS
TE	1.000000	0.158440
IDS	0.158440	1.000000

Surce: Output Eviews 13, 2025

The table above shows that the correlation between TE (X1) and IDS (X2) is 0.158 < 0.80; therefore, it can be concluded that each variable passes the multicollinearity test.

Figure. 1 Heteroskedasticity Test Results (Residual Graph)



Source: Output Eviews 13, 2025

From the residual graph, it can be seen that the values do not exceed the limits (500 and -500), which means that the residual variance is constant. Therefore, there is no indication of heteroskedasticity, or in other words, the data pass the heteroskedasticity test.

Tabel. 10 Regretion Data Panel

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.336104	0.036033	-9.327651	0.0000
TE	0.028767	0.007439	3.867103	0.0011
IDS	0.025054	0.009492	2.639630	0.0166

Source: Output Eviews 13, 2025

From the results of the data processing above, the Fixed Effect Model regression equation is obtained as follows: Yit = -0.3361 + 0.0288TE + 0.0251IDS

a. The constant value of -0.3361 indicates that if the TE and IDS variables are equal to zero, the value of the dependent variable Y is estimated to be -0.3361. This means that without the presence of the TE (X1) and IDS (X2) variables, the TKSI (Y) variable would experience a change of -0.3361.
b. The coefficient value of the TE variable (X1) is 0.0288. If other variables are held constant and variable X1 increases by one unit, then variable Y will increase by 0.0288.
c. The coefficient value of the IDS variable (X2) is 0.0251, which is positive, indicating a positive relationship between X2 and Y. If other variables are held constant and variable X2 increases by one unit, then variable Y will increase by 0.0251.

Table. 11 T Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.336104	0.036033	-9.327651	0.0000
TE	0.028767	0.007439	3.867103	0.0011
IDS	0.025054	0.009492	2.639630	0.0166

Source: Output Eviews 13, 2025

Based on the data above, it can be explained that the t-test results for the TE variable (X1) show a coefficient value of 0.028 with a probability value of 0.001 < 0.05; therefore, H_0 is rejected, meaning that variable X1 partially has a positive and significant effect on informal sector labor absorption (Y). In other words, every one-unit increase in X1 will increase the value of Y, assuming other variables remain constant. Furthermore, the t-test results for the IDS variable (X2) indicate a coefficient value of 0.025 with a probability value of 0.0166 < 0.05; thus, H_0 is also rejected, which means that variable X2 partially has a positive and significant effect on informal sector labor absorption (Y).

Table. 12 F-Statistik Test

F-statistic	**5606.540**
Prob(F-statistic)	**0.000000**

Source: Output Eviews 13, 2025

Based on Table 4.8 above, it can be explained that the calculated F value is 5606.540 > F table value of 2.074, and the probability value (F-statistic) is 0.00 < 0.05, so H_0 is rejected. This indicates that simultaneously all independent variables, TE (X1) and IDS (X2), have a significant effect on the dependent variable TKSI (Y).

Table. 10 R^2 Test

R-squared	0.999465
Adjusted R-squared	**0.999287**

Source: Output Eviews 13, 2025

The adjusted R-square value is 0.999287 or 99.9287%. This coefficient of determination indicates that the independent variables TE (X1) and IDS (X2) are able to explain the dependent variable TKSI (Y) in five metropolitan cities in Indonesia by 99.9287%, while the remaining 0.0713% (100% minus the adjusted R-square value) is explained by other variables that are not included in this study.

Discussion

The Effect of E-Commerce Transactions on Informal Sector Employment Absorption in Five Metropolitan Cities in Indonesia, 2020–2024

Based on the results of panel data regression analysis conducted using Eviews 13, the e-commerce transaction variable shows a positive coefficient of 0.028767. This indicates that an increase in e-commerce transactions by one unit will increase employment absorption in the informal sector by 0.028767 units. The probability value obtained is 0.0011, which is smaller than the significance level of 0.05, meaning that the effect is statistically significant. This confirms that the influence of e-commerce transactions on informal sector employment absorption is real and not coincidental. Therefore, it can be concluded that e-commerce transactions have a positive and significant effect on informal sector employment absorption in five metropolitan cities in Indonesia during the period 2020–2024. This finding supports the hypothesis that increased e-commerce activities contribute positively to economic dynamics, particularly in creating informal job opportunities.

Theoretically, these findings are in line with the Endogenous Growth Theory introduced by Paul Romer (1990) and Robert Lucas (1988). According to this theory, economic growth is not only determined by external factors such as physical capital accumulation but also by internal factors such as technological innovation, knowledge development, and productivity improvement. E-commerce activities represent a concrete manifestation of technological innovation that enhances economic efficiency, expands market reach, and increases productivity in the informal sector. The use of digital platforms allows small businesses and informal workers to access wider markets, reduce transaction costs, and create new economic opportunities.

Furthermore, according to Digital Economy Theory proposed by Don Tapscott (1995), digitalization enables higher efficiency in production and distribution processes through the utilization of digital platforms such as e-commerce. This transformation opens broader economic opportunities for small businesses and informal workers. In addition, based on the Digital Transformation Theory by Westerman, Bonnet, and McAfee (2014), the rapid development of digital technology forces economic actors to adapt to new ways of working and trading. The increase in e-commerce transactions reflects the digital transformation occurring within the informal sector, where many workers shift from traditional economic activities to digital-based jobs. This phenomenon became especially evident during the COVID-19 pandemic, when many formal workers transitioned into informal digital jobs such as online sellers and delivery couriers. These findings are also consistent with research by Suryo Adi Rakhmawan (2022), which concluded that digitalization significantly accelerates the formalization and development of informal labor.

The Effect of Startup Investment on Informal Sector Employment Absorption in Five Metropolitan Cities in Indonesia, 2020–2024

The results of panel data regression analysis show that the startup investment variable has a positive coefficient of 0.025054. This means that an increase in startup investment by one unit will increase informal sector employment absorption by 0.025054 units. The probability value of 0.0166 is smaller than 0.05, indicating that the effect is statistically significant. Additionally, the regression results reveal that a 1% increase in startup investment will raise informal sector employment absorption by approximately 2.5054%. These findings confirm that startup investment plays an important role in expanding employment opportunities, particularly in the informal sector.

From the perspective of Endogenous Growth Theory by Romer (1990) and Lucas (1988), startup investment functions as an internal driver of economic growth. Startups are closely related to innovation, digital technology, and new business model development, all of which contribute to economic expansion and job creation. Investment in startups can be considered as investment in intellectual capital and entrepreneurship, which ultimately increases productivity and generates new employment opportunities. This is particularly relevant in urban informal sectors, where many micro and small businesses rely on digital platforms created by startups to sustain and expand their operations.

In addition, according to Keynesian Economic Theory by John Maynard Keynes (1929–1939), startup investment acts as an economic stimulus that drives productive activities across various sectors, including the informal sector. Increased investment in digital startups not only creates direct job opportunities but also generates indirect demand for supporting goods and services, leading to a multiplier effect in the economy. The surge in startup investment during 2021 was largely driven by

rapid digitalization during the COVID-19 pandemic, when economic activities shifted massively to online platforms. This finding is consistent with research by Abdul Haris Romdhoni (2017), which concluded that higher investment significantly increases labor absorption.

The Simultaneous Effect of E-Commerce Transactions and Startup Investment on Informal Sector Employment Absorption

The F-test results indicate that the independent variables—e-commerce transactions (X1) and startup investment (X2)—simultaneously have a significant effect on informal sector employment absorption (Y). This is evidenced by an F-statistic value of 5606.540 with a probability value of 0.000000, which is far below the significance level of 0.05. These results confirm that both variables together contribute significantly to the absorption of informal sector labor in five metropolitan cities in Indonesia during 2020–2024.

This finding is strongly supported by Endogenous Growth Theory, which emphasizes the role of innovation and technology in driving economic development. E-commerce transactions enable informal sector actors to expand their market access, reduce operational costs, and increase efficiency through digital platforms. Meanwhile, startup investment encourages the development of new technologies and digital ecosystems that create new forms of employment and economic activities. The interaction between these two variables forms a cycle of digital economic growth that continuously stimulates labor demand in the informal sector.

The synergy between e-commerce growth and startup investment demonstrates that digital transformation has become a crucial factor in modern labor market dynamics. As digital activities increase, informal workers gain more opportunities to participate in the digital economy, either as online entrepreneurs, digital service providers, or gig-economy workers. This confirms that digitalization and investment in technology-based businesses are key drivers of inclusive employment growth in urban areas.

Digitalization, Startup Investment, and Informal Sector Employment from the Perspective of Islamic Economics

In Islamic economics, digital economic activities are not only evaluated from the perspective of efficiency and profit but also from the perspective of maqasid sharia, which emphasizes the realization of public welfare (maslahah). The main objective of Islamic economics is to achieve benefit and prevent harm (dar'u al-mafasid wa jalb al-masalih). According to Imam al-Shatibi, maslahah is classified into three levels: daruriyyah (essential needs), hajiyyah (complementary needs), and tahsiniyyah (enhancement needs). Digitalization and startup investment can be assessed through these three dimensions in relation to informal sector employment.

At the level of maslahah daruriyyah, digitalization contributes to the protection of wealth (hifz al-mal) and economic stability. Sharia-compliant startups and fintech platforms must avoid riba, gharar, and fraud to ensure fairness and justice in economic transactions. Meanwhile, at the level of maslahah hajiyyah, digital platforms help reduce structural barriers faced by informal workers and micro-entrepreneurs. Access to sharia-based financing, e-commerce platforms, and digital payment systems enables small businesses to grow, improve productivity, and create new employment opportunities.

At the level of maslahah tahsiniyyah, Islamic digital economy promotes ethical business practices, transparency, and social responsibility. The integration of Islamic values into digital economic activities helps create a more just and dignified working environment for informal workers. As stated in the Qur'an Surah Al-Baqarah verse 195, Muslims are encouraged to contribute to social welfare and avoid actions that lead to harm. Therefore, from an Islamic economic perspective, digitalization and startup investment should not only aim at economic growth but also at achieving holistic welfare that includes material, social, and spiritual dimensions. Islamic-based digital economy has the potential to become a key pillar of sustainable and inclusive development that benefits society as a whole.

E. CONCLUSION

Based on the results of panel data regression analysis using the Fixed Effect Model (FEM) on five metropolitan cities in Indonesia during the period 2020–2024, several important conclusions can be drawn. First, e-commerce transactions (X1) have a positive and significant effect on informal sector employment absorption. This indicates that the growth of e-commerce activities contributes directly to

the expansion of job opportunities in the informal sector. The development of digital transactions enables informal business actors to access broader markets, information, and technology, which ultimately increases productivity and income. Second, startup investment (X2) also shows a positive and significant influence on informal sector employment absorption. This finding confirms that increased investment in startups plays an important role in stimulating urban economic dynamics and expanding employment opportunities, particularly within the informal sector, which remains a crucial component of the national economy.

Furthermore, the simultaneous analysis reveals that both e-commerce transactions and startup investment jointly have a significant impact on informal sector employment absorption. The coefficient of determination (R^2) of 0.998068 indicates that approximately 99.8068% of the variation in informal sector employment absorption can be explained by these two independent variables, while the remaining 0.1932% is influenced by other factors outside this study. From the perspective of Islamic economics, digital economic development is expected to contribute to the realization of comprehensive maslahah in accordance with the principles of Maqasid al-Shariah. Economic digitalization supports maslahah daruriyyah through the protection of wealth and economic stability, maslahah hajiyyah by facilitating access to sharia-based financing, digital markets, and informal employment opportunities, and maslahah tahsiniyyah through the enhancement of business ethics, transparency, and social responsibility. This is in line with the values emphasized in Qur'an Surah Al-Baqarah verse 195. Therefore, a digital economy grounded in Islamic values can serve as an essential instrument for achieving sustainable, ethical, and inclusive economic development that promotes social welfare.

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