The relationship between economic growth and e-commerce at the beginning of covid-19 pandemic in east Java

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CHRONICLE	ABSTRACT
	The purpose of this study is to analyse the simultaneous spatial relationship between economic growth and e-commerce as well as the spillover effect between the two variables in East Java at the beginning of the Covid-19 pandemic in 2020. To answer the research objectives, spatial simultaneous modeling is used with the Spatial Autoregressive Generalized Spatial Three Model. Stage Least Square (SAR-GS3SLS) using rook contiguity. Based on the results of the SAR-GS3SLS, it can be concluded that at the beginning of the Covid-19 pandemic in 2020 in East Java, economic growth and e-commerce were simultaneously spatially interconnected. Variables that affect East Java's economic growth are e-commerce activities, the number of villages that have Base Transceiver Stations (BTS) and the spatial lag of economic growth (ρ_1) while the open unemployment rate (TPT) and the Gini ratio have no significant effect on growth. economy. Variables that affect e-commerce are economic growth, internet banking users, percentage of population who have cellphones, number of millennials, number of villages that have ATMs and spatial lag of e-commerce (ρ_2) while the number of villages with 4G/LTE signals has no effect on e-commerce. commerce. Regencies/cities that provide the highest spillover of economic growth and e-commerce in East Java are Malang, Mojokerto and Madiun Regencies. The three districts were able to provide a positive net spillover.

1. Introduction

The spread of Covid-19 has changed almost all orders of life, including the system of economic activity in East Java. The impact of Covid-19 at the beginning of the pandemic in 2020 on the East Java economy was very significant. The East Java economy in the fourth quarter of 2019 was 5.52 percent, contracted in the first quarter of 2020 to 2.92 percent, then contracted by 1.61 percent in the second quarter of 2020. The economy of East Java continued to decrease, specifically by 2.3 percent in the third quarter of 2020 and contracted by 2.39 percent in the fourth quarter of 2020.

Digital financial transactions surged at the beginning of the COVID-19 pandemic in accordance with the widespread use of e-commerce and other digital instruments (Bank Indonesia, 2020). The widespread use of e-commerce is in line with data from the National Socio-Economic Survey (SUSENAS) East Java in 2020, the percentage of consumers and e-commerce entrepreneurs has increased. The percentage of consumers and e-commerce entrepreneurs in East Java was 13.78% in 2019 and grew to 14.70% in 2020, indicating that Covid-19 has reduced economic activity while accelerating the use of digital financial technology (Bank Indonesia, 2020).
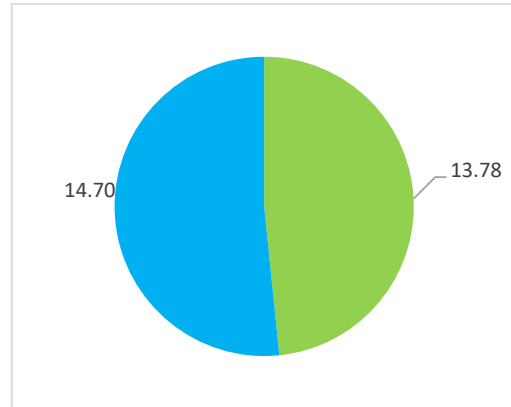
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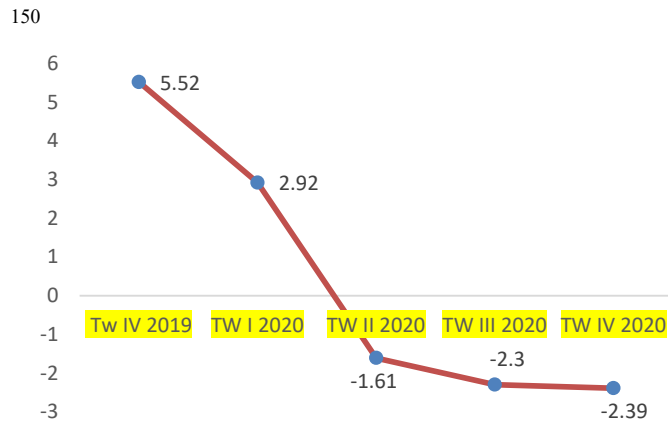
Fig. 1. East Java Economic Growth in Quarter IV 2019 – Quarter IV 2020

Fig. 2. The Growth of E-Commerce Entrepreneurs and Consumers in East Java From 2019-2020
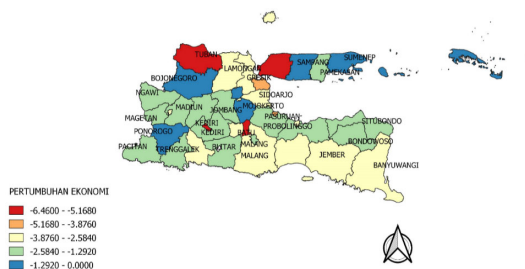
Source: Statistics Indonesia of East Java Province

Table 1

The results of Pearson correlation analysis between economic growth on consumers and e-commerce entrepreneurs in East Java in 2020

	Description	Consumers and e-consumerce entrepreneurs
Economic Growth	Pearson's correlation coefficient	-0.297
	p_value	0.070**

Note: ** significance at $\alpha=10\%$
Source: Data analysis result

According to the results of the Pearson Correlation analysis between economic growth and e-commerce conducted in 2020 throughout all districts or cities in East Java, it can be concluded that there is a strong negative association between economic growth and e-commerce activities. When the economy contracted, the number of consumers and e-commerce entrepreneurs increased. The Endogenous Growth Theory, developed by Paul Romer, winner of the 2018 Nobel Prize in Economics, explains the phenomenon of the relationship between economic growth and technology, for instance, the use of e-commerce. Endogenous economic growth is an economic model that optimizes and prioritizes technological assets and human resources within a country as variables that affect economic growth in a country (Jones, 2019). In some countries, the economic structure is leading to a very fast level of development by utilizing technology, not least in trade, e-commerce is able to influence the acceleration of economic development in a country (Weiyue, 2017). E-commerce is a potential new engine to accelerate economic growth, especially in Asian countries (Kinda, 2019; Liu, 2013). In other conditions, the implementation of e-commerce regulations and policies in a country completely depends on the infrastructure and economic development of the country. This indicates that the number of e-commerce transactions in a nation is significantly impacted by economic growth (Kabango et al., 2015), Ho et al. (2011)). Theoretically, it follows from this explanation that in some circumstances, e-commerce activities have an impact on economic growth, while in others, the reverse is true—economic growth has an impact on e-commerce activities. This explanation shows that theoretically there is a simultaneous relationship between economic growth and e-commerce. In simultaneous modeling, the explanatory variable in one equation can be the dependent variable in another equation (Johnston & Dinardo, 1963; Gujarati, 2009; Vo et al., 2019; Kim et al., 2020).

Fig. 3. Distribution of Economic Growth by Regency/City in East Java in 2020
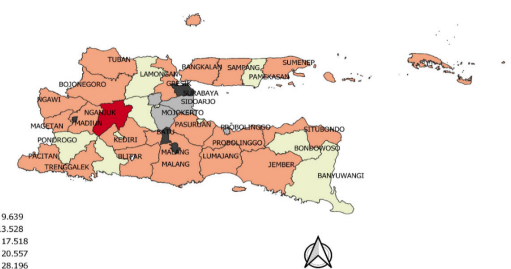
Fig. 4. Distribution of E-commerce Consumers and Entrepreneurs in East Java

Source: Statistics Indonesia of East Java Province

In its development, simultaneous modeling also includes spatial aspects in its modeling, so that spatial simultaneous modeling develops (Kelejian & Prucha, 2004). In the spatial aspect, if data is displayed using a thematic map, then adjacent areas have relatively the same value (Anselin, 1988; Cliff & Ord, 1981). Fig. 3 and Fig. 4 show that the East Java regions in 2020 which are close to one another will have approximately similar rates of economic and e-commerce growth. Analysis of the pattern of inter-regional relations in regional economic studies is a method to describe the problem of inter-regional

development inequality. The spread (spillover) pattern can assist policymakers create development plans for certain regions. Development gaps across regions/cities in a province will increase as a consequence of policies that do not take into consideration interregional links. Based on the explanation of the simultaneous phenomenon and the spatial interaction between economic growth and e-commerce, it is very interesting to examine the relationship between economic growth and e-commerce in the spatial simultaneous concept and how the spillover effect between the two variables was in East Java at the beginning of the Covid-19 pandemic in 2020. Thus, there are two research objectives in this study: how are the spatial simultaneous relationship between economic growth and e-commerce and how are the spillover effects of these two variables, particularly in East Java at the beginning of the Covid-19 pandemic in 2020.

2. Literature Review

2.1 E-Commerce

According to Presidential Regulation Number 74 of 2017, e-commerce is an electronic-based trading system. E-commerce is a business that uses the internet to buy and sell products and services (BPS, 2019). The relationship between economic growth and E-Commerce can be seen in Table 2.

Table 2
The relationship between economic growth and E-Commerce

Author	Country Sample	Data Type	Method	Finding
Anvari and Norouzi (2016)	21 selected countries	Panel Data 2005-2013	Generalized Least Square Regression (GLS) panel data	E-commerce has a significant positive effect on GDP (Gross Domestic Product) per capita in a country.
Mewes dan broekel (2020)	European country	Panel Data 2000-2014	Dynamic panel regression with fixed effects	E-commerce and other complex technologies have a significant positive impact on economic growth.
Toader et al (2018)	European Union Countries	Panel Data 2000-2017	Panel data regression	Economic growth is positively and significantly impacted by ICT infrastructure. In the countries of the European Union, macroeconomic factors and ICT infrastructure have a significant impact on economic growth.
Jianu (2021)	European countries	Panel Data 2010-2018	Panel data regression with generalized Least Square with fixed effect	An economy's ability to grow can be affected by income inequality. Nevertheless, income inequality under certain conditions can have a positive or negative effect on economic growth, depending on the circumstances of the country concerned.
Maz Bayar 2015	European countries	Panel Data 1999-2012	Poisson panel regression and negative binomial panel regression	Economic growth, financial development, savings, research, and development spending, and exports of advanced technology have a positive impact on technology development.
Rathod, 2020	200 respondents in india	Cross-sectional data	*Chi-square*	The use of mobile phones is very strongly related to e-commerce activities in a region.
Nakabashi (2018)	Brazil	Panel Data 1980-2015	Panel data regression	The poverty rate has a negative effect on economic growth.
Ho et al., (2011)	China	Panel Data 1997-2011	Time Series Regression	Economic growth is one of the factors that influence investment in the telecommunications and information technology sector. Among other factors, e-commerce development is influenced by the growth of investment in the telecommunications and information technology sectors.
(Waseem et al., 2018).	145 countries	2014 Data	Multiple Regression	Information and communication technology infrastructure, such as 3G and 4G signal networks, has a beneficial impact on the growth of e-commerce enterprises.

2.2 Spatial Simultaneous Equations

For *G* the spatial simultaneous equation according to Kelejian and Prucha (2004) uses the following equation:

$$\mathbf{Y}_n = \mathbf{Y}_n \mathbf{B} + \mathbf{X}_n \mathbf{\Gamma} + \mathbf{W}_n \mathbf{Y}_n \mathbf{\Lambda} + \mathbf{U}_{n,} \qquad (1)$$

where
$$\mathbf{Y}_n = (\mathbf{y}_{1,n}, \dots, \mathbf{y}_{G,n}), \quad \mathbf{X}_n = (\mathbf{x}_{1,n}, \dots, \mathbf{y}_{K,n}), \quad \mathbf{U}_n = (\mathbf{u}_{1,n}, \dots, \mathbf{u}_{G,n}),$$
$$\mathbf{W}_n \mathbf{Y}_n = \mathbf{W}_n \mathbf{y}_{j,n} \qquad \mathbf{W}_n \mathbf{U}_n = \mathbf{W}_n \mathbf{u}_{j,n} \qquad \mathbf{E}_n = (\varepsilon_{1,n}, \dots, \varepsilon_{G,n})$$

2.3 Research Framework

In previous studies, panel data regression was commonly used in the analysis of economic growth and e-commerce; nonetheless, in this study, the relationship between economic growth and e-commerce will be analyzed using a different

methodology, specifically spatial simultaneous modeling with the Generalized Spatial Three-Stage Least Square (SAR-GS3SLS) Spatial Model. In addition, the spatial intersection matrix used is rook contiguity, which is a Novelty in this study.
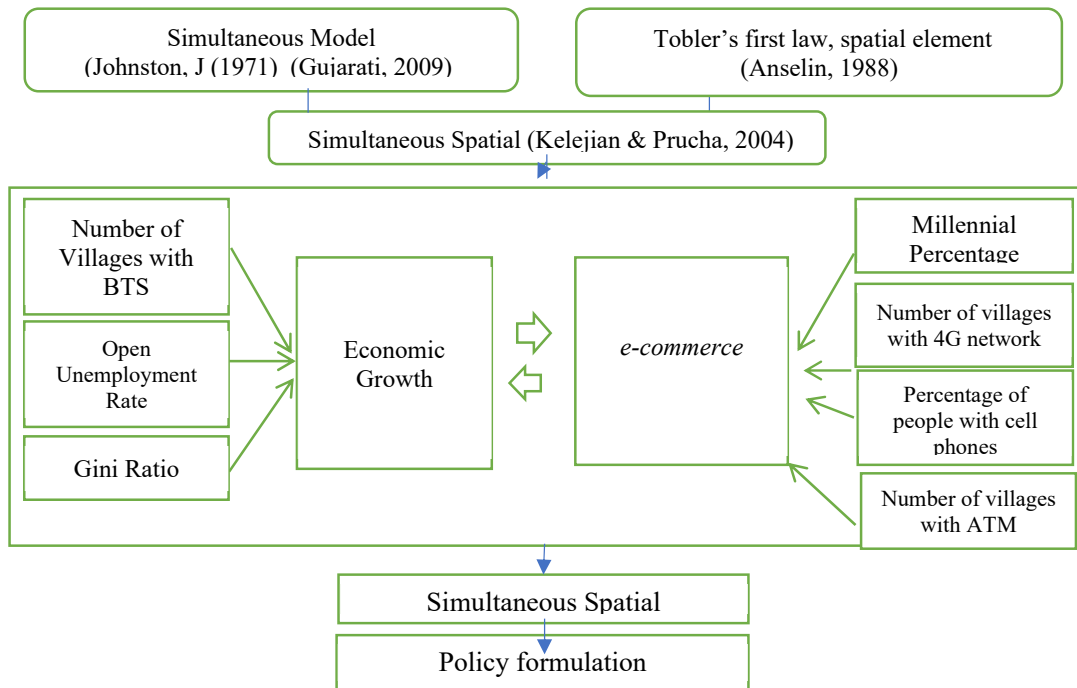
Fig. 5. Research Framework

2.4 Hypothesis

The alternative hypotheses that are used as below:

1. E-commerce and economic growth in East Java at the beginning of the Covid-19 pandemic in 2020 were simultaneously spatially related.
2. There is the influence of e-commerce, the number of villages that have Base Transceiver Stations (BTS), the open unemployment rate, the Gini ratio, and the spatial dependence of economic growth on East Java's economic growth at the beginning of the Covid-19 pandemic in 2020.
3. There is the influence of economic growth, internet banking users, the number of villages with 4G/LTE networks, the number of millennials, the number of villages that have automatic teller machines (ATMs), and the spatial dependence of e-commerce on consumers and e-commerce businesses.

3. Research Methods

3.1 Data

The following information pertains to data and research variables:

Table 3
Research Variables and Data

Variables	Description	Data Source
Economic growth	Comparison of the GRDP of a region in the actual period to the GRDP of the previous period.	BPS
E-Commerce	In this study, E-commerce refers to both consumers and e-commerce businesses.	BPS
E-Commerce business	Businesses that use the internet to sell goods or services.	BPS
E-Commerce consumer	People who use the internet to buy goods and services.	BPS
Gini Ratio	An indicator that describes the income inequality of a region.	BPS
Internet banking users	Residents who use the internet to access banking and financial facilities.	BPS
Millennials	Residents between the ages of 24 and 39 years.	BPS
Open unemployment rate	Comparison of unemployment to the labor force.	BPS
ATM	Electronic machines that serve bank customers to carry out various banking activities independently.	BPS
Number of villages with Base Transceiver Station (BTS)	A cell phone tower/mobile phone is a device that can send and receive cellular communication signals.	BPS
Number of villages with 4G/LTE network	4G/LTE is a packet internet data network with data transfer speeds up to 100 Mbps.	BPS
Residents who own cellphones	Residents who own or can use mobile phones with at least 1 active phone card for personal use.	BPS

3.2 Simultanous Equation Model

The spatial simultaneous model used is as follows:

$$\text{Economic Growth}_i \tag{2}$$
$$= \beta_0 + \beta_1 e\,commerce_i + \beta_2 \text{Villages with BTS}_i + \beta_3 \text{Open Unemployment Rate}_i$$
$$+ \beta_4 \text{Gini Ratio}_i + \rho_1 \text{W\_Economic Growth}_i$$
$$e\_commerce_i = \gamma_0 + \gamma_1 \text{Economic Growth}_i + \gamma_2 \text{Internet Banking}_i + \gamma_3 \text{Villages with 4G network}_i \tag{3}$$
$$+ \gamma_4 \text{Percentage of population who own a cell phone}_i$$
$$+ \gamma_5 \text{Millennial population percentage}_i + \gamma_6 \text{Villages with ATM}_i + \rho_2 \text{W\_e commerce}_i$$

4. Results and Discussion

4.1 Descriptive Analysis

East Java's economy contracted by 2.39 percent in 2020. Sampang Regency experienced the shallowest economic growth slowdown, which was as deep as 0.29 percent, whereas Batu City faced the steepest slowdown, which was as deep as 6.46 percent. The city of Surabaya generates an added value based on a cash price of Rp. 390.94 trillion as the provincial capital, the center of government and the economy. The City of Surabaya makes the biggest contribution with its added value. The city of Surabaya, in fact, provides the greatest added value to the East Java economy. Meanwhile, the Regency/City that produces the smallest added value in East Java in 2020 is Blitar City, which produces added value at a constant price of Rp. 4.723 trillion. Malang City has the highest percentage of consumers and e-commerce enterprises in East Java, which is approximately 28.20 percent, whilst Nganjuk Regency has the lowest rate, which is only 8.68 percent.

Table 4
Research Data for Explanatory Variables

Variables	East Java	Maximum		Minimum	
		Score	City/Regency	Score	City/Regency
Economic growth	-2.39	- 0.29	Sampang	-6.46	Batu City
GDP at constant prices	42550.26	390.936.43	Surabaya City	4722.55	Blitar City
E-commerce	14.70	28.20	Malang City	8.68	Nganjuk
Internet banking	6.11	14.86	Malang City	1.72	Sampang
Villages with BTS	4.062	259.00	Malang Regency	3.00	Mojokerto
Open Unemployment Rate	5.84	10.97	Sidoarjo	2.28	Pacitan
Gini Ratio	0.366	0.40	Malang City	0.26	Sumenep
Villages with 4G/LTE	3.974	299.00	Sidoarjo	10.00	Blitar City
Millennial	24.66	28.82	Sampang	22.20	Magetan
Cell phone ownership	88.60	97.25	Malang City	75.76	Bondowoso
Villages with ATM	1.838	148.00	Surabaya City	12.00	Batu City

Source: Data Analysis Result from Statistics Indonesia of East Java Province

Another variable that is assumed to influence the economic growth in East Java during the Covid-19 pandemic is the number of villages with BTS. The regency/city with the village that has the most BTS is Malang Regency with 259 BTS and the least is Mojokerto Regency, which is 3 villages. In relation to the open unemployment rate, Sidoarjo Regency in East Java has the greatest open unemployment rate in the province with a rate of 10.97 percent, while Pacitan Regency has the lowest open unemployment rate at 2.28 percent. The Gini ratio is the last factor hypothesized to affect economic growth. The regency/city with the highest Gini ratio is Malang City with a Gini ratio of 0.400, while the Regency/City with the lowest Gini ratio is Sumenep Regency with a Gini Ratio of 0.260. On the other hand, another variable that is expected to influence e-commerce in East Java during the 2020 Covid-19 pandemic is regencies/cities with a percentage of the population using internet banking. Malang City has the highest percentage of people using internet banking (14.86%), while Sampang Regency has the lowest percentage (1.72%) of people using the internet. Another variable is the number of villages with the existence of a 4G/LTE network. The most 4G/LTE networks are found in Sidoarjo Regency, which has 299 villages, and the least in Blitar City, which has 10 villages. The next variable is the percentage of millennials. Sampang Regency has the highest percentage of millennials (28.82%), while Magetan Regency has the lowest percentage of millennials (22.20%). In relation to the number of residents who have a mobile phone, Malang City has the highest percentage of people who own a mobile phone (97.25%), while Bondowoso Regency has the lowest rate (75.76%). The last variable that potentially affects e-commerce in East Java is the number of villages with ATMs. Surabaya City has the most villages with ATMs, specifically 148, and Batu City has the fewest, with 12 villages.

4.2 GS3SLS Spatial Autoregressive Simultaneous Modeling Analysis (SAR-GS3SLS) the Order Condition of Identification

The order condition examination's findings indicate that the equation is overidentified so the analysis can be conducted using a simultaneous equation approach because the results of checking the order conditions indicate that the equation is overidentified.

Table 5

Order Condition Check

Equation	K-k	m-1	Description
(2)	10 – 4	2 - 1	*Overidentified*
(3)	10 – 6	2 - 1	*Overidentified*

Source: Data analysis result

4.2.1 The Haussman Specification Test

The results of the Haussman test show that e-commerce and economic growth are interconnected simultaneously.

Table 6

Order Condition Checking of The Equations

Equation	Variable	F-Statistic	Prob	Description
2	Economic Growth	3.79	0.008	There is a simultaneous effect
3	E-Commerce	5.17	0.001	There is a simultaneous effect

Source: Data analysis result

4.2.2 Tests for Spatial Dependence

P-values in the Robust Lagrange Multiplier Spatial Lag and Robust Lagrange Multiplier Spatial Error results are less than $\alpha = 5\%$, indicating that the lag or error has a spatial dependence. Spatial autoregressive (SAR) was utilized in this study.

Based on the LM*Lag (Robust)* dan Lm*error (Robust)* tests result, this study will use simultaneous spatial modeling with the Spatial Autoregressive Generalized Spatial Three-Stage Least Square (SAR-GS3SLS) model using rook contiguity.

Table 7

Tests for Spatial Dependence

Test	Stat	*P-value*
LM*Lag (Robust)*	4.8600	0.0275*
LM*error* (*Robust*)	6.1295	0.0133*

Source: Data analysis result

4.2.3 Parameter Estimation Results of the Economic Growth Equation

Table 8 illustrates the parameter estimates for economic growth. Based on the estimation results using the Spatial Autoregressive Generalized Spatial Three Stage Least Square (SAR-GS3SLS) model, e-commerce and the number of villages with Base Transceiver Stations (BTS) had a significant impact on East Java's economic growth at the beginning of the Covid-19 pandemic in 2020 at $\alpha=5\%$, while the open unemployment rate and the Gini ratio had no significant effect on East Java's economic growth. Moreover, the spatial lag of economic growth ($\rho1$) significantly affects East Java's economic growth at $\alpha=10\%$.

At the beginning of the Covid-19 epidemic, the percentage of customers and e-commerce entrepreneurs had a positive impact on economic growth in East Java. The economy will increase by 1.4342 percent as a consequence of a 1% increase in the percentage of consumers and online business owners. E-commerce and Research & Development (R&D) significantly have a positive effect on GDP (Gross Domestic Product) (Anvari & Norouzi, 2016). In addition to the positive impact of advanced technologies like e-commerce, the application of technology has an influence on economic growth, according to Jones (2019) and Mewes & Broekel (2020). E-commerce was one of the economic enterprises that was able to survive and even increase during the Covid-19 pandemic. With e-commerce, the buying and selling of goods and services is effective, efficient, and able to reduce the possibility of being infected with Covid-19.

Another variable that affects East Java's economic growth at the beginning of the Covid-19 pandemic in 2020 is the number of villages that have Base Transceiver Stations (BTS). BTS is a kind of telecommunications infrastructure. Network operators and communication devices can connect wirelessly by using BTS. The existence of BTS can facilitate other sectors in carrying out their activities during the Covid-19 pandemic. Online learning and education, e-commerce trading, banking industry, and e-banking operations all run more smoothly with BTS. Consequently, the BTS's presence can contribute to East Java's economic growth. The marginal change in villages that have BTS/transmitting stations by 1 percent will cause the economy to grow by 1.0212 percent. A nation's economic growth is strongly impacted by the infrastructure for information and communication technologies, including the availability of BTS. For a very long time, a nation's information and communications technology infrastructure has been a key factor in its economy (Toader et al., 2018).

The open unemployment rate and the Gini ratio had no effect on East Java's economic growth at the beginning of the Covid-19 pandemic in 2020. This is different from Mewes and Broekel's (2020) research findings, which showed a positive relationship between unemployment and economic growth. Furthermore, during the Covid-19 pandemic, East Java's

economic growth was unaffected by the Gini ratio. Contrary to what Jianu et al. (2021) found, income inequality can actually damage a nation's ability to develop its economy. However, income inequality under certain conditions can have a negative or positive effect on economic growth, depending on the state of the country concerned.

The spatial variable lag of economic growth (ρ_1) significantly has a positive effect on economic growth with a value of (ρ_1) = 0,3910 at α = 10%. This result implies that the economic growth in the related regencies/regencies-cities/cities will have a positive impact on economic growth in other regencies and cities.

According to the value of the coefficient of determination (R^2), that is 64.72%, the variance of East Java's economic growth at the beginning of the Covid-19 pandemic in 2020 of 64.72 percent can be explained by e-commerce, the number of villages with base transmitter stations, the unemployment rate, the Gini ratio, and inter-regional linkages for economic growth, while the remaining 35.28 percent is explained by other variables.

Table 8
Parameter Estimation Results of the Economic Growth Equation Model

Variable	Coefficient	T-Statistics	P-Value
Constant	-5.5594	-1.8600	0.0680**
E-Commerce	1.4342	2.8000	0.0070*
Villages with BTS	1.0212	7.4700	0.0000*
Open Unemployment Rate	0.3503	1.0000	0.3220
Gini Ratio	-0.2008	-0.1900	0.8460
ρ_1 (W'Economic Growth)	0.3910	1.8700	0.0670**
$R^2 = 0.6472$			

Description: ** significance at α=10%, * significance at α=5%,

The simultaneous model of SAR-GS3SLS economic growth in East Java at the beginning of the Covid-19 pandemic in 2020 is:

$$
\begin{aligned}
\widehat{\text{Economic growth}_i} &= -5{,}5595 + 1{,}4342\ \text{Consumer and Ecommerce Business}_i + 1{,}0212\ \text{Villages With BTS}_i \\
&\quad + 0{,}3503\ \text{Open Unemployment Rate}_i - 02008\ \text{Gini Ratio}_i \\
&\quad + 0{,}3910 \sum_{i=1}^{n} \sum_{j=1}^{m} w_{ij}\ \text{Economic Growth}_i
\end{aligned}
\tag{4}
$$

4.2.4 E-commerce Equation Parameter Estimation Results

The SAR-GS3SLS Model's estimation results reveal that the variables that significantly influence e-commerce at α = 5% are economic growth, Internet Banking users, the percentage of the population that owns a cellphone, the number of millennials, the number of villages with ATMs, and the spatial lag of e-commerce (ρ_2), while the number of villages with 4G/LTE signals has no impact on e-commerce. E-commerce activities are impacted by economic growth. E-commerce will increase by 0.5011 percent for every percent that the economy increases. The development of e-commerce is identical to the development of technology, there are several factors that influence the development of technology, including economic growth, financial development, savings, spending on research and development, and exports of high-tech products that have a positive impact on technological development (Bayar, 2015).

Internet banking usage has a positive impact on e-commerce. Consumers or e-commerce businesses will increase by 0.2342 percent for every percent increase in internet banking utilization. The trend of using e-commerce can be utilized by fintech (financial technology) companies and internet banking service providers to provide e-commerce transaction payment convenience. Internet banking has a significant impact on e-commerce and other sustainable businesses. Collaboration between internet banking and e-commerce is very open and synergizes with each other (Soegoto et al., 2020). Internet banking service providers try to provide consumers with various funding, payment, or credit options to facilitate e-commerce transaction payments which will increase e-commerce transactions. The use of e-banking, which includes the use of internet banking, has a positive effect on consumer habits, for example in the use of e-commerce. This is caused by the fact that e-banking provides easy, convenient, and efficient services in various transactions, including e-commerce transactions (Nustini & Fadhillah, 2020).

The number of people who own a cellphone is another factor that influences e-commerce. The number of consumers and e-commerce businesses will increase by 1.328 percent for every 1 percent increase in the percentage of the population that owns a cell phone. Technological improvements, the accessibility of mobile broadband infrastructure, and the inexpensive price of smartphones will encourage the development of digital industries, including e-commerce. The ease of using a mobile phone anytime and anywhere is very strongly related to e-commerce activities in a region (Rathod, 2020).

The population, including millennials, has an impact on e-commerce as well. Every 1% increase in millennials will lead to a 1.5471% increase in consumers and e-commerce entrepreneurs. The popularity of online shopping among millennials is increasing very quickly and in many different ways. Moreover, the utilization of e-commerce is impacted by the millennial generation (Mahendra et al., 2020). The millennial generation is a creative generation that is connected to the online world and swiftly adapts to all technology-related activities, including how to perform online purchases. Millennials are very interested in online shopping, which is growing so quickly. The millennial generation's close relationship to digital technology and the prevalence of e-commerce among millennials cannot be separated (Piarna et al., 2020).

E-commerce was significantly impacted by the number of villages that had ATMs during the beginning of the Covid-19 outbreak. At the beginning of Covid-19 outbreak, despite their fear of getting infected with Covid-19, many people continued to use ATMs to perform a variety of financial activities, including e-commerce payments. E-banking usage has a positive impact on consumer behaviors, such as e-commerce utilization. An instance of e-banking is an ATM (Nustini & Fadhillah, 2020).

The number of villages with 4G/LTE networks has no effect on e-commerce. This is different from the research of Waseem et al. (2018) which says that e-commerce businesses are positively influenced by the development of information and communication technology infrastructure such as 3G and 4G signal networks.

Spatial lag variable percentage of consumers and e-commerce entrepreneurs (ρ_2) significantly has a positive impact with a value of (ρ_2) = 0,7038 at α = 5%. This finding indicates that the percentage of consumers and e-commerce entrepreneurs in related regencies/regencies-cities/cities has a positive impact on e-commerce in other regencies and cities.

Based on the value of the coefficient of determination (R^2) on the equation of consumers and e-commerce entrepreneurs, which is 28,02%, the variance of consumers and e-commerce entrepreneurs in East Java during the 2020 Covid-19 pandemic of 28,02% can be explained by economic growth, e-banking users, the number of villages with 4G/LTE signals, the percentage of the population with mobile phones, the number of millennials, the number of villages with ATMs, and spatial lag of e-commerce (ρ_2), while the remaining 71,98% is explained by other variables.

Table 9
Estimation Result of E-Commerce Consumer and Entrepreneur Equation Model

Variable	Coefficient	T-Statistics	P-Value
Constant	0.4766	0.1700	0.8620
Economic Growth	0.5011	5.1000	0.0000*
Internet banking	0.2342	3.6400	0.0010*
Villages with 4G network	-0.0923	-1.0900	0.2810
Percentage of population who own a cell phone	1.3280	2.2600	0.0280*
Millennial population percentage	1.5471	2.6300	0.0110*
Villages with ATM	-0.5550	-3.2400	0.0020*
ρ_2 (W'*E-Commerce*)	0.7038	2,3300	0,023*
R^2 = 0.2802			

Description: ** significance at α=10%, * significance at α=5%

Simultaneous models of SAR-GS3SLS e-commerce in East Java at the beginning of the 2020 Covid-19 pandemic is:

$$
\begin{aligned}
e\ commerce_i = {} & 0.4766 + 0.5011\ Economic\ growth_i + 0.2342\ E\ Banking_i \\
& - 0.0923\ Villages\ with\ 4G\ network_i \\
& + 1.328\ Percentage\ of\ population\ who\ own\ a\ cell\ phone_i \\
& + 1.5471\ Millennial\ population\ percentage_i - 0.5550\ Villages\ with\ ATM_i \\
& + 0.7038 \sum_{i=1}^{n}\sum_{j=1}^{m} w_{ij}\ e\ commerce_i
\end{aligned}
\tag{5}
$$

4.2.5 Simultaneous Spatial Relationship between Economic Growth and E-Commerce Enterprises

Based on the results of the previous analysis, the percentage of e-commerce affects economic growth. On the other hand, economic growth affects e-commerce. This information shows that economic growth and e-commerce are simultaneously related. Economic growth is more impacted by e-commerce than the other way around. This is demonstrated by the fact that the coefficient value of e-commerce activities on economic growth, which is 1.4342, while the coefficient value of economic growth on e-commerce is 0.5011. These coefficients also demonstrate a positive relationship between the two; a growing economy will lead to an increase in e-commerce in East Java at the beginning of the Covid-19 pandemic, and vice versa. According to the previously described spatial lag, the economic growth spatial variable lag (ρ_1) significantly at α = 10% has a positive effect with a value of ρ_1 = 0.3910, although the e-commerce spatial variable lag (ρ_2) significantly at α = 5% has a positive effect with a value of ρ_2 = 0.7038. This result implies that the percentages of consumers and e-commerce entrepreneurs in other regencies/cities will increase as a result of economic growth and the percentages of

consumers and e-commerce entrepreneurs in the related regencies/regencies-cities/cities. The effect of the spatial lag on the percentage of consumers and e-commerce entrepreneurs (ρ_2) is greater than the spatial lag of economic growth (ρ_1). The analysis that has been done leads to the conclusion that there is a spatially simultaneous relationship between e-commerce and economic growth.

4.2.6 Testing the Residual Assumptions of Spatial Simultaneous Equations

Table 10
Normality Test and Heterogeneity of Residual

Equation	Normality Test (Anderson-Darling Z Test)		Uji Heterogenitas (Hall-Pagan LM Test)	
	Anderson Darling	*p*-value	F-Stat	*p*-value
SAR GS3SLS	0.2385	0.7910	0.6226	0.4301

Source: Data analysis result

According to Table 10, it can be concluded that the assumptions of normality and homoscedasticity are significant.

4.2.7 Spillover effect between East Java regions

In the previous discussion, it was mentioned that the spatial interactions between the regencies and cities of East Java are a result of their closeness to one another, the sides of the border that intersect between regencies/cities or between regions directly adjacent to each other, in relation to the spatial balance employed, known as rook. The Covid-19 pandemic has restricted movement from one region to another. At this point, inter-regional interactions occur because of e-commerce transactions.

Table 11
Regency/City Spillover in East Java

| Regency/City	Economic Growth			E-Commerce		
	Given Spillover	Received Spillover	*Net Spillover*	Given Spillover	Received Spillover	*Net Spillover*
Malang	1.085155	0.391047	0.694108	1.953086	0.703815	1.249271
Mojokerto	1.065603	0.391047	0.674556	1.917895	0.703815	1.21408
Madiun	0.873338	0.391047	0.482291	1.571853	0.703815	0.868038
Probolinggo	0.827716	0.391047	0.436669	1.489741	0.703815	0.785926
Kediri	0.79187	0.391047	0.400823	1.425225	0.703815	0.72141
Ponorogo	0.697367	0.391047	0.30632	1.255136	0.703815	0.551322
Blitar	0.602864	0.391047	0.211817	1.085048	0.703815	0.381233
Sampang	0.58657	0.391047	0.195523	1.055722	0.703815	0.351907
Pamekasan	0.58657	0.391047	0.195523	1.055722	0.703815	0.351907
Bojonegoro	0.547466	0.391047	0.156419	0.985341	0.703815	0.281526
Lamongan	0.498585	0.391047	0.107538	0.897364	0.703815	0.193549
Jember	0.469256	0.391047	0.078209	0.844578	0.703815	0.140763
Sidoarjo	0.420375	0.391047	0.029329	0.756601	0.703815	0.052786
Gresik	0.420375	0.391047	0.029329	0.756601	0.703815	0.052786
Trenggalek	0.35846	0.391047	-0.03259	0.645163	0.703815	-0.05865
Tulungagung	0.35846	0.391047	-0.03259	0.645163	0.703815	-0.05865
Banyuwangi	0.35846	0.391047	-0.03259	0.645163	0.703815	-0.05865
Bondowoso	0.35846	0.391047	-0.03259	0.645163	0.703815	-0.05865
Nganjuk	0.351942	0.391047	-0.0391	0.633433	0.703815	-0.07038
Situbondo	0.338907	0.391047	-0.05214	0.609973	0.703815	-0.09384
Jombang	0.319355	0.391047	-0.07169	0.574782	0.703815	-0.12903
Ngawi	0.273733	0.391047	-0.11731	0.49267	0.703815	-0.21114
Magetan	0.260698	0.391047	-0.13035	0.46921	0.703815	-0.2346
Lumajang	0.224852	0.391047	-0.16619	0.404693	0.703815	-0.29912
Pacitan	0.195523	0.391047	-0.19552	0.351907	0.703815	-0.35191
Bangkalan	0.195523	0.391047	-0.19552	0.351907	0.703815	-0.35191
Sumenep	0.195523	0.391047	-0.19552	0.351907	0.703815	-0.35191
Surabaya City	0.195523	0.391047	-0.19552	0.351907	0.703815	-0.35191
Tuban	0.156419	0.391047	-0.23463	0.281526	0.703815	-0.42229
Blitar City	0.097762	0.391047	-0.29329	0.175954	0.703815	-0.52786
Batu City	0.097762	0.391047	-0.29329	0.175954	0.703815	-0.52786
Probolinggo City	0.078209	0.391047	-0.31284	0.140763	0.703815	-0.56305
Pasuruan City	0.078209	0.391047	-0.31284	0.140763	0.703815	-0.56305
Kediri City	0.065174	0.391047	-0.32587	0.117302	0.703815	-0.58651
Madiun City	0.065174	0.391047	-0.32587	0.117302	0.703815	-0.58651
Malang City	0.048881	0.391047	-0.34217	0.087977	0.703815	-0.61584
Mojokerto City	0.048881	0.391047	-0.34217	0.087977	0.703815	-0.61584

Soure: Data analysis result
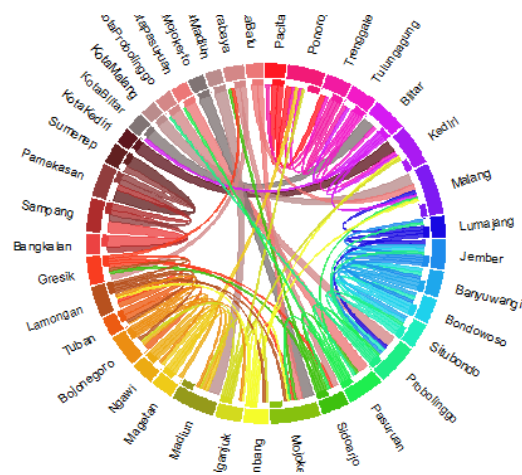
Fig. 6. Flow of Spillover Degrees Between Regencies/Cities in East Java

Based on Fig. 6 and Table 11, it can be concluded that the regencies and cities that contribute the most to e-commerce and economic growth in East Java are Malang, Mojokerto, and Madiun Regencies. The three districts can provide a positive net spillover. At the beginning of the Covid-19 pandemic in 2020, there were no fears about a backwash effect occurring in the three districts. East Java's economic growth centers that have a major contribution to the GRDP of East Java Province, such as the City of Surabaya and Pasuruan City (BPS East Java Province, 2021) have a negative net spillover. This indicates that at the beginning of the 2020 COVID-19 pandemic, there was a close regional disaster that caused a backwash effect in the cities of Surabaya and Pasuruan.

4.2.8 Local Spillover Analysis

Based on local spillover analysis, Malang Regency, for instance, has the highest net Spillover in East Java. According to Figure 7, the regencies/cities that influence and are influenced by Malang Regency are the regencies/cities closest to and directly adjacent to Malang Regency, such as Mojokerto, Kediri, Pasuruan, Jombang, Blitar, Lumajang, Batu City, and Malang City. The figure shows that Malang City, Batu City, and Lumajang Regency are the three main regencies or cities that have an impact on one another's economic growth or e-commerce in Malang Regency.
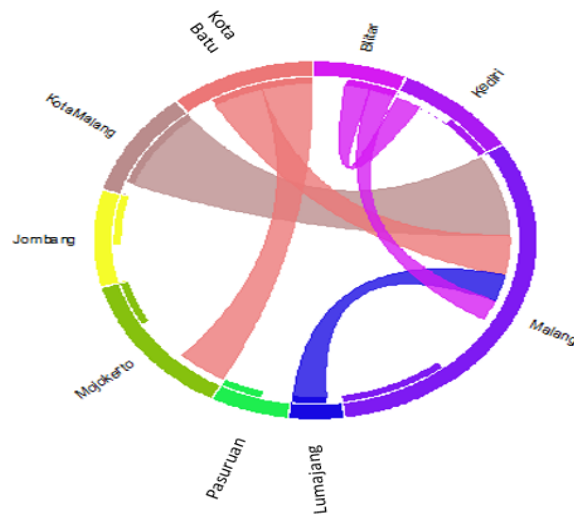
Fig. 7. The flow of spillover degrees between regencies/cities that affect and is affected by Malang Regency

4.2.9 Local Spillover Analysis of Malang Regency Economic Growth

The regencies most influenced by Malang Regency are Malang City by 0.3910 percent, Batu City by 0.1955 percent, Lumajang City by 0.1303 percent, Blitar by 0.0978 percent, Jombang and Pasuruan each by 0.0782, Kediri by 0.0652 percent, and Mojokerto by 0.0489 percent, whilst the regencies/cities that were previously influenced by Malang Regency

are $\frac{0.3910}{8} = 0.0489$ percent respectively. The amount of mutual influence and influence for all districts/cities in East Java can be seen in the appendix table.

Fig. 8. Regencies/Cities Affecting Economic Growth in Malang Regency

Fig. 9. Regencies/Cities Affected by Economic Growth in Malang Regency

The economic growth equation for Malang Regency is as follows:

$$\widehat{\text{Economic growth}}_{\text{Malang}} \tag{6}$$
$$= -5{,}5595 + 1{,}4342 \; e \; commerce_i + 1{,}0212 \; \text{Villages With BTS}_i$$
$$+ 0{,}3503 \; \text{Open Unemployment Rate}_i - 02008 \; \text{Gini Ratio}_i$$
$$+ \frac{0.3910}{8} \; (\text{Economic Growth}_{Malang \; City} + \text{Economic Growth}_{Batu \; City}$$
$$+ \text{Economic Growth}_{Lumajang} + \text{Economic Growth}_{Blitar} + \text{Economic Growth}_{Jombang}$$
$$+ \text{Economic Growth}_{Pasuruan} + \text{Economic Growth}_{Kediri} + \text{Economic Growth}_{Mojokerto})$$

4.2.10 Local Spillover Analysis of Malang Regency E-Commerce Activities

The regencies most influenced by Malang Regency are Malang City by 0.7038 percent, Batu City by 0.3519 percent, Lumajang City by 0.2346 percent, Blitar by 0.1760 percent, Jombang and Pasuruan by 0.1408 each, Kediri by 0.1173 percent, and Mojokerto by 0.0880 percent, while the regencies/cities previously influenced by Malang Regency were $\frac{0.7038}{8} = 0.0880$ percent respectively.

The equation of e-commerce in Malang Regency is as follows:

$e\ commerce_{Malang\ Regency} = 0.4766 + 0.5011$ Economic growth $_{Malang} + 0.2342$ E Banking$_{Malang} -$ $\qquad$ (7)
0.0923 Villages with 4G network$_{Malang} + 1.328$ Percentage of population who own a cell phone$_{Malang} +$
1.5471 Millennial population percentage$_{malang} - 0.5550$ Villages with ATM$_{malang} +$
$\frac{0.7038}{8}$ ($e\ commerce_{Malang\ City} + e\ commerce_{Batu\ City} + e\ commerce_{Lumajang} + e\ commerce_{Blitar} +$
$e\ commerce_{Jombang} + e\ commerce_{Pasuruan} + e\ commerce_{Kediri} + e\ commerce_{Mojokerto}$)

Fig. 10. Cities and Regencies Affecting Malang Regency's E-Commerce Activities

Fig. 11. Regencies and Cities Affected by Malang Regency's E-Commerce Activities

5. Conclusion

Economic growth and e-commerce were spatially interconnected at the beginning of the Covid-19 pandemic in East Java in 2020. The e-commerce activities, the number of villages with Base Transceiver Stations (BTS), and the spatial lag of economic growth (ρ_1) are factors that affect economic growth in East Java, whereas the open unemployment rate and the Gini ratio have no significant effect on economic growth. Variables that affect e-commerce are economic growth, internet banking users, the percentage of people with cellphones, the number of millennials, the number of villages with ATMs, and spatial lag of e-commerce (ρ_2) while the number of villages with 4G/LTE signals has no effect on e-commerce. Malang, Mojokerto, and Madiun Regencies are the regions with the greatest e-commerce and economic growth spillover in East Java. The three districts are able to provide a positive net spillover.

6. Suggestions and Recommendations

The East Java Provincial Government and Regional Governments throughout East Java must continue to support digital transformation both at the beginning and until the end of the pandemic in order to revive East Java's economic growth, which contracted at the beginning of the Covid-19 pandemic. This digital transformation will change the way of transacting

from offline to online. The Covid-19 pandemic can be used as a momentum to accelerate digital transformation in various sectors.

The government must continue to support all the necessary infrastructure for internet banking and other digital economic activities. To ensure the expansion of the internet service network to the village level, the government must collaborate with the Ministry of Communication and Information (Kominfo), which plans to build 4,200 Base Transceiver Stations (BTS) in 2021 (annual report of the Ministry of Communication and Information (Kominfo), 2020). With the increase in facilities and infrastructure supporting e-commerce activities, it is expected that e-commerce will keep growing and will be one of the solutions to boost economic growth in East Java.

Through training activities for current or potential e-commerce business actors about selling online, the competence of human resources in the field of e-commerce in East Java can be improved. Along with this strategy, offline businesses can be encouraged to go online, and those that are already online can increase sales and reach global markets.

Researchers' findings that millennials have an impact on economic growth in the pandemic era can be utilized as a reference for e-commerce business owners when it comes to selecting the target market for their products and services. Entrepreneurs in e-commerce must understand the characteristics of millennials, the appearance of the application interface must be able to attract millennials, and the types of goods sold must be taken into consideration millennial preferences in order to achieve business targets and eventually raise the East Java economy.

The banking sector as an internet banking service provider must be able to provide internet banking applications that are easy to understand, easy to use, and certainly must be able to guarantee the security of internet banking users.

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