The Effect of the Internet on Inflation: A Research on ASEAN-5 Countries

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Abstract

Information and communication technologies have become widespread with the onset of globalization, affecting almost every facet of human life. Increasing internet usage has made accessing information swift and easy. The internet has also had a significant economic impact and provided financial benefits to nations all around the world to increase productivity and efficiency and reduce costs. Customers had been able to access products at lower prices as a result of the reduction in market entry barriers and search costs, which led to an increase in competition in the markets. The research aimed to investigate the effect of the internet on inflation in ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand). Consumer prices (annual %) were used as an indicator of inflation, and individuals using the internet (% of population) were used as an indicator of internet usage. Control variables such as unemployment rate, real interest rate, energy use and money growth were also included in the research. Panel data analysis was performed using the data of ASEAN-5 countries covering the period of 1994-2014. Pooled least squares method (Pooled OLS) was applied to obtain an estimation of the model. As a result, it is found that as internet usage increases, inflation rates decrease in ASEAN-5 countries.

Keywords: internet, inflation, panel data analysis, ASEAN-5 Countries

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Introduction

Technological innovation has played a very important role in the advancement of humanity. Education and health facilities have been developed as a result of new technologies and other innovations, and these improvements have spread all over the world with unquestioned efficiency. Such advancements have had a positive effect on the quality of life of people across the globe. The world mortality rate decreased by approximately 50% between 1960-1990 through modernization in science technology, trade, agriculture, and similar fields (Ejemeyovwi et al., 2019; Hettiarachchi, 2006).

In the last thirty years, there has been a significant increase in the use of information and communication technologies throughout the world (Chavanne et al., 2015). The use of such technologies has made significant contributions to the increase of productivity, which has led to a new awareness of energy efficiency (Salahuddin et al., 2016).

The internet is a global system consisting of interconnected computer networks used by billions of users worldwide. It is defined as the network consisting of millions of private and public, academic, business, and local networks connected by fiber optic cables, copper wires, wireless connections, and other technologies (Simsim, 2011).

The various economic consequences of this growth in internet usage are currently being researched, although the overall effect of the internet on the economy should not be discussed in such a narrow field. It is seen that the internet has a direct impact on foreign investment, technological productivity, inflation, democracy, as well as the shadow economy (Elgin, 2013; Salahuddin & Gow, 2016; Sassi & Goaied, 2013).

The internet promotes economic growth by facilitating the spread of information (Romer, 1986, 1990) to just about every aspect of life. Employees can access information about their jobs via the internet. They can communicate with others, call potential customers, and use the internet for commercial transactions. On the other hand, researchers can also access data for their subjects online. Consumers can purchase goods and services and access information about the product they want to purchase all through the convenience of the internet. Consumers can also make payment transactions for invoices, etc. via the internet without physically leaving their homes or places of business. During this recent worldwide pandemic, online educational activities have gained momentum and countries have started to develop their distance education learning programs. Most of these activities tend to increase productivity, increase private expenditure, reduce the cost of doing business, and increase the welfare level of people and the national output (Hsing et al., 2020).

The internet has been described as the eighth wonder of the world and is defined as one of the most important works of humanity (Sathiaseelan et al., 2013). It has changed the way we work, socialize, create, and share information, which mediates the flow of ideas and communication between people all over the world. Big businesses and national economies have gained significant benefits from the internet. If the internet were its own financial sector,

it would likely have a greater share in GDP than either the agriculture or utility sectors (Manyika & Roxburgh, 2011).

With the advancement of internet technology, shopping options allow for quick and easy online purchases, a major advancement from offline shopping methods, which require a potential customer to physically travel to the business to collect information and make decision. It allows for much more efficient use of time. For example, a consumer may access information about prices over the internet instead of physically visiting different stores to compare them. Through the increase in internet usage and the development of internet technology, consumers can now use the internet for various purposes such as researching, communicating, online banking, and shopping (Shanthi & Desti, 2015).

It is also well-known that the internet increases economic productivity. Market entry costs end up reduced while an increase develops in competition in industries related to various products. It also helps to shorten the supply chain and significantly reduce internet search costs. Prices fall with the lowering of internet-related search costs. Lower search costs and fewer market entry barriers lead to more competition in product markets (Wadhwani, 2000).

There is a widespread belief that inflation rates will decrease as the rate of internet usage, which is one of the digital economy indicators, becomes widespread; and productivity will, therefore, see an increase. Today, as the effects of globalization and digitalization are being clearly felt, it can be argued that studying the correlation between internet usage and inflation has become even more important.

With the increasing use of the internet, the e-commerce industry has grown rapidly and provided an equally important opportunity to remove barriers to entry. As online competition is increasing, businesses are doing their best to offer low prices to consumers, which puts downward pressure on the price of goods. People can now showcase their products on giant e-commerce platforms such as Alibaba and Amazon, and they can access international markets as well (Charbonneau et al., 2017; Mentsiev et al., 2020).

Increasing use of the internet through technological advances has also contributed to the creation of a productive business environment in many different countries. As the level of ease of doing business locally or abroad has increased, bureaucratic obstacles and time costs have decreased. Businesses are also able to file their taxes online, making it easier for people to find their way into the tax network (Mentsiev et al., 2020; Nuccio & Guerzoni, 2019).

The internet has disinflationary effects in the short and medium-term. Transparency of prices subject to e-commerce paves the way for a more competitive environment than traditional retail trade. The internet, which supports international trade in goods and services, has a positive effect on the trend of globalization, resulting in disinflationary effects. Higher productivity levels brought on by internet usage also lead to significant reductions in the costs of producers (Coffinet & Perillaud, 2017).

Over the past few decades, ASEAN economies have undergone a significant transformation, with liberalization and fiscal deregulation. Such initiatives have resulted in

the expansion of the banking and financial services sectors in ASEAN countries, significant growth in capital markets, and the emergence of private-sector financial institutions. The correlation between digitalization brought by globalization and its indicators and macroeconomic variables in these economies that have liberalized with globalization has mostly remained unexplored.

ASEAN-5 countries have made significant breakthroughs in information and communication technologies in recent years (Jing & Ab-Rahim, 2020). The development in information and communication technologies has a significant role in the transformation of Singapore from a third world country to a country with a high level of welfare. Information and communication technology plays a crucial role in Singapore's policy and development strategy. To stimulate economic growth, Singapore started its strategy of embracing the ICT revolution in the early 1980s, when the first generation of personal computers showed its potential. The effort is concentrated in two directions: 1) promoting ICT adoption and 2) promoting ICT production (Vu, 2013). The importance of information and communication technologies in Malaysia's fundamental transformation of society, politics, and economy has been expressed in Malaysia's Third Outline Perspective Plan. ICT in Malaysia has been identified as one of the 12 New Key Economic Areas (NKEA) (Salleh et al., 2020). Thailand was the world's second-largest hard disk drive (HDD) country after China in 2015. The Communication Technology Policy (2011-2020) adopted in Thailand is the basis for developing information and communication technologies (Charnsripinyo & Inluksana, 2015). Liberalisation and privatisation of the Internet Service Provider (IPS) in Indonesia only started in the early 1990s. The situation has led to Indonesia's telecommunications infrastructure being inadequate to other ASEAN-5 countries (Eick, 2007). Although access to the wireless internet connection in Indonesia is concentrated in big cities, it is stated that access to the internet is limited outside the big cities. In Indonesia, Electronic Information and Transaction Act was introduced in 2008 and created the legal infrastructure of e-commerce (Ruslijanto, 2012). It can be said that Indonesia has made significant progress in the field of ICT in recent years (Jing & Ab-Rahim, 2020). Although internet usage in the Philippines was shallow between 2000 and 2009, it can be said that there was a severe increase, especially after 2009. It is stated that e-commerce will create enormous growth potential in the Philippines, although the growth of ICT has come later compared to other ASEAN-5 countries (Villegas, 2014).

With the spread of information and communication technologies, the increase in internet usage, and the digital economy’s development, competition between online and traditional retailers is increasing, which puts downward pressure on prices. The situation is defined as the Amazon Effect in the literature (Cavallo, 2018). ASEAN-5 countries are increasing their level of integration into the digital economy day by day, and it also helps these countries achieve price stability. In the Philippines, one of the ASEAN-5 countries, the Central Bank of the Republic of the Philippines cooperates with the Phillippine Statistics Authority to evaluate the impact of increasing e-commerce. It is also working with The Ministry of Commerce of Thailand to add more online pricing to the Bank of Thailand consumer price index. Central banks of ASEAN-5 countries are putting forward policies to create downward pressure on prices by taking advantage of the increasing competition

between online and traditional retailers, increasing internet usage, and the spread of information and communication technologies.

In the research, the effects of internet usage on inflation in ASEAN-5 countries were investigated. The research result has found that inflation rates decrease as internet usage increases. It can be stated that the increase in internet usage in ASEAN-5 countries causes a rise in the level of productivity, which reduces the costs of producers. This, in turn, leads to a decrease in inflation rates. It has become clear that the level of competition in ASEAN-5 countries has increased and inflation rates have decreased due to the role of the internet.

The relationship between the internet and inflation is also an object of curiosity within the scope of the economic effects of the digital age. There are not many studies on the subject in the literature. The research aims to investigate the effect of the internet on inflation in ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, and Thailand) countries. In accordance with the specified purpose, the inflation rate (consumer prices annual %) was used as the dependent variable. As an indicator of internet usage, the ratio of people using the internet to the population is preferred. Panel data analysis will be conducted using the data of the mentioned countries covering the years 1994-2014. The following section will constitute the literature review, and that will be followed by the research method. After the research method, there is an analysis section and a conclusion section to finalize.

Literature Review

When the literature is examined, it is seen that the relationship between the internet and inflation has not been the subject of many studies. However, a significant number of researchers have found that as internet use increases, inflation decreases (Priyono, 2016, Friesenbichler, 2018; Koyuncu & Unver, 2018; Yi & Choi, 2005). Some researchers have accepted that while the internet has been able to lessen inflation in the short-term, the long-term effect of the internet on inflation is uncertain (Coffinet & Perillaud, 2017). It is possible that the internet could even lead to higher inflation in the long term (Meijers, 2006). Some of the researchers examine the correlation between e-commerce activities and inflation with the spread of the internet (Calson-Öhman, 2018; Charbonneau et al., 2017; Goolsbee & Klenow, 2018; Kulakov & Vinogradov, 2020).

Regarding the studies on the subject, first, the arguments put forward in these studies will be discussed, and then the findings obtained in the literature will be discussed in detail. Yi and Choi (2005) have stated that increasing investments in internet infrastructure in a country may help reduce inflation. It has been also stated that the rapid development of the internet will affect the traditional correlation between money and inflation. Likewise, it has been indicated that monetary authorities should act more cautiously in the transition to contractionary monetary policy when faced with increased employment and production. The development of the internet may cause downward pressure on inflation in the new economy as a result. Meijers (2006) has stated that as more companies invest in the internet, competitive pressure will increase among both internet users and non-internet users, which will reduce

the profit margin. This situation explains the low inflation rate in knowledge-based economies. It means that the prices in the output market decrease depending on the fixed factor prices. Fixed wages and fixed energy prices are examples of this situation. If the spreading process of the internet stops, the markets will revert to a situation consisting of a fixed profit margin on the unit cost of production and fixed prices, even when some firms do not invest in the internet. This process implies that inflation falls during the spread of the internet. Priyono (2016) argues that the use of the internet should be used not only for communication but also for research and development and cost-efficiency. It has been indicated that the use of the internet, which may have an impact on the productivity of commodity costs, will have an inflation-reducing effect. Charbonneau et al. (2017) have shared findings from European countries regarding the inflation-reducing effects of digitalization, but believe they are an issue best left to policymakers. Some have suggested that research should be conducted on whether the effects of digitalization on inflation are permanent or temporary. Calson-Öhman (2018) has suggested that increasing e-commerce with the increase in internet usage contributes to increased competition, which causes downward pressure on prices. Eventually, the slowed rate of price increase and lower inflation rates will be encountered. Friesenbichler (2018) believes that the widespread use of broadband internet supported by infrastructure and economic policies will reduce consumer price inflation rates. Koyuncu and Unver (2018) remarked that more investments should be made in information and communication technologies to spread the use of the internet in economies that aim to reduce inflation and that policies making internet access easier and cheaper should be supported in these economies. Kulakov and Vinogradov (2020) add that inflation has disinflationary effects on the internet.

Yi and Choi (2005) investigate the effects of the internet on inflation. In the research examining 207 countries, the data of these countries covering the years 1991-2000 were used. The effects of the internet on inflation were analyzed with pooled least squares and random-effects model. The result finds that the internet does, in fact, reduce the inflation rate.

Meijers (2006) has in-depth discussion on the relationship between internet diffusion and inflation in information economies. He makes an assessment on the discourses of high production, low unemployment, and low inflation of the supporters of the new economy. It is stated that the internet will reduce inflation in the short term, but the suppressive effect of internet use on inflation will end in the long term which will increase inflation.

Priyono (2016) analyzes the effects of the number of internet users on inflation. A panel data analysis is performed in the study in which China, India, Japan, Indonesia, and South Korea are examined. It is determined that as internet usage increases in these countries, inflation decreases.

Charbonneau et al. (2017) study the disinflationary effects of digitalization in the Canadian economy. They find that as e-commerce grows, the downward pressure on inflation may increase in the future with the effect of increasing competition.

Coffinet and Perillaud (2017) make an assessment on the direction of the relationship between internet use and inflation in European countries. In the research, in which the

statistical data of European countries are examined and put into tables, it is stated that the increased use of the internet has an effect on inflation in the short term, but it is claimed that it is still difficult to determine the effects of the internet on inflation in the long run.

Calson-Öhman (2018) examines the effect of increasing e-commerce activities on inflation. A panel regression analysis is conducted on data from 28 European countries for the period 2016-2017. In the study, in which the model is estimated with the fixed effects model, it is found that increased e-commerce activities affect inflation negatively.

Cavallo (2018) analyzes the effects of internet transparency and online competition on the pricing behavior of large retailers and aggregate inflation dynamics. It is found that online competition increases the frequency of price changes, and is also stated that there has been a uniform pricing degree among locations in the USA in the last 10 years.

Together with the increase in e-commerce, Goolsbee and Klenow (2018) examine the effects of these increases on CPI inflation. The research uses data from online transactions between 2014 and 2017. It is concluded that inflation could be lower by 1,5% to 2,5% with the increase in e-commerce. Additionally, the net increase in the number of new products has a significant effect on the decrease in inflation.

Fabo and Slovenska (2018) analyze the potential implications of e-commerce for the National Bank of Slovakia. Recent developments and available data in the economics literature are utilized in their research. They find that although the short-term effect of e-commerce is not noteworthy, there is a significant impact potential on price stability in the long run. Therefore, central banks should follow the developments in e-commerce by collecting data and examining prices online.

Friesenbichler (2018) looks at the effects of broadband internet usage on inflation in OECD countries. The research is conducted by an unbalanced panel data analysis by using data of 30 OECD countries covering the years 1995-2014. Yi and Choi (2005) have proven the effect of the internet in reducing inflation.

Jo et al. (2019) examine the effects of e-commerce on inflation in Japan. Data challenges are overcome by utilizing datasets covering a wide period of time and past catalog sales. As a result, they find that the relative inflation rates for goods sold heavily online by e-commerce decrease. Koyuncu and Unver (2018) review the effects of internet use on inflation in OECD countries.

In the research conducted by unbalanced panel data analysis, data of 22 OECD countries covering the period 1995-2015 are included. The results obtained after the analysis indicate a negative and statistically significant relationship between variables. As internet usage increases in OECD countries, the rate of inflation decreases.

Csonto et al. (2019) investigate the effects of digitalization on domestic inflation. In the research, panel data analysis is carried out using the data covering 2009-2014 in China. It appears to be no definitive evidence that digitalization affects inflation through inflation expectations. However, it is stated that as long as the digitalization process affects trend

inflation and contributes to reducing inflation, central banks will have to readjust their policy responses to the reality of the new digital world.

Lv et al. (2019) investigate the relationship between technological development and inflation. The New Keynesian Philips Curve (NKPC) model is used in the research, which looks at trends in the United States. The results find that technological development has more of an effect than globalization on low inflation in the US.

Kulakov and Vinogradov (2020) study the effect of the development in e-commerce on inflation in the euro area. A panel data analysis is conducted within the scope of the study in which 19euro area countries are examined. It has been found in the model estimated with fixed effects that the development of e-commerce affects inflation negatively.

Lindgren et al. (2021) examine the effects of increasing use of the Swedish price comparison website PriceSpy on prices. It is determined that the website led to a potential savings of 290 million SEK in 2016 as a result of its increased use. Manufacturers benefit even more, saving approximately 2,9 billion SEK. It is emphasized that price comparison sites increase economic efficiency by creating downward pressure on prices.

Research Methods

In the research, panel regression analysis is performed using data of ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand) covering the period 1994-2014. Inflation rate is used as the dependent variable. The rate of individuals usage of the internet to the overall population is included as an indicator of internet usage among the independent variables. Unemployment rate, broad money growth, real interest rate, and energy use are also included in the research as explanatory variables. The data of all variables are obtained from World Development Indicators, the database of the World Bank.

Information about the variables in the research is shown in Table 1. It contains variables, definitions of variables, and the expected sign of the coefficients expressing the effects of independent variables on the dependent variable.

Table 1. Information on Variables

Definition of Variable	Variable	Expected Effects on Inflation
Individuals using the internet (% of population)	INTERNET	-
Unemployment, total (% of total labor force)	UNEMPLOYMENT	-
Broad money growth (Annual %)	MONEYGROWTH	+
Real Interest Rate (%)	INTERESTRATE	-
Energy Use (kg of oil equivalent) per $1,000 GDP (constant 2017 PPP)	ENERGYUSE	+
Consumer Prices (Annual %)	INFLATION	

To briefly note the correlation between the unemployment rate and inflation, which are both control variables, the Phillips curve is known to explain the correlation between these two variables. In simple terms, the Phillips curve states that full employment causes inflation (Piore, 1978). As it tries to reach full employment, increases are observed in the general level of prices. In terms of the correlation between monetary growth and inflation, it is well understood that increasing the money supply will raise aggregate demand, resulting in inflation (Thoma, 1994). Regarding the correlation between real interest rate and inflation, it can be claimed that lowering real interest rates will lead to higher real output and increase the inflation rate. If the inflation forecast is lower than the target inflation, the Monetary Policy Committee lowers the policy rate. This leads to higher inflation (Kose et al., 2012). It is stated for the correlation between energy use and inflation that energy use will increase the inflation rate of a country. The cost of energy resources is lowered when they are used optimally. It does not result in a significant rise in production costs. However, the non-optimal use of energy resources leads to more of them being consumed. This increases overall energy costs and costs per unit. Careless and excessive use of energy resources, therefore, helps cause inflation (Wasti & Zaidi, 2020)

A number of similar research in the literature are reviewed in determining which variables ought to be included in this research. Descriptive statistics are stated first, and then the validity of the classical model is investigated. Then, analysis is performed with the appropriate resistant estimator after heteroscedasticity and autocorrelation tests.

The hypothesis is developed under the research:

H_0 = Increases in internet usage have no effect on the decrease in inflation.

H_1 = Increases in internet usage have an effect on the decrease in inflation.

After the hypothesis is expressed, the model created under the research is given.

$$INFLATION_{it} = \alpha_0 + \alpha_1 INTERNET_{it} + \alpha_2 UNEMPLOYMENT_{it} + \alpha_3 MONEYGROWTH_{it} + \alpha_4 INTERESTRATE_{it} + \alpha_5 ENERGYUSE_{it} + \alpha_i + \lambda_t + \varepsilon_{it}$$

Description:

$INFLATION_{it}$	: consumer prices (annual)
$INTERNET_{it}$	: ratio of internet usage to population internet
$UNEMPLOYMENT_{it}$	: unemployment rate
$MONEYGROWTH_{it}$	: monetary expansion
$INTERESTRATE_i$	: real interest rate
$ENERGYUSE_{it}$	: energy usage
α_0	: to constant parameter
α_i	: unit effect

λ_t : time effect

ε_{it} : error

The model is estimated with the panel OLS method, and Stata 14 package program is used in the analysis of the data. Descriptive statistics of the variables are shown in Table 2. It contains the number of observations, average values, standard errors, minimum and maximum values of the variables are expressed.

Table 2. Summary Statistics of the Variables

Variable	Number of Observations	Average	Standard Error	Minimum	Maximum
INFLATION	105	4,723	6,235	-0,845	58,451
INTERNET	105	22,696	24,407	0,001	80,902
UNEMPLOYMENT	105	3,682	1,677	0,21	8,06
MONEY GROWTH	105	12,091	8,179	-2,049	62,762
ENERGY USE	105	107,743	22,156	57,023	141,243
INTEREST RATE	105	4,050	4,512	-24,600	12,322

Analysis

The F-test is conducted first to test the existence of the classical model, and to test the existence of unit effect and time effect, respectively. After testing the existence of unit effect and time effect through the F-test, the likelihood ratio test is applied to test the classical model against the random-effects model. The heteroscedasticity in the model will be tested, and then the presence of autocorrelation will be studied. After all these tests are completed, the model will be estimated with the appropriate resistive estimator.

Table 3 shows the results of F-test to test the unit effect and the time effect. However, Table 3 shows the results of Likelihood Ratio test to determine whether the random effect model or classical model is effective.

Table 3. F-Test and Likelihood Test Results

Testing the Existence of Unit Effect	
F Statistics	0,92
Probability Value	0,565
Testing the Existence of Time Effect	
F Statistics	1,91
Probability Value	0,114
Likelihood Ratio Test	
LR Test Statistics	0,00
Probability Value	1,000

In the F-test, the hypothesis that all units are equal to zero (H_0: α_i=0) and that all-time effects are equal to zero (H_0: λ_t=0) are tested. The likelihood ratio test is used to test the classical model against the random-effects model. The H_0 hypothesis is established as the classical model is true (Tatoğlu, 2016).

According to the results of F-test conducted to test the unit effect, it is found that there is no unit effect. H_0 hypothesis is accepted. The classic model has been deemed suitable. According to the results of F-test conducted to test the time effect, it is seen that time effects are insignificant. H_0 hypothesis is not rejected. When the likelihood test results are examined, it is found that H_0 hypothesis, which states that the classical model is correct, is valid.

After determining that the classical model, otherwise known as the pooled regression model, is valid, the next steps are to investigate the existence of heteroscedasticity and autocorrelation in the model.

Heteroscedasticity is frequently encountered in panel data models due to the presence of unit size. This causes the assumption that conditional covariance is zero between the error terms of different periods. In other words, there is no autocorrelation. In addition, if there are unit effects in the error term and the model is estimated by the pooled least squares method, the previous assumption is likewise invalid since the unit effect (α_i) causes autocorrelation in the error term for each unit (Tatoğlu, 2016).

Table 4 shows the results of Breusch-Pagan/Cook-Weisberg (Breusch & Pagan, 1979; Cook & Weisberg, 1983) test to examine the existence of variance. The basic hypothesis is established as "H_0=no heteroscedasticity" in the Breusch-Pagan/Cook-Weisberg test.

Table 4. Breusch-Pagan/Cook-Weisberg Heteroscedasticity Test

Step 1	
chi2(1)	144,62
Prob>chi2	0,000
Step 2	
F(1,103)	45,12
Prob>F	0,000
Step 3	
chi2(1)	31,98
Prob>chi2	0,000
Step 4	
chi2(5)	157,35
Prob>chi2	0,000

The chi2(1) (χ^2) test statistics with 1 degree of freedom was calculated in tests 1 and 3, F-test statistics with (1,103) degree of freedom is calculated in test 2 and chi2 (1) (χ^2) test statistics with 5 degrees of freedom is calculated in the final test. H_0 hypothesis, which describes the constant variance, is rejected according to all test results. There is heteroskedasticity in the model.

It is known that autocorrelation in panel data models occurs mostly due to the unit effect. If there is no unit effect in the model, the autocorrelation in the combined error will decrease, but the correlation in the error will no longer be affected. For this reason, it is important to test the autocorrelation in the residual error element (Tatoğlu, 2016).

Wooldridge's test is used to investigate autocorrelation in the model, whose results is shown in Table 5 (Wooldridge, 2002). Wooldridge proposed an autocorrelation test with the H_0 hypothesis of "there is no first-order autocorrelation" to test autocorrelation in panel data models. Drukker (2003) finds that the test is powerful even in small samples thanks to the simulation results he has concluded (Tatoğlu, 2016).

Table 5. Wooldridge Autocorrelation Test

F value (1,4)	Probability Value
14.330	0,019

Table 5 shows F statistics with (1,4) degree of freedom and probability value. According to the results, H_0 hypothesis stating that there is no first degree autocorrelation is rejected. The model includes first degree autocorrelation.

After the relevant tests are conducted, heteroscedasticity and autocorrelation findings are found in the model. The next step is to perform the regression analysis with the resistant estimator that takes into account heteroscedasticity and autocorrelation. Arellano, Froot, and Rogers' resistive estimator can produce resistant standard errors in the existence of heteroscedasticity and autocorrelation. In the research, the estimation of the model is made by the Arellano, Froot, and Rogers (Arellano, 1987; Froot, 1989; Rogers, 1994) resistant estimator. Table 6 shows the results after the analysis made with Arellano, Froot, and Rogers resistant estimators.

Table 6. Estimation Results

Independent Variables	Coefficient	Standard Error	Probability Value
INTERNET	-0,060	0,010	0,005***
UNEMPLOYMENT	0,763	0,221	0,026**
MONEYGROWTH	0,330	0,123	0,055*
ENERGYUSE	-0,004	0,020	0,853
INTERESTRATE	-0,545	0,061	0,001***
R^2= 0.6173			
***: 1%Significance Level			
**: 5%Significance Level			
*: 10%Significance Level			

Considering the coefficient of INTERNET variable, it is seen that the direction of the coefficient is negative. It is observed that as internet usage increases in ASEAN-5 countries, the rate of inflation decreases. Although the direction of the coefficient is as expected, the result is statistically significant.

The estimated coefficient of UNEMPLOYMENT is positive and significant at the 5% level. UNEMPLOYMENT has the unexpected sign. The estimated coefficient of the MONEYGROWTH is positive and significant at the 10% level. MONEYGROWTH have the expected sign. The estimated coefficient of ENERGYUSE is negative and insignificant. ENERGYUSE have the unexpected sign. The estimated coefficient of INTERESTRATE is negative and significant at the 5% level, and has the expected sign.

It is seen that the results are compatible with a significant part of the results in similar studies (Yi & Choi, 2005; Priyono, 2016; Calson-Öhman, 2018; Cavallo, 2018; Friesenbichler, 2018; Goolsbee & Klenow, 2018; Koyuncu & Unver, 2018; Kulakov & Vinogradov, 2020) The increase in internet usage in ASEAN-5 countries has increased competition and led to a decrease in the general level of prices.

Conclusions

Within the scope of the research, the effect of internet usage on inflation in ASEAN-5 countries (Indonesia, Malaysia, Philippines, Singapore, and Thailand) between 1994-2014 is investigated. Balanced panel data analysis is performed in this regard. Consumer prices (annual %) are used as inflation indicator in the research where the pooled least squares method is applied. Individuals using the internet (% of population) are used as an indicator of internet usage. Unemployment rate, money growth, real interest rate, and energy use are also included as control variables in the research.

Regression analysis results on the relationship between internet use and inflation has shown that internet use in ASEAN-5 countries leads to a decrease in the rate of inflation. The result is found statistically significant at the 1% significance level. These results are consistent with the results obtained in other studies in the literature (Friesenbichler, 2018; Koyuncu & Unver, 2018; Yi & Choi, 2005).

When the relationship between the unemployment rate (a control variable) and the inflation rate (the dependent variable) is analyzed, it is seen that the direction of the coefficient is positive. As unemployment increases in ASEAN-5 countries, the rate of inflation also increases. The result is statistically significant at the 5% significance level. Similar results are obtained in previous studies analyzing the relationship between relevant variables in ASEAN countries (Furuoka & Munir, 2009; Puzon, 2009).

Regarding the effect of money growth on inflation, it is found that increases in money supply increase inflation in ASEAN-5 countries. The result also seems to be statistically significant at the 10% significance level. These results obtained are in the expected direction.

It is observed that the direction of the coefficient is negative in the relationship between energy use and inflation. However, the results are statistically insignificant. The relationship between real interest rate and inflation is analyzed to finally find a negative relationship between these two variables, as expected. The result also indicates a statistically significant at

the 1% significance level. In ASEAN-5 countries, as real interest rates increase, inflation rates decrease.

It is widely believed that information and communication technologies reduce costs by leading to high efficiency, in this case, reduces consumer prices by affecting inflation rates. It is stated that the increase in internet usage contributes to the decrease in inflation rates. The effects of internet use on inflation in ASEAN-5 countries are investigated, and it is found that inflation rates decrease as internet usage increases. The results obtained within the research scope are consistent with the findings in similar studies (Calson-Öhman, 2018; Cavallo, 2018; Friesenbichler, 2018; Goolsbee & Klenow, 2018; Koyuncu & Unver, 2018; Kulakov & Vinogradov, 2020; Priyono, 2016; Yi & Choi, 2005).

Digitization has varying effects on inflation. It can affect inflation directly through the prices of information and communication technology products, and through the sharing of these products in the household consumption basket. Indirectly, it can affect inflation through firms' pricing behavior, market power and market concentration, productivity, and marginal costs (Koester et al., 2021).

Technological developments and globalization have made the use of information and communication technologies widespread. Digitization and the accompanying widespread use of the internet have increased efficiency and productivity, while significantly reducing costs. It has been stated that inflation rates will decrease significantly as the costs decrease (Friesenbichler, 2018; Litan & Rivlin, 2001; Salvatore, 2003; Yi & Choi, 2005).

The use of the internet is increasing rapidly in the world, the digital economy is rapidly spreading, and its influence is increasing. This makes it more important for policy makers and economic agents to understand the effects of internet use and digital economy indicators on macroeconomic variables, including inflation (Csonto et al., 2019). Considering that the use of the internet reduces inflation through increased productivity or increased competition, it should not be forgotten that countries must give importance to information and communication technologies and the sector that hosts these technologies.

With the increase in internet use, consumers become more conscious and knowledgeable. The formation of a more aware consumer profile, on the other hand, contributes to the increase in price competition. Using smart phones, people can compare prices of products and services with a single click. Companies that are aware of the situation enter into competition with other companies by applying lower prices and various discount campaigns to continuously attract customers. This can lead to a significant decrease in inflation rates (Matolcsy et al., 2020).

The research suggests that governments make productivity, competition, and e-commerce become widespread by ensuring there are no obstacles to internet usage. Consumers, who are spared significant time cost and search cost by shopping online, will be able to buy products and services at lower prices with the increase of competition. Central banks should follow the developments related to e-commerce and continue their activities since e-commerce is effective on price stability. It is seen that there are very few studies on the

subject in the literature. It is believed that studies to be conducted to review the relationship between these two variables in different country groups will enrich the relevant literature.

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