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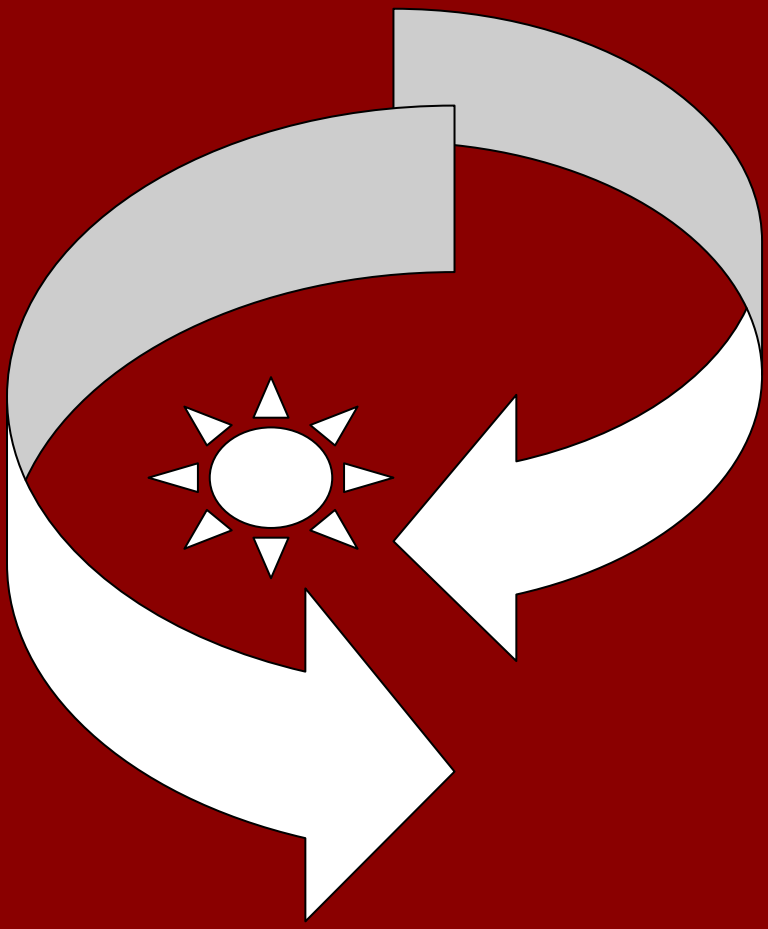

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Jurnal
Perspektif Pembiayaan dan Pembangunan Daerah
(Journal of Perspectives of Financing and Regional Development)

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The impact of pandemic COVID-19 on remittances and macroeconomy fundamental in ASEAN 6

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Abstract

Globalization and liberalization increasingly provide opportunities for each country to increase regional and global cooperation. Socio-economic integration is also increasing, along with community cooperation in the regional and global scope. This study aims to determine the effect of remittances and other macroeconomic variables such as FDI, inflation, and export-import on GDP per capita in ASEAN 6 countries. The panel data analysis method used is regression using panel data sourced from the World Bank and ASEAN datasets in the form of annual data. The estimation results from FEM found that exports and remittances showed a significant positive effect on GDP per capita in ASEAN 6. In addition, imports showed a significant negative effect on GDP per capita in ASEAN 6. Meanwhile, several macroeconomic variables that were not significant were FDI, which showed a significant negative effect. Positive but not significant, inflation has a negative but not significant effect on GDP per capita in ASEAN 6. The emphasis on the positive effect of remittances on GDP per capita proves that the flow of remittances into developing countries will help increase income per capita. Vice versa, a crisis that hinders the increase in the enthusiasm of emigrants. The COVID-19 pandemic delays the emigrant's production activities and increases that will hinder the flow of remittances into the country of origin, such as in ASEAN 6 countries.

Keywords: *Internation migration, Macroeconomy, Pandemic COVID-19, Remittances*

JEL Classification: F22, F24, F41, J61

INTRODUCTION

Globalization and liberalization are increasingly providing opportunities and opportunities for every country to increase cooperation both regionally and globally along various lines. Socio-economic integration also aligns with community cooperation in the regional and global scope. This integration facilitates cooperation and development between countries (Lloyd & Smith, 2004). In his theory, Lee (1966) states that migration can be influenced by driving factors from the country of origin and pulling factors from the destination country, so internal and external factors have a large influence. In addition, labor market conditions and internal macroeconomic factors within a country also play a role in influencing international migration. Labor mobility through international migration also contributes to a country's financial condition.

Remittances generated by emigrants sent to their home countries have a major impact on families' financial development and welfare in their home countries. Remittances can increase household and state income, thereby reducing poverty. In addition, remittances also have great potential benefits related to international labor remittances for developing countries (Sari, 2019; Manzoor, 2018). In this context, remittances are one of the sources of income from emigrants that a household and state receive (in the form of foreign exchange) to support the domestic economy and development.

According to Adams & Cuecuecha (in Noveria, 2017), there are three categories of the use of remittances. First, remittances as income earned by households. Second, remittances as a cause of changing household consumption behavior. Third, remittances as temporary income are used to improve the quality of human resources. ASEAN's mobility and labor market conditions have a high volume, reflected in the states in recent years. Labor mobility through international migration is mainly carried out by developing ASEAN countries to developing countries like Malaysia and Singapore. Labor mobility through international migration is also influenced by various factors, both social and economic perspectives. In developing countries, remittances are one of the largest sources of income and money flows (Acosta et al., 2008; Meyer & Shera, 2017). Remittances are an important component of capital inflows, as is export income, contributing to economic growth. Remittances are the same as other capital inflows that can be used as a source of finance for the state (Adenutsi, 2011).

One form of cooperation that can benefit each country is freedom in the labor market. International migration flows in ASEAN countries experience different dynamics. Based on World Bank data, which is found longitudinally every five years, Malaysia, Singapore, and Thailand dominate immigration (in-migration) compared to emigration (out-migration) (Figure 2).

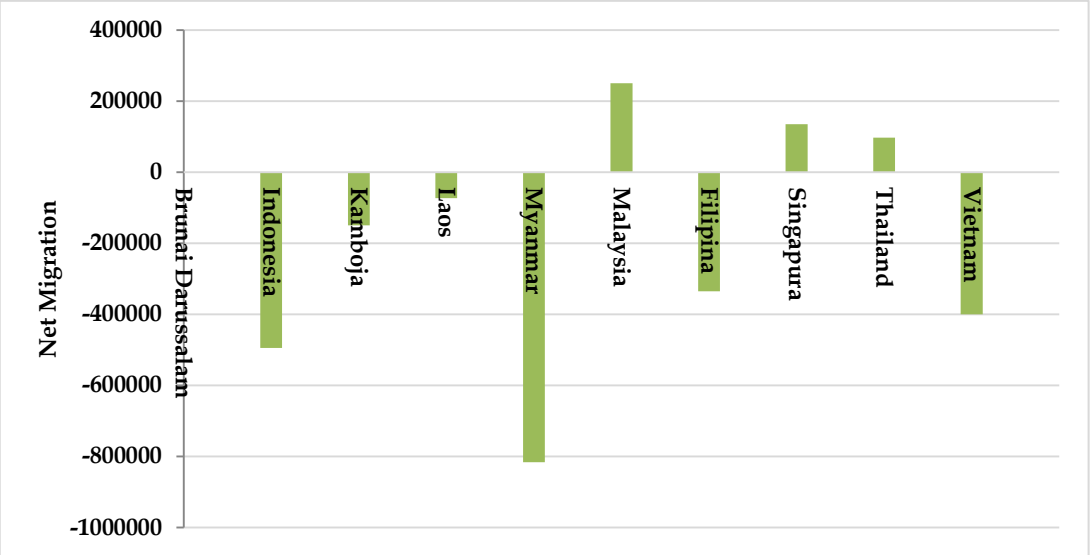

Figure 1. The flow of migration (net migration) in ASEAN Year 2017
Source: World Bank, 2021

Figure 2 also shows that Myanmar's migration flow is dominated by in-migration. A negative value reaches 816564 inhabitants, which means that migration flows are dominated by emigration in various countries with various underlying factors. Then Indonesia, Vietnam, and the Philippines showed a large negative number.

Furthermore, Cambodia and Laos also showed negative numbers, although they tended to be small. It indicates that the international labor force in and out of mobility in Cambodia and Laos tends to be below. This condition will also impact state income from remittances in each country.

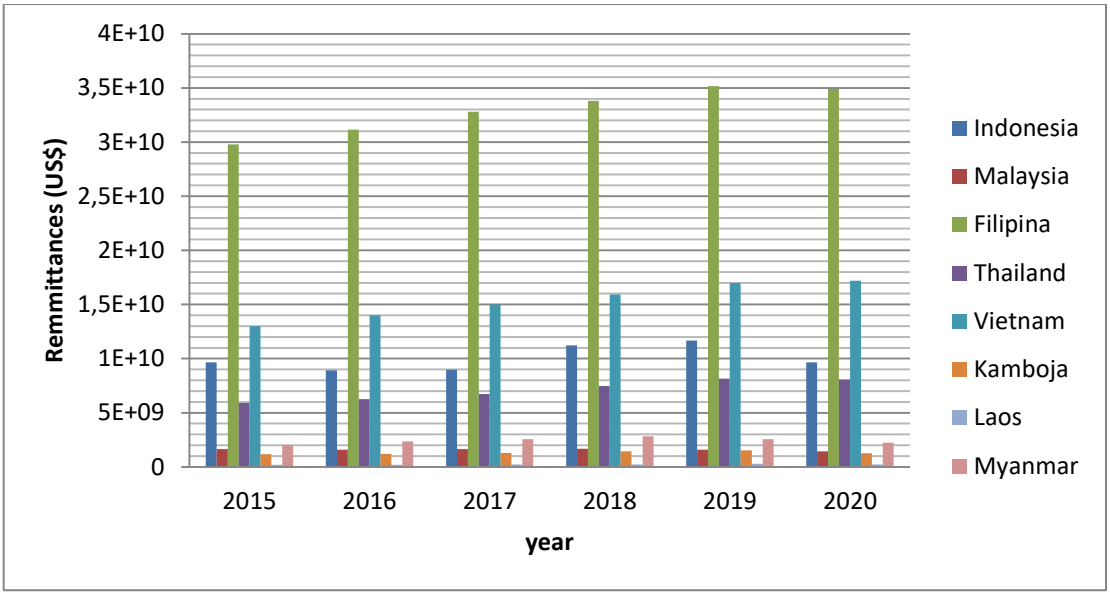

Figure 2. Remittances in ASEAN Countries
Source: World Bank, 2021

The performance of remittances in ASEAN shows conditions in line with the migration flow. Figure 2 shows that countries with migration flows that are dominated by emigration make a large contribution to remittances. This condition is shown in the countries of Indonesia, the Philippines, Thailand, and Vietnam, with large remittances. Meanwhile, countries with low migration flow, especially low emigration, also generate relatively small remittances, such as Myanmar, Laos, Cambodia, and Malaysia. International population mobility through migration also impacts economic growth through remittance performance.

2020 saw a massive decline in remittances in almost all ASEAN countries caused by the COVID-19 pandemic. It resulted in a decrease in remittances to the country of origin. Some researchers have found that remittances have a positive impact on economic growth, such as the findings by Jongwanich et al. (2014), Jebran et al. (2016), Hassan & Shakur (2017), Afriska et al. (2018), Manzoor (2018); Abduvaliev & Bustillo, (2020). There is also a study that provides inconsistent results and shows a negative impact of remittances on economic growth conducted by Chami et al. (2008), Barajas et al., (2009), Alkhathlan, 2 (013), and Hassan et al., (2016). According to the data above, remittances can positively impact economic growth through increased consumption and poverty reduction (Abduvaliev & Bustillo, 2020). Apart from the remittance factor, economic growth is also influenced by the performance of macroeconomic fundamentals in each country, including investment, inflation, trade openness (open trade), and government spending (Meyer & Shera, 2013: Abduvaliev & Bustillo, 2020; Jebran et al. al., 2016).

In contrast to previous research, this position will emphasize the discussion of remittances with the COVID-19 phenomenon, one of the obstacles to global economic activity, including the economic activities of immigrants and emigrants in the ASEAN

region. In addition, this study hypothesizes that an increase in remittance income for a country can increase per capita income, which reflects people's welfare. Judging from the current phenomenon, the presence of the COVID-19 outbreak also impacts macroeconomic performance and the performance of international migration. The social and physical have had a significant impact on the economy and remittance flows as a reflection of the performance of international migration.

METHODS

This study uses secondary data sourced from the World Bank and ASEAN data set with the object of ASEAN countries. The selection of objects for ASEAN countries is based on the phenomenon of international migration increasingly occurring in ASEAN, which impacts increasing remittances for their home countries to contribute to growth and development. Based on previous literature studies and the empirical phenomena presented, this research uses macroeconomic data such as investment, inflation, trade openness, and government spending and remittance variables in influencing economic growth proxies by GDP in ASEAN countries.

The data used is panel data, a combination of data time series (From 2011 to 2020) and cross-section (ASEAN 6 countries). The analytical method used is a multiple linear regression method using several independent variables, including investment, inflation, trade openness, government spending, and remittance variables. In regression analysis using panel data, the authors carried out several stages to choose the best model between Pooled Least Square (PLS), Fixed Effect Model (FEM), and Random Effect Model (REM). The best model selection among the three models uses the Chow, Hausman, and LM tests. The specification of the research model used is the Cobb-Douglass double log-linear production function as follows:

$$lnGDP\_cap_{it} = \beta_0 + \beta_1 lnREM_{it} + \beta_2 lnINV_{it} + \beta_3 lnINF_{it} + \beta_4 lnTRDe_{it} + \varepsilon_{it}$$

Where GDP_cap is real GDP per capita; REM is per capita remittances in US $; INV is FDI inflow which is used to capture the effect of external sources of capital (US $); INF is the GDP inflation deflator (percent); TRD is the ratio of export and import price index to capture the impact of trade, or economic openness (US $).

RESULTS AND DISCUSSION

This study emphasizes the effect of remittances from emigrants in several countries in influencing the per capita income of the home country, which is proxies by the GDP per capita of each ASEAN 6 country. This can be an indicator to see remittance performance as a measure of the success of workers working abroad and contributing to the country of origin's financial inflows and foreign exchange reserves. These countries include Indonesia, Malaysia, Thailand, the Philippines, Vietnam, and Cambodia.

The data stationary test aims to determine the stationary data at the level, first or second different. In testing the stationary data test in panel data using four tests, namely the Lin, Levin & Chun (LLC) test; Im, P Magnification & Shin (IPS) test; ADF Fisher and Phillips Peron (PP). In addition, there is a test for selecting the best model because, in the panel data model, there are three models which will be selected, which is the best model for further estimation. There are three tests in choosing the best model: Chow test, Hausman test, and Lagrange Multiplier (LM) test.

Table 1 will show the data stationary test results using the LLC, IPS, ADF, and PP tests on each of the variables used in the study.

Table 1. Result of stationary

Variables	LLC	IPS	ADF	PP
GDP_Cap	0.0988*	0.3730	0.3394	0.0001**
Remittance	0.0001	0.0000*	0.0686*	0.0097
Export	0.0005*	0.0071**	0.0958*	0.0072
Import	0.0005*	0.0162*	0.0667	0.0080**
FDI	0.0113*	0.0172**	0.0065**	0.0268
Inflation	0.0000	0.0181	0.0084	0.0000*

Note: () stationary at the level; (*) is stationary in the first difference; (**) stationary on a second difference. Alpha Significance of 5% and 10%

The results of the data stationary test with the unit root through the LLC, IPS, ADF, and PP tests showed that the data on each variable had stationary at different levels. The GDP per capita variable has data stationary in the LLC and PP tests shown in Table 1. In the LLC test, the GDP per capita variable is stationary at the first difference level with a probability value smaller than alpha 10%, namely 0.0988. In addition, in the PP test, the GDP per capita variable has stationary at the second difference level with a value of 0.0001 smaller than alpha 5% and 10%. The remittance variable has stationary at the level in the LLC and PP tests, with each probability value smaller than alpha 5% and 10%, which is 0.0001 in the LLC test and 0.0097 in the PP test. Exports also show different stationary in each of the unit root tests. In the LLC test and stationary ADF at the first difference level, each probability value is smaller than alpha 5% and 10%, namely 0.0005 and 0.0958. In the ADF test, the export is stationary at the second difference level with a probability value of 0.0071. In the PP test, it has stationary at the level with a value of 0.0072, smaller than alpha 5% and 10%.

In the imported variable, the LLC and IPS tests are stationary at the first difference level with a probability value of 0.0005, smaller than alpha 5% and 10% for the LLC test. IPS tested has stationary at the first difference level with a probability value of 0.0162 smaller than alpha 5% and 10%. While in the ADF test, the imported variable is stationary at the level with a probability value of 0.0667 and in the stationary PP test at the second difference level with a probability value of 0.0080 smaller than alpha 5% and 10%. FDI has stationary at the first difference level in the LLC test, and in the IPS and ADF tests, it has stationary at the second difference level, while in the PP test, it is stationary at the level. Each probability value is smaller than alpha 5% and 10%, namely 0.0113 in the LLC test, 0.0172 in the IPS test, 0.0065 in the ADF test, and 0.0268 in the PP test.

Furthermore, for the inflation variable, the stationary test on the LLC, IPS, and ADF test is stationary at the level and on the stationary PP test at the first difference level. The probability value of each confirms this result is smaller than alpha 5% and 10%, which is 0.0000 in the LLC test, 0.018 for the IPS test, the ADF test of 0.0084, and the PP test of 0.0000. These results confirm that the data used in the study can be used further to be estimated because they have stationary in all variables in each test.

After the stationary data test has been carried out, the model is in the panel model consisting of the common effect model, the fixed-effect model, and the model selected random effect. Three tests were carried out in selecting the model: the Chow test, Hausman test, and Lagrange Multiplier test. Chow test to see the best model between the common and fixed-effect models by looking at the Chi-Square probability value. If the Chi-Square probability value is smaller than alpha 5%, the best model chosen is the fixed effect and vice versa. If the probability value is greater than alpha%, the best

model is chosen as the common effect.

Furthermore, the Hausman test is used to see the best model between the random effect and the fixed effect by looking at the random cross-section value. If the random cross-section value is greater than 5% alpha, then the best model used is the random effect and vice versa if the random cross-section value is smaller. From alpha 5%, the best model used is the fixed effect. Meanwhile, the Lagrange Multiplier test is used to see the best model between random and common effects. This test is seen from the probability value of Breusch Pagan. If it is smaller than alpha 5%, then the best model is a random effect, and if it is greater than alpha, then the best model is a common effect. Table 2 presents the best model test results in this research panel model.

Table 2. Best model test

	Probability	Description
Chow test	0.0000	Fixed Effect
Hausmand test	0.0000	Fixed Effect
Lagrange Multiplier test	0.0000	Random effect

Table 2 shows the best model tests used in panel data. The results show that the best model that can be further estimated is the fix effect model. The probability value confirms this result in Chow's test of 0.0000, which confirms that the best model is the Fix Effect Model compared to the common effect model. Furthermore, to see the best model between the random model effect and the fixed effect with the Hausman test, which shows the probability value of 0.0000 is smaller than alpha 5%, which means the best model between the two is the fixed effect. Then, the next test is the Lagrange Multiplier test to see the best model between the random and common effects. The result is that the Breusch Pagan probability is 0.0000 smaller than alpha 5%, confirming that the best model used is the random effect. Based on these results, the best model for which further estimation can be made is the fixed effect model.

Furthermore, the model is a fixed effect estimated to see the effect of the variables of remittances, exports, imports, FDI, and inflation on GDP per capita in ASEAN 6 countries. The estimation results of the fixed effect model are shown in Table 3 as follows.

Table 3. Estimation results of Fixed Effect Model (FEM)

Variable	Coefficient	Probability	Description
FDI	0,0009306	0,5028	Positive not significant
Export	33,33081	0,0613	Positive significant
Import	-51,56226	0,0071	Negative significant
Inflation	-12,74994	0,5691	Negative not significant
Remittance	1,31E-07	0,0000	Positive significant

The estimation results in the fixed effect model show that the variables of remittances, exports, and imports have a significant positive effect on GDP per capita in ASEAN 6 countries. Meanwhile, other macroeconomic variables such as foreign capital inflows and inflation do not significantly affect in different directions. Imports show a negative but insignificant effect. Meanwhile, the direct foreign capital inflow variable shows a positive but insignificant effect. In addition, inflation also does not show a significant effect but shows a negative direction. The remittance shows a probability value smaller than the alpha value of 5%, namely 0.0000 with a coefficient of 1,31E-07. This result means that when there is an increase in remittances by one unit, it will impact an increase in GDP per capita by the coefficient value of 1,31E-07 and vice

versa. If the remittance decreases by one unit, it will reduce GDP per capita in ASEAN 6 countries by the coefficient value of 1,31E-07.

During the last two decades, the volume of remittances to countries of origin or remittances has attracted significant attention, especially in developing countries. Some of the basic reasons migrants send part of their income are altruism, self-interest, loan repayments, and insurance motives. During the 2008 financial crisis, the appreciation of the migrant currency against the Philippine peso led to an increase in household remittances received from abroad (Vargas-Silva et al., 2009). This remittance can affect a large number of variables in the recipient country because of its complexity in influencing the conditions of the recipient country.

Remittances are also a source of household income in poor areas so that through the flow of remittances will have a good impact on rebalancing growth by expanding domestic demand. This income also helps smooth consumption and encourages human resource development by increasing household capacity to spend on education, health, and nutrition. Remittances promote economic growth by spurring entrepreneurial activity, increasing labor productivity, and boosting consumption and investment demand. If they increase the income of the poor, such flows can reduce poverty and income inequality. The complexity of remittances can also contribute to macroeconomic stability through foreign exchange and improve creditworthiness. In addition, by reducing credit constraints and funding physical infrastructure, remittances can encourage financial and economic development (Vargas-Silva et al., 2009).

Meanwhile, remittances can also have detrimental consequences on the economic and social dimensions. Remittances can hinder growth and cause the exchange rate to appreciate, which will lead to lower trade competitiveness, and increasing inflation. From a business cycle perspective, remittances can be very useful for Asian countries to react adequately to fluctuations in the output cycle. If remittances are against the domestic economy, the receiving country could potentially use remittances as part of their strategy to offset negative cyclical fluctuations in output. On the other hand, if the sender is mostly interested in investing in the home country, then the remittance may decrease following negative cyclical fluctuations in output.

From the financial aspect, remittances sent to countries with inadequate credit market conditions can ease credit constraints as capital for business. The money remittance market is experiencing significant dynamics given the rapid pace of modernization. This will have an impact on financial access to remittances. This condition requires policy response initiatives, including:

1. Raise awareness about the scale and scope of Asian remittances, especially to rural areas, to encourage the private sector, civil society, and government to be directly involved in maximizing the development impact of these remittance flows.
2. Applying the General Principles for International Money Transfers.
3. Addressing legal and regulatory constraints to promote more competition in the market.
4. Partnering with commercial banks, in particular, to expand the financial options available to remittance recipient households.
5. Support the modernization of other major remittance payers, such as post offices, microfinance institutions, and mobile network operators.
6. Strengthen commitment to financial inclusion, particularly through literacy programs.
7. Promote asset development and diaspora investment mechanisms in home countries.

Southeast Asia is the world's most dynamic and diverse remittance center, with

nearly 13 million migrants living abroad. The outflow of migrants has increased in nearly every country over the past decade, with the largest outflow from the Philippines (4.28 million) and the largest inflow to Malaysia (2.36 million). The inflow of remittances from 2000 to 2012 increased significantly in every country in Southeast Asia. The Philippines, the world's third-largest recipient of remittances with US $ 24.3 billion and more than 10 percent of GDP, accounts for more than half of all remittances to Southeast Asia. Other main recipients of remittances in the sub-region are Vietnam (the US $ 9.1 billion), Indonesia (the US $ 7.2 billion), and Thailand (the US $ 4.1 billion). At the same time, Malaysia, Singapore, and Thailand are attracting more migrants to work in developing countries. The three countries currently accommodate nearly 6 million migrant workers. This is more than double the number of nationals who have migrated abroad. However, Indonesia, Myanmar, and Vietnam continue to send more workers than they receive (IFAD, 2013). During the COVID-19 pandemic, remittances declined, resulting in a decreased flow of remittances in countries with many emigrants. This is caused by a decrease in wages and work activities during the pandemic, which affects the decline in per capita income of a country and occurs massively in all countries, especially developing countries. This condition confirms that remittances have a significant positive effect on GDP per capita in ASEAN 6 countries. Projections made by ADB predict that remittances will decline to reach USD 12 billion in Southeast Asia.

The export variable also shows a significant positive effect on GDP per capita in ASEAN 6. The coefficient value confirms this result on the export variable of 0.499388 and a probability value of 0.0000 smaller than alpha 5%. This result means that if there is an increase in exports by one unit, it will impact an increase in GDP per capita in countries and vice versa when there is a decrease in exports by one unit. It will reduce GDP per capita by the coefficient value.

Export is one of the contributors to a country's economy. The export element can affect several other components: the trade balance, balance of payments, foreign exchange reserves, and economic growth. It is important to pay attention to the complexity of this export effect so that its performance can significantly affect the economy. Regional cooperation, as outlined in the AEC (ASEAN Economic Community), also contributes to aspects of international trade through beneficial regulations. Several regulations, including the tariffs that apply intra ASEAN, have been removed, and almost 98.6% of tariff posts have been removed to facilitate trade. This effort is being paid attention to and is being intensified to improve trade facilities and minimize trade barriers in regional countries (ASEAN Integration Report, 2019).

The integration of digital technology also plays an important role in international trade. Through ATIGA (ASEAN Trade in Goods Agreement), an agreement related to international trade in goods has integrated technology in the form of e form D for media to give tariff preference based on ATIGA through the ASW platform. This is one of the steps so that exporters cooperating with the international scope have an operationally independent certificate. All ASEAN member countries have also been connected to a web-based system at the ASEAN level as providers and custodians of trade and customs-related information.

Other initiatives on trade facilitation include the ASEAN Seamless Trade Facilitation Indicators (ASTFI), which were adopted in 2017 and designed to measure and monitor the implementation of trade facilitation measures across the region. Practical trade facilitation tools were also developed, such as the ASEAN Tariff Finder, a free, online search engine for up-to-date information on tariff-related information

under various ASEAN Plus One FTAs, and the ASEAN Solution for Investment, Services, and Trade (ASSIST), the mechanism does not binding and consultative for fast and effective solutions to operational problems faced by ASEAN-based companies in implementing ASEAN economic agreements (ASEAN Integration Report, 2019).

Apart from the export of goods, in the intra-ASEAN scope, there is also an increase in service exports. Services exports were recorded to have increased by 50.7% in 2018. Intra-ASEAN service exports grew by an average of 5.5% per year, compared to 5.0% for service imports. ASEAN service exports were valued at USD 404.9 billion in 2018, an increase of 89.4% from USD 213.8 billion in 2010, while imports of services reached USD 373.8 billion in 2018, an increase of 65.8% from USD 225.4 billion in 2010.

Although ASEAN has recorded a deficit in its services trade since 2010, significant growth in services trade has narrowed the ASEAN trade deficit (ASEAN Integration Report, 2019). Since 2016, ASEAN has recorded a trade surplus in its services trade, with services exports growing higher than imports at 8.3% per annum between 2010 and 2018, compared to 6.5% for imports. In 2018, ASEAN's top three service exports were travel services (34.3%), other business services (22.1%), and transportation services (18.6%).

From the import side, services that dominate include transportation services (30.7%), other business services (24.1%), and travel services (21.1%). Travel services, other business services, and transportation services have consistently dominated the exports and imports of ASEAN services in the last decades. Travel and Transportation consistently recorded the highest share during the 2010-2018 period in terms of the services trade sub-sector. At 28.0%, exports from travel services recorded the highest share in 2018, increasing from 26.1% in 2010.

The performance of export and import trade in goods and services will, directly and indirectly, contribute to the national production output of ASEAN countries that can form each country's national GDP so that the effect of an increase in exports can have an impact on increasing GDP in ASEAN while an increase in imports can actually result in a decrease in GDP in ASEAN, especially for per capita income which is reflected in GDP per capita which can interpret a local purchasing power and demand.

Meanwhile, this study did not significantly affect GDP per capita in ASEAN 6 countries in this study. The result shows that the import shows a negative coefficient with an insignificant probability which is confirmed by a coefficient value of -0.070690 and a probability of 0.5283. This result means that an increase in imports in ASEAN 6 countries can impact a decrease in GDP per capita and vice versa. However, in this study, this effect did not show significant results. In addition, FDI also indicates a positive influence in influencing GDP per capita in ASEAN 6, but it does not have a significant effect. This result is confirmed by a coefficient value of 0.014653 and a probability value greater than alpha 5%, which is 0.3695. So these results confirm that an increase of one unit of foreign capital flows into ASEAN 6 countries can increase GDP per capita by the coefficient value and vice versa. In this study, this influence did not affect significantly.

ASEAN continues to advance its four-pronged agenda in the investment sector, namely liberalization, promotion, facilitation, and protection. A protocol to amend the ASEAN Comprehensive Investment Agreement (ACIA) has been signed, which is expected to contribute to increasing investment cooperation through the incorporation of built-in agenda items in ACIA and the incorporation of WTO Trade-Related Investment Measures-plus Prohibition Performance Requirements obligations into one

agreement. Consistent reforms in ASEAN countries have also supported a better investment environment in the region through more detailed regulations related to sustainable investment, increased investment protection, and increased investment facilitation. In addition, due to increasing concern for sustainability throughout ASEAN, interest in sustainable investment has also increased in the region (ASEAN Integration Report, 2019).

Integrating the concept of sustainability from all aspects of both investment and trade through various regulations that support environmental sustainability can have a significant positive impact on creating inclusive growth and development. This is also a form of appreciation and support for the global agenda to achieve sustainable development to mitigate pollution and environmental degradation, which is currently increasingly happening. In addition, the existence of investment by prioritizing the concept of sustainability will also impact the absorption of more workers by minimizing the use of technology that can pollute the environment. More technology-intensive flows will be diverted to labor-intensive with various considerations and other aspects to reduce excessive energy use as engine fuel and absorb more labor supply.

Other results also show that price increases as reflected by inflation show a negative but insignificant effect on GDP per capita in ASEAN 6. This result is confirmed by a coefficient value of -0.000878 and a probability value greater than alpha 5%, namely 0.7790. When there is an increase in the price of one unit, it will impact the decrease in GDP per capita by the coefficient value and vice versa. A massive price increase will hamper people's purchasing power so that it can reduce aggregate demand. This will result in a decrease in output from production, so it has a significant impact on the downward trend in GDP. This cycle will occur as a domino effect caused by unstable prices.

The phenomenon of the economic and health crisis that occurred in early 2020 had a major impact on the global economic downturn. This condition is indicated by a downward trend in all economic performance resulting from the Great Recession. The declining value of GDP indicates this to a negative number, the decline in the contribution of various sectors to the preparation of GDP in all countries to the flow of remittances which also decreased. Social restrictions decrease demand and reduce human activities in carrying out their socio-economic activities. The economic and domestic activity also experienced a largely downward trend, such as exports and imports, which experienced a decline in performance from 2020 to 2021 in the first quarter. Macroeconomic fundamentals experience increasing uncertainty with the decline in performance in various aspects.

This study is in line with the results of research by Mariska et al. (2021); Romadona et al. (2021); Cazachevici et al. (2020), and Meyer & Shera (2017) that an increase in remittances will have an impact on an increase in GDP per capita which reflects a growth in the economy. Meanwhile, Alkhathlan's (2013) empirical study found contradictory results. His study showed that remittances had a significant negative effect on the economy in Saudi Arabia. However, the same results show that exports in Saudi Arabia increase economic growth in line with the results of this study.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

GDP per capita in ASEAN 6 is significantly affected by remittances and export performance in a positive direction. Meanwhile, imports also showed significant negative results. In addition, FDI also shows the direction of a positive relationship in

affecting GDP per capita in ASEAN 6 but does not significantly influence it. Inflation as a proxy for purchasing power and prices also negatively impacts GDP per capita in ASEAN 6 but does not significantly affect it.

Recommendations

The results of this study can be to serve as a reference in making policies or regulations, especially for the management of remittances and FDI, so that they can contribute significantly to affecting GDP per capita. Especially for remittances which can be managed further to increase access to finance and business capital so that the circulation of money will be longer and have a significant impact in encouraging an increase in GDP per capita. Policies in strengthening protection and guarantees for international migrants are very important, especially during a pandemic, both from the health and economic aspects. Legal international migrants need to be properly nurtured and supervised for the purpose of social protection so that from the health aspect, there is also a need for special guarantees. In addition, from the economic aspect, to maintain income, workers need to be transferred to jobs that still have a relationship with their previous work while still paying attention to aspects of health protocols. For example, each country's embassy in another country can provide other related jobs so that migrants can continue to be productive and earn income even though it is not as optimal as the previous income.

In addition, FDI is also very important to encourage job creation by integrating the concept of sustainability. In terms of international trade, the various existing regulations to integrate trade in the ASEAN region have been well applied but have not been able to have a massive impact in terms of quality and quantity of trade and institutional aspects. Price stability is also a very important instrument to maintain demand so that production output performance remains stable and creates a more conducive economic condition because weakening prices, which are an indicator of an economic downturn, will also have a negative impact on the economy.

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The impact of monetary policy on private capital formation in Nigeria: Autoregressive Distributed Lag Approach

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Abstract

The study examines the impact of monetary policy on private capital formation in Nigeria from 1980 to 2020. The study adopts Keynes's theory of capital formation as its theoretical framework. The stationarity tests show a mixed level of stationarity among the variables. Consequently, the study employs ARDL as its estimation technique. The study reveals that Monetary Policy has a positive impact on Private Capital Formation in Nigeria. Based on the findings, the study recommends that the government should maintain the current Monetary Policy Rate (MPR) to continue impacting Private Capital Formation positively. Secondly, the government should formulates appropriate policies that will ensure that the Exchange Rate (EXCHR) is stable so that it can improve the level of Private Capital Formation in Nigeria. Lastly, the government should embark on policies that will curb inflation or help reduce the rate of inflation to increase the level of Private Capital Formation.

Keywords: *ARDL, Monetary policy, Private capital formation*

JEL Classification: C23, D24, E52

INTRODUCTION

One of the major objectives of macroeconomics is maintaining sustainable economic growth, and the role of Private Capital Formation in achieving this objective is of great importance (Robert, 2014). For a country to achieve impactful Private Capital Formation, the role of government policy and its impact cannot be over-emphasized. Capital formation, which is an increase in or expansion of real capital stock such as machines, tools, factories, and transport equipment in a country, is usually geared towards future good production (Suman, 2018). Savings and investment are indispensable in the addition of capital stock, and the monetary policy can mainly stimulate this.

Due to the claim that monetary policy as one of the government policies determines the rate of accumulation of physical capital (otherwise called capital formation) through its mechanism, it, therefore, becomes an important factor in the increase of productive activities of the country and contributes to growth generally. Monetary policy, which is a deliberate action imposed by the government through the Central Bank in order to maintain domestic prices and exchange rate stability, the balance of payment equilibrium, among others, has been identified as a vital instrument that enhances private capital formation by affecting the level of the money supply

through either the expansionary or contractionary measures. It also influences the level and structure of interest rates and, thus, the cost of funds in the market depending on the prevailing economic conditions (Nzotta, 2014). Capital formation is therefore said to be a prerequisite to an increase in the physical capital stock with investment in social and economic infrastructures (Atuma et al. 2017).

Over the years, the Nigerian government has adopted various monetary policies through the Central Bank in order to attain stabilization in economic growth, which is one of the objectives of Monetary Policy. To achieve this, the Central Bank relies on Monetary Policy tools as its major barometer for adjusting economic activities designed by the monetary measures to be either expansionary or contractionary (Nwoko et al., 2016). These policies seek to impact directly or indirectly on the supply of money, supply of credit to the economy, the structure of interest rate to achieve price stabilization, the balance of trade equilibrium, and sustainable rate of growth (Uwazie & Aina, 2015), which will result to either an increase or decrease in the capital formation of the country which tends to boost the private sector or the public sector through increased economic activities.

Unfortunately, these policies are yet to drive the country's capital formation to its desired point, as revealed in Table 1. The table shows that despite the reducting in MPR from 14 points in 2018 to 13.5 points in 2019, the increase in Capital Formation does not commensurate with the reduction of MPR. The table further shows that the reduction of MPR by one point from 12.5 in 2020 to 11.5 in 2021 had no positive impact on capital formation rather, it reduced its value. Hence, the authority has moved further to introduce privatization and commercialization to encourage private and public investment due to the country's low productivity, which, when encouraged, will increase the country's Gross Domestic Product (GDP) and, ultimately, the total capital formation. Private Capital Formation has the tendency to increase the level of investment and capital stock in the country which will also give rise to a stable Economic Growth (Osundina & Osundina, 2014). Despite the increase in the Monetary Policy regulations by the monetary authorities in Nigeria, the problems of shortage of private capital formation persist. This study will investigate the impact of monetary policy on private capital formation in Nigeria.

Table 1. Monetary Policy Rate (MPR) and Gross Capital Formation (GCF) in Nigeria, 2016 - 2021

Year	MPR (%)	GCF (US $)
2016	14.0	62,181,498,801
2017	14.0	58,144,239,836
2018	14.0	78,698,428,099
2019	13.5	113,893,799,699
2020	12.5	127,089,444,456
2021	11.5	120,491,622,077

Sources: 1. MPR from Central Bank of Nigeria statistical bulletin.
2. GCF from World Bank indicator

This current research investigates how monetary policy instruments have contributed to Private Capital Formation in Nigeria. The study seeks to add to an existing body of knowledge. It will also greatly benefit the government and policymakers in terms of helping them understand the influence of monetary policies on private investment and building policies that will ensure increased and sustainable

private investment growth in Nigeria. This study will help policymakers, government, agents, and researchers in monetary policy and private capital formation.

Dang, et al. (2020) sheds new light on the relationship between monetary policy and private investment in Vietnam. They found that private investment is positively affected by monetary policies through broad money, domestic credit, and interest rate channels. There is no credible evidence yet regarding the effect on the exchange rate. Similarly, Okumoko & Akarara (2016) investigated the impact of the Monetary Policy rate on savings and investment in the Nigerian economy from 1960 to 2016. The study employed Vector Autoregressive (VAR) technique to estimate the data, and they found that shocks such as an increase in Monetary Policy Rate (MPR) increase both Savings Rate (SAVR) and Total Investment (INVR) in the short-run and the long-run.

Hassan (2015) explored the impact of Monetary Policy on Private Capital Formation in Nigeria. The study covered 1986 to 2013 and used the Ordinary Least Square Multiple regression techniques. The study showed that the GDP growth rate had not attracted significant private investment. In contrast, the money supply and the exchange rate have been relatively stable, encouraging an increase in private investment and promoting sustainable economic growth through private investment. Ayodeji & Oluwole (2016) investigated the impact of Monetary Policy on Economic Growth in Nigeria between 1981 and 2016 using the Johansen cointegration and vector error correction model. The findings revealed that money supply and exchange rate are positively related but have a fairly insignificant impact on Economic Growth. Also, interest rate and liquidity ratio are negatively related but have a highly significant impact on Economic Growth. The study advised that full autonomy should be in place for Central Banks of developing countries, and Government interference should be encouraged. Egbe et al. (2015) investigated the impact of Monetary Policy on corporate investment in Nigeria. The study revealed no significant relationship between the volume of investment and interest rate, and there is a weak relationship between the cost of capital and interest rate. Shuaib & Ndidi (2015) examined the Private Capital Formation impact on Nigerian economic growth between 1980 and 2013. From the empirical findings, it was discovered that there is a significant relationship between capital formation and Economic Development in Nigeria. The study recommended that the government continue to encourage savings, create a conducive investment climate, and improve the infrastructural base of the economy to boost capital formation and promote sustainable growth. Anowor & Okorie (2013) reassessed the impact of Monetary Policy on Economic Growth in Nigeria between 1982 and 2013. They found that interest rate and Monetary Policy rate have a negative relationship with Economic Growth, and the cash reserve ratio has a positive relationship with Economic Growth.

This study, therefore, revealed that for Nigeria's economy to be put along the path of sustainable growth and development particularly through an increase in private investment, Monetary Policy that directs credit to the private sector is expected to be embarked upon to encourage private investment in Nigeria. Given the important role of Monetary Policy and Private Capital Formation in Nigeria, this study will contribute enormously to the planning and implementation of Monetary Policy to increase private investment in Nigeria.

METHODS

This study adopts Keynes's theory of capital formation as its theoretical framework. The theory emphasizes that given the marginal efficiency of capital, a fall in

the interest rate will increase the volume of investment (capital formation). Keynes believes that the economy is always at or near the natural level of real GDP. The main function of this approach is to act as a medium of exchange and determine the general price level of which goods and services are to be exchanged (Blinder, 1987). The quantity theory of money is usually discussed in Fisher's equation of exchange, where it was believed that there is full employment in the economy. Thus, the amount of investment taken depends on the expected returns and the cost of capital (interest rate). The investment will only be profitable when the marginal efficiency of capital is equal to the cost of capital. Assuming the price of capital goods changes over time, it becomes necessary to distinguish between the marginal efficiency of capital (MEC) and the marginal efficiency of investment (MEI).

The data used in this study were sourced from the Central Bank of Nigeria statistical bulletin and World Bank indicator. This study employs the model of Hassan (2015) with modifications.

$$\text{GFCF} = F(\text{MPR}, INF, RGDP, \text{EXCHR}, \text{PUBEXP}) \quad \text{(1)}$$

The econometric form of the model above is stated as:

$$GFCF_t = \beta_0 + \beta_1 MPR_t + \beta_2 INF_t + \beta_3 RGDP_t + \beta_4 EXCHR_t + \beta_5 PUBEXP + \mu_t \quad \text{(2)}$$

where

GFCF = Gross Fixed Capital Formation
MPR = Monetary Policy rate
INF = Inflation rate
RGDP = Real Gross Domestic Product
EXCHR = Exchange rate
PUBEXP = Public expenditure
μ_t = stochastic error term
β_0 = constant intercept
$\beta_1 - \beta_5$ = coefficient of the associated variables

However, the dependent variable and one of the independent variables were not in the same unit. Hence, they were logged to bring the data to the same level. Thus, the above equation (2) can be re-specified as;

$$LOG(GFCF)_t = \beta_0 + \beta_1 MPR_t + \beta_2 INF_t + \beta_3 RGDP_t + \beta_4 EXCHR_t + \beta_5 LOG(PUBEXP)_t + \varepsilon_t \quad \text{(3)}$$

RESULTS AND DISCUSSION

Descriptive statistics

Table 2 indicates that from 1980 to 2020, all of the variables under consideration show an averaged positive mean value with 40 observations. The standard deviation showed that the GFCF records the highest standard deviation (869090.4) while MPR records the least. The skewness statistics from the table revealed that five of the variables are positively skewed, while one variable is skewed negatively. The kurtosis coefficients show that two of the variables are leptokurtic, suggesting that the distributions are high relative to a normal distribution. Three variables are mesokurtic, indicating not too flat-topped, while one other variable is platikurtic, suggesting that the distributions are flat-topped.

Table 2. The descriptive statistics

	GFCF	MPR	INF	RGDP	EXCHR	PUBEXP
Mean	630714.4	6.209944	18.89225	4.893821	97.62067	3869836.
Median	154362.5	6.709583	12.15500	5.260085	97.40000	1211066.
Maximum	2442704.	11.06417	72.84000	14.60438	365.9000	12700000
Minimum	10597.00	0.316667	5.380000	-1.583065	0.550000	14697.41
Std. Dev.	869090.4	3.056790	16.91599	3.669652	106.1097	4422113.
Skewness	1.196938	-0.234382	1.823960	0.409243	1.187449	0.601925
Kurtosis	2.728945	2.069166	5.151077	2.695332	3.795190	1.668728
Jarque-Bera	9.673521	1.810319	29.89076	1.271236	10.45412	5.369234
Probability	0.007933	0.404477	0.000000	0.529608	0.005369	0.068247
Sum	2522858	248.3977	755.6900	195.7529	3904.827	1.55E+08
Sum Sq. Dev.	2.95E+13	364.4147	11159.88	525.1876	439111.5	7.63E+14
Observations	40	40	40	40	40	40

The Jarque-Bera (JB) test statistic was used to determine whether the variables (control variables) follow the normal probability distribution. The JB test of normality is a large-sample or asymptotic test that computes kurtosis and the skewness measures. Therefore, we examine the Sample mean, standard deviation, skewness and kurtosis, and the Jacque-Bera statistics and p-values. The probabilities of the Jarque-Bera test of normality for the variables indicate that four of the variables have values greater than the 5% significance level, thus indicating that the variables are normally distributed.

Correlation

Under the correlation test, we conduct the test to ascertain the degree of relationship that exists between the dependent variable and the independent variables. It is done using the correlation matrix. In the correlation test, we test the variables to ascertain the degree of relationship between the independent and dependent variables. The relationships among the studied variables depicted in the model were tested using a correlation matrix, and the result is presented in Table 3.

Table 3. The correlation matrix

	GFCF	MPR	INF	RGDP	EXCHR	PUBEXP
GFCF	1.000000	0.603761	-0.300488	-0.173753	0.872786	0.846234
MPR	0.603761	1.000000	-0.190167	-0.092143	0.615049	0.547866
INF	-0.300488	-0.190167	1.000000	-0.208966	-0.308031	-0.362926
RGDP	-0.173753	-0.092143	-0.208966	1.000000	-0.090602	0.050619
EXCHR	0.872786	0.615049	-0.308031	-0.090602	1.000000	0.815902
PUBEXP	0.846234	0.547866	-0.362926	0.050619	0.815902	1.000000

The correlation result shows that three variables have positive relationships with private investment. The relationships are at 60%, 87%, and 84%, respectively, while two variables, INF and RGDP, indicate negative signs ranging from -30% and -17%, respectively. Hence, we conclude no multicollinearity among the variables under consideration.

Unit root test

Economic variables are generally non-stationary, and they are a random process. Linear combination of non-stationary series, in general, is a non-stationary series and closely associated with economic theory. Because economic theory guarantees stagnation of a combination of economic variables, Dickey Fuller's generalized test for investigating stationary variables are used in this study. In order to assess the time-series properties of the data, a unit root test was conducted. As Engle & Granger (1987) argued, if individual time series data are non-stationary, their linear combinations could be stationary if the variables were integrated of the same order. The assumption is stated

as follows: If the absolute value of the Augmented Dickey-Fuller (ADF) test is greater than the critical value either at 1%, 5%, or 10% level of significance at order zero, one, or two, it shows that the variable under consideration is stationary otherwise it is not. The results of the Augmented Dickey-Fuller (ADF) test obtained are as follow:

Table 4. The unit root test

Variable	Level difference	Probability	Order of integration	First difference	Probability	Order of integration
GFCF	4.713284	1.0000		-4.470275	0.0010	I(1)
MPR	-2.007436	0.2826		-12.68686	0.0000	I(1)
INF	-3.001260	0.0435	I(0)			
RGDP	-3.412167	0.0165	I(0)			
EXCHR	0.314309	0.9761		-3.863114	0.0052	I(1)
PUBEXP	-0.505734	0.8786		-10.80370	0.0000	I(1)

The stationarity test result indicates that three of the variables under consideration are stationary at the level difference. In contrast, order one integrates four other variables at a 5% significance level. A bound cointegration test is conducted since there is a mixed order of cointegration.

Bound Auto-Regressive Distributed Lag (ARDL) testing approach

Conducting the ARDL bounds test procedure, it is expected that the variables are I(0) or I(1). Otherwise, the variable may be considered spurious. In the conduct of the ARDL test, we adopt the Augmented Dicky Fuller (ADF) test to determine the different levels of the variables. We, therefore, compute an F-statistics test procedure to test the long-run relationship in which the maximum lag length p is 2 in the ECM. The results for the bounds F-test is presented in Table 5.

Table 5. The ARDL Bound test results

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	4.327165	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18
1%	3.41	4.68

The Bound test result from the table above indicates that the underlining ARDL model can be established to determine the long-run slope-estimated coefficients and the short-run dynamic-estimated coefficients for the private investment in Nigeria. The ARDL (1, 4) is selected based on the Akaike information criterion (AIC).

The short-run error correction coefficients

There is a long-run equilibrium relationship among the variables in the regression model; however, the short-run transmits to the long-run. Thus, the Error Correction Mechanism (ECM) is used to correct or eliminate the discrepancy that occurs in the short run. The assumption of the ECM states that if two variables are cointegrated, then there is an error correction mechanism to revise instability in the short term (Engle and Granger, 1987). ECM is used to see the speed of adjustments of the variables to deviations from their common stochastic trend. ECM corrects the deviations from the long-run equilibrium by short-run adjustments. It shows us that changes in independent

variables are a function of changes in explanatory variables and the lagged error term in cointegrated regression. The ECM result is presented in Table 6.

Table 6. The short-run error correction coefficients results

ARDL Cointegrating And Long Run Form					
Dependent Variable: LOG(GFCF)					
Variable		Coefficient	Std. Error	t-Statistic	Prob
DLOG(GFCF(-1))		0.246864	0.167130	1.477076	0.1545
D(MPR)		0.037702	0.021846	1.725788	0.0991
D(MPR(-1))		-0.036036	0.021048	-1.712079	0.1016
D(INF)		-0.000966	0.002467	-0.391460	0.6994
D(RGDP)		-0.003000	0.011148	-0.269118	0.7905
D(EXCHR)		0.000441	0.000850	0.518653	0.6094
DLOG(PUBEXP)		-0.047848	0.065888	-0.726204	0.4757
DLOG(PUBEXP(-1))		0.070593	0.071935	0.981340	0.3376
DLOG(PUBEXP(-2))		-0.009619	0.070308	-0.136806	0.8925
DLOG(PUBEXP(-3))		-0.268678	0.069576	-3.861621	0.0009
ECM(-1)		-0.374290	0.094476	-3.961763	0.0007
R-squared	0.641354	Mean dependent var		0.132075	
Adjusted R^2	0.402256	S.D. dependent var		0.238203	
SE of regression	0.184164	Akaike info criterion		-0.251645	
Sum squared resid	0.712243	Schwarz criterion		0.408155	
Log-likelihood	19.52961	Hannan-Quinn criteria.		-0.021357	
F-statistic	2.682396	Durbin-Watson stat		2.453156	
Prob(F-statistic)	0.020083				

The equilibrium error-correction coefficient ECM (-1) is -0.374290. The coefficients have the expected negative sign and are statistically significant at 5% significant levels. It implies that there is a long-run impact running from independent variables to a dependent variable. It also confirms that all the variables are cointegrated or have a long-run relationship. Therefore, we can state that 37 percent gaps between long-run equilibrium values and the actual values of the dependent variable have been corrected. It can also be said that the speed of adjustment towards long-run equilibrium is 37 % annually. Its t-ratio is -3.961763, and the probability of the null hypothesis being true for zero is [0.0007], which is significant even when $\alpha = 0.05$. Thus, it can also be concluded that the adjustments are quite meaningful in the short-run ARDL relationship.

Statistically, the coefficient of determination R-squared is 0.641354. This implies that the independent variables explain the dependent variable to the tune of 64%. The F-statistic shows that the overall estimate of the regression has a good fit and is statistically significant. Also, the Durbin Watson (DW) statistics DW = 2.453156 greater than the R2 show that the overall regression is statistically significant. Thus, the result indicates no serial autocorrelation among the variables under consideration.

The long-run relationship between the monetary policy rate and private investment

Table 7 shows that MPR has a positive and significant impact on private investment in Nigeria at a 10% significant level in the long run. A 1% change in MPR will lead to a 0.112365% increase in private investment in Nigeria. The result is in line with the findings of Auer, 2014 and Dang et al. 2020. It also conforms with the apriori expectation. It implies that the monetary authority is formulating appropriate policy that stimulates the expansion of real capital stock such as machines, tools, factories, and

transport equipment in a country are usually geared towards future production of a good in Nigeria.

Table 7. Long run coefficients results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MPR	0.112365	0.061282	1.833583	0.0809
INF	-0.002580	0.006556	-0.393471	0.6979
RGDP	0.029949	0.037186	0.805393	0.4296
EXCHR	0.001178	0.002087	0.564343	0.5785
LOG(PUBEXP)	0.604552	0.096080	6.292199	0.0000
C	3.478699	0.944730	3.682215	0.0014

The result further shows that the inflation rate, real gross domestic product, and exchange rate have no significant impact on private investment in Nigeria. It implies the variables are irrelevant and of no value in enhancing private investment in the country.

Lastly, the result reveals that exchange rate public expenditure has a positive and significant impact on private investment at a 1% significant level. A 1% change in public expenditure will lead to a 0.604552% increase in private investment. The result is in line with the study of Hassan (2015), Adegboyo, and Olaniyan (2021), and it conforms to the apriori expectation. It implies that the government is judiciously expending the available resources, stimulating private investment in Nigeria.

Diagnostic test

Diagnostic tests examine the model for serial correlation, functional form, non-normality and heteroscedasticity.

Table 8. Serial correlation tests

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	5.070848	Prob. F(2,19)	0.0172
Obs*R-squared	12.52848	Prob. Chi-Square(2)	0.0019

The serial correlation test result shows that the null hypothesis of a serial correlation is rejected. The corresponding probability values of the F-statistics are statistically insignificant at a 5% level. Thus, we conclude no serial correlation among the variables under consideration.

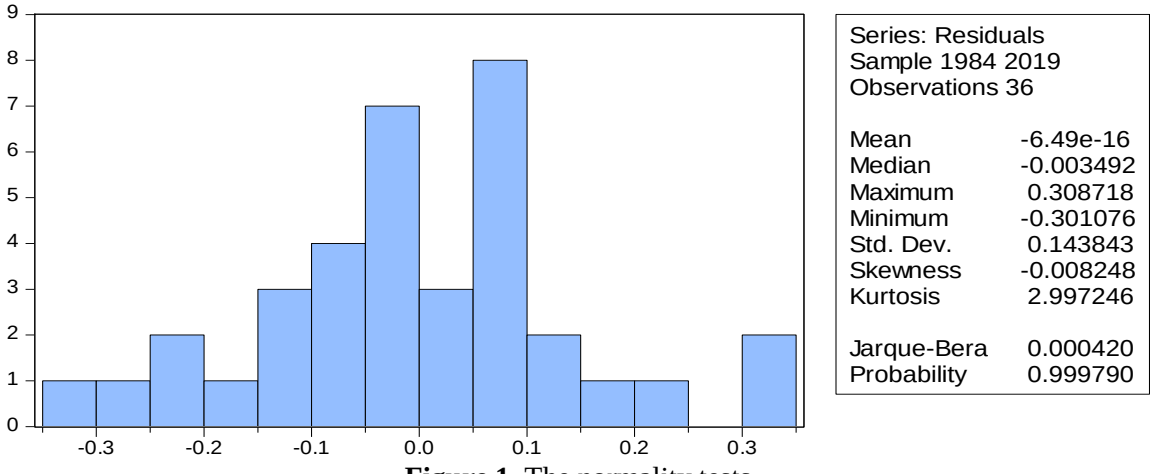

Figure 1. The normality tests

Ho: The sample data are not significantly different than a normal population
H1: The sample data are significantly different than a normal population.
Probabilities > 0.05 accept the null hypothesis
Probabilities < 0.05 reject the null hypothesis

The probability is 0.999790, greater than 0.05 at a 5% significant level; therefore, the null hypothesis is accepted. It implies that the residuals are normally distributed.

The heteroskedasticity test

Table 9 shows the probability of Chi-Square (14) is 0.2965, greater than 0.05 at a 5% significant level; therefore, the null hypothesis is accepted. It implies and therefore confirms the absence of heteroscedasticity in the model. That is, the error terms are homoscedastic, i.e., they have constant variance in repeated sampling

Table 9. Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.279684	Prob. F(14,21)	0.2965
Obs*R-squared	16.57333	Prob. Chi-Square(14)	0.2796
Scaled explained SS	5.631772	Prob. Chi-Square(14)	0.9749

Ho: homoscedasticity
H_1: heteroscedasticity
Probabilities > 0.05 accept the null hypothesis
Probabilities < 0.05 reject the null hypothesis

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study examined the impact of Monetary Policy on Private Capital Formation in Nigeria from 1980 to 2020. This study adopts Keynes's theory of capital formation as its theoretical framework. The stationarity tests show that two of the variables under consideration are stationary at the level difference, while four other variables are integrated of order one at a 5% significance level. Based on the mixed result of the unit root test, the study employs ARDL as its estimation technique. The study concluded that monetary policy and public expenditure positively and significantly impact Nigeria's private capital formation based on the regression estimates. In contrast, the inflation rate, real gross domestic product, and the exchange rate had no significant impact on private investment in Nigeria.

Recommendations

From the findings discussed, the following recommendations were offered: first the government should maintain the current Monetary Policy Rate (MPR) to continue impacting Private Capital Formation positively. Secondly, the government should formulates appropriate policies that will ensure that the Exchange Rate (EXCHR) is stable so that it can improve the level of Private Capital Formation in Nigeria. Lastly, the government should embark on policies that will curb inflation or help reduce the rate of inflation to increase the level of Private Capital Formation.

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Indonesian molasses export supply in world trade

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Abstract

This study examines the factors affecting Indonesian molasses exports in international trade using time series data from 2003 to 2019. The analysis tool used is the Error Correction Model (ECM). The analysis results show that in the long run, the variables of molasses production, exchange rates, and inflation have a significant effect on Indonesia's molasses export supply. In contrast, Indonesia's GDP, molasses export prices, and world CPO prices have no significant effect. In the short run, the variables of molasses production, world molasses prices, exchange rates, and inflation have a significant effect. The variables of Indonesia's GDP, molasses export prices, and world CPO prices have no significant effect on Indonesia's molasses export supply in world trade.

Keywords: *Error Correction Model, Export supply, Molasses, World trade*

JEL Classification: E23, F14

INTRODUCTION

The plantation is one of the sub-sectors with a vital role in the agricultural sector, namely a national economy that can improve farmers' welfare and reduce unemployment (Suryana 2014). The plantation sub-sector has considerable potential. In 2019, the plantation sub-sector contributed 3.27 percent to the Gross Domestic Product (GDP), the first contributor to the agriculture, livestock, hunting, and agricultural services sectors. Apart from contributing to GDP, the plantation sector is also a provider of raw materials for industry, an absorber of labor, and a foreign exchange earner (BPS 2020). Sugarcane is one of the plantation products that has been processed into various products and traded on the international market. Sugarcane has been cultivated extensively and intensively in Indonesia. The sugarcane plantation area reaches 413.05 thousand ha with around 2.23 million tons of production. Smallholders cultivated around 239.23 thousand ha in this area (BPS 2020).

Along with the development of technology, besides being processed into sugar, sugar cane can also be used as a variety of alternative food, feed, fiber, and energy products in the form of biofuels to support the needs of the electrical and automotive industries. Apart from being used for domestic consumption, some products are also exported in derivative products, namely molasses. The development of sugarcane derivative products, especially cane molasses, can be traded on the world market. Indonesia's molasses export contribution to world trade in 2019 reached 14.7 percent and was in second place after India. Indonesia's molasses exports have increased compared to exports in 2017, which reached 9.43 percent (OEC 2020). India is the

world's foremost exporter of molasses, accounting for 19.4 percent of the world's total molasses exports. After Indonesia, Thailand and Guatemala contributed 11.9 percent and 9.33 percent of world exports, and the rest were met by other countries such as El Salvador, Australia, and Pakistan.

The export contribution of Indonesian molasses is around 78.4 percent of the total export of sugarcane products (Erliza et al., 2007). Nearly 50 percent of Indonesia's molasses production is exported to destination countries such as Japan, South Korea, the Philippines, and other export destination countries. During the last three periods, Molasses exports grew from 426,000 tons in 2017 to 642,000 tons in 2019. Molasses production in 2019 reached 1.24 million tons, and 52 percent was exported from domestic supplies. This excess of domestic molasses that has not been utilized is then exported. Inefficiency is a vital problem in the national sugar industry because much sugar cane is wasted during processing in sugar factories. It resulted in the yield tending to below. Therefore, the government revitalized and built several new factories to diversify products from sugar cane derivatives to add value.

The Government of Indonesia requires the use of E5 bioethanol in 2020 with a formulation of 5 percent ethanol and 95 percent gasoline and increases to E20 in 2025 (Government Regulation of the Republic of Indonesia No. 79 of 2014 concerning energy policy and the Minister of Energy and Mineral Resources Regulation No. 12 of 2015 concerning biofuels' supply, utilization, and trading as other fuels). It is done because the utilization of molasses in Indonesia is still very low. However, the plan has faced various obstacles, such as the limited production infrastructure, the less competitive cost of processing bioethanol, and the distribution of biofuels, especially in Eastern Indonesia, and the limited raw material for molasses is often exported. In addition, the selling price of bioethanol is not compatible. So the government revised the use of bioethanol by lowering the ethanol content to 2 percent. Ghani & Gheewala (2021) stated that the sale of E5 has not been implemented throughout the country, resulting in the export of molasses and bioethanol being greater than consumption in the domestic market. The lack of financial support to run the blending program and the mandate that was never enforced resulted in the downstream molasses not being optimal (Rahmanulloh, 2021).

Waste treatment is still a problem in the sugar industry because waste cannot be adequately treated, so production is hampered, and factory performance will decline. It has caused the incessant export of molasses so that the stock of molasses raw materials is decreasing, and the price of raw materials is not controlled. The low domestic molasses price makes farmers sell molasses abroad than domestically. Utami & Hasanah (2017) mention that the high price of molasses in the global market is why molasses are exported more than sold in the domestic market. Domestic molasses development is a challenge for the Indonesian government. Limitations in processing molasses into processed products are an obstacle for Indonesia in exporting processed molasses products. It is what makes Indonesia export molasses in its raw form. In the face of declining exports and competition with the fellow world, molasses producers will increase in the future. The existence downstream can increase employment, and factories will create demand for a product which ultimately gives value to the product (Szulczyk et al., 2021).

In contrast to previous studies on export offers, this study focuses on examining the export offers of molasses, which is a by-product of sugarcane processing. The limited research related to molasses, especially in the economic field, makes this research interesting to study by adding several economic variables. Therefore, a more

in-depth analysis will be carried out on supply performance and production capability determined by farmers' response to changes that occur either due to market mechanisms or government policies.

METHODS

This study uses secondary data in the form of time series (quarterly time series) for 17 years from 2003 (2003:Q1) to 2019 (2019:Q4). Data sources were obtained from various sources such as the Central Bureau of Statistics, International Trade Center, Food Agriculture of Organization, UN Comtrade, and the World Bank. Analysis of quantitative data and factors that affect molasses export supply using the *Error Correction Model* (ECM) method. The data was processed quantitatively using Microsoft Excel and Eviews 12 programs.

Stationarity test

Regression using non-stationary data will lead to spurious regression. This problem arises due to a strong trend of the dependent and independent variables in the time series. This study for stationarity uses the unit root test by comparing Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF). If the value of DF and ADF is greater than the critical value, then the data is stationary. Vice versa, if the DF and ADF values are smaller than the critical value, the data is not stationary and is continued with the cointegration test (Dzakiyah *et al.* 2018).

Cointegration test

The cointegration test is used to continue the analysis of non-stationary time series data (Falanta 2017). The cointegration technique was first introduced by Engle & Granger (1987) and developed by Johansen (1988). A cointegration test is carried out to see the long-run equilibrium, while the imbalance fluctuations in the short run are corrected using an Error Correction Model (ECM).
The formation of the Error Correction Model (ECM) in the equation of Indonesian molasses export supply, in the long run, can be formulated as follows:

$$LnXMo = \alpha_0 + \alpha_1 LnQMo + \alpha_2 LnGDP + \alpha_3 LnPXMo + \alpha_4 LnPWMo + \alpha_5 LnER + \alpha_6 LnPCPO + \alpha_7 LnInf + \varepsilon_t \quad \ldots\ldots (1)$$

Where:

XMo	= Molasses export volume to destination country (tons)
QMoi	= Indonesian molasses production (tons)
GDPi	= Gross Domestic Product of Indonesia (US$)
PXMoi	= Indonesian molasses export price (US$/ton)
PWMo	= World molasses export price (US$/ton)
ERij	= Exchange rate (Rp/US$)
PWCPO	= World palm oil price (US$/ton)
Inf	= Inflation (%)
ε	= Error term

The model specification using ECM is then tested on the *Error Correction Term* (ECT) coefficient. In this model, the coefficient value must be negative and statistically significant. If these conditions are violated, the variables will move further away from the balance line and form a new imbalance so that the model cannot be used (Iladini and Agustina 2020). In order to know the relationship between Indonesian molasses exports and the independent variable empirically, the balance cannot be known directly.

However, it can be estimated in the short-run equation by including the element of ECT. The equation of the short-run model is shown as follows:

$$LnXMo = \alpha_0 + \alpha_1 \Delta QMo + \alpha_2 \Delta GDP + \alpha_3 \Delta PXMo + \alpha_4 \Delta PWMo + \alpha_5 \Delta ER + \alpha_6 \Delta PCPO + \alpha_7 \Delta Inf + ECT_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

The ideal and optimal linear regression estimation model must produce an estimator that meets the Best Linear Unbiased Estimator (BLUE) criteria. The classical assumption test includes multicollinearity, heteroscedasticity, and autocorrelation tests.

RESULTS AND DISCUSSION

The dependent variable in this model is Indonesian molasses export, influenced by independent variables such as molasses production, Indonesian GDP, molasses export price, world molasses price, exchange rate, world palm oil price, and inflation. The stages in the Error Correction Model analysis are as follows:

Heteroscedasticity test

Heteroscedasticity is a regression problem that does not have the same variance or variance is not constant. The heteroscedasticity test used the Breusch-Pagan-Godfrey. The results of the Breusch-Pagan-Godfrey test obtained the value of Prob. Chi-Square of 0.8243 > 0.05 (α = 5%), it can be concluded that the regression model made does not have heteroscedasticity. The results of the heteroscedasticity test can be seen in Table 1.

Table 1. Heteroscedasticity test results

F-statistic	0.503309	Prob. F(8,58)	0.8489
Obs*R-squared	4.349331	Prob. Chi-square (8)	0.8243
Scale explained SS	10.10468	Prob. Chi-square (8)	0.2578

Multicollinearity test

Multicollinearity is a deviation that occurs due to the relationship between the independent variables that make up the model. This study determines the presence or absence of multicollinearity by calculating the *Variance Inflation Factor* (VIF) value. Based on the results of the multicollinearity test in Table 2, all independent variables have a VIF value of less than 10. So it can be concluded that the regression model is free from multicollinearity problems.

Table 2. Multicollinearity test results

Variable	Coefficient Variance	Centered VIF
Constanta	74.97140	NA
Production	0.003461	1.021278
Indonesia's GDP	0.627893	7.638991
Molasses export price	0.227821	1.845274
world molasses price	0.005749	1.917338
Exchange rate	2.192618	5.263387
World palm oil price	0.216196	2.700599
Inflation	0.077726	2.063878

Autocorrelation test

Autocorrelation shows a high correlation between the errors. The occurrence of correlation is caused by standard errors that are biased downwards or smaller than the actual value so that the statistical value is high (Juanda & Junaidi, 2012). This study uses the *Breusch-Godfrey test*. If the probability value is less than 0.05, it indicates an autocorrelation. The autocorrelation results show that the probability value is 0.2372 >

0.05 (α = 5%). So it can be concluded that the model made has no symptoms of autocorrelation.

Table 3. Autocorrelation test results

F-statistic	1.475170	Prob. F(2,58)	0.2372
Obs*R-squared	3.291584	Prob. Chi-Square (2)	0.1929

Stationarity test

The first step in the ECM analysis is the unit root test. Data that contains a unit root test means that the data is not stationary by comparing the *Augmented Dickey-Fuller* (ADF) value with the critical value. Anfosino et al. (2016) found that the ADF value is greater than the critical value. The data is stationary, and vice versa; if the ADF value is less than the critical value, the data is not stationary.

Table 4. Unit root test results at the level

Variable	ADF Value	Test Critical Value	Description
Molasses export	-6.882178	-2.906210	Stationary
Molasses production	-7.496940	-2.906210	Stationary
Indonesia's GDP	0.490174	-2.906210	Not Stationary
Molasses export price	-2.229426	-2.906210	Not Stationary
world molasses price	-2.913210	-2.906923	Stationary
Exchange rate	-1.156728	-2.906210	Not Stationary
Palm oil price	-2.151974	-2.906210	Not Stationary
Inflation	-2.073911	-2.906210	Not Stationary

Based on the unit root test results above, it shows that the variables of Indonesia's GDP, molasses export prices, exchange rates, palm oil prices, and inflation are not stationary at levels with the ADF value less than the critical value. These circumstances do not meet the requirements to proceed to ECM estimation. So it is necessary to do a unit root test at the first difference level (α = 5%). Table 5 shows that the variables of molasses exports, molasses production, Indonesia's GDP, molasses export prices, world molasses prices, exchange rates, world palm oil prices, and inflation have negative values and are less than the critical value. Stationary at the first difference level.

Table 5. Unit root test results at 1st difference

Variable	ADF Value	Test Critical Value	Description
Molasses export	-6.882178	-2.906210	Stationary
Molasses production	-7.496940	-2.906210	Stationary
Indonesia's GDP	-9.222981	-2.906923	Stationary
Molasses export price	-4.494588	-2.906923	Stationary
world molasses price	-9.361071	-2.906923	Stationary
Exchange rate	-6.571988	-2.906923	Stationary
Palm oil price	-5.485797	-2.906923	Stationary
Inflation	-5.837182	-2.906923	Stationary

Cointegration test

The cointegration test is a follow-up test of ECM estimation after the unit root test. Muhammad (2014) states that cointegration occurs when the dependent and independent variables are both a trend so that each is not stationary. If the dependent and independent variables are not stationary but are mutually cointegrated, there can be a long-run equilibrium relationship between the dependent and independent variables. The cointegration test results in this study can be seen in Table 6.

Table 6. Cointegration test results

Cointegration Hypothesis	Lag	Trace Test		Max Eigen-Value Test	
		Trace Statistics	Critical Value	Max Eigen Statistics	Critical Value
None*	2	212.3564	159.5297	67.98803	52.36261
At most 1*	2	144.3684	125.6154	47.83636	46.23142
At most 2*	2	96.53205	95.75366	36.54840	40.07757
At most 3	2	59.98365	69.81889	27.95190	33.87687
At most 4	2	32.03176	47.85613	16.68670	27.58434
At most 5	2	15.34505	29.79707	8.953644	21.13162
At most 6	2	6.391409	15.49471	6.390917	14.26460
At most 7	2	0.000492	3.841465	0.000492	3.841465

**significant at 0.05%*

The Trace Test and Max Eigen-Value Test values cointegrate with the tested variables. According to Annisa (2021), the cointegration test has at least two cointegration relationships on the test variables. The existence of cointegration between variables can be continued to the ECM estimation because it has met the stationary and cointegration requirements.

Error Correction Model (ECM)

Error Correction Model (ECM) is used to see the effect of the independent variable on the dependent variable in the short and long run. In addition, ECM is used to avoid an imbalance in the relationship between variables in the short run.

Table 7. Estimation results of Long-Run Error Correction Model

Variable	Coefficient	Probability
Constanta	2.557765	0.7687
Molasses production	0.319332	0.0000***
Indonesia's GDP	-0.478583	0.5481
Molasses export price	0.372216	0.4386
world molasses price	0.080248	0.2941
Exchange rate	-1.550387	0.0299**
World palm oil price	0.462202	0.3242
Inflation	0.290727	0.0899*
R-Squared = 0.392469		
Adjusted R-Squared = 0.321591		

** significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%*

The long-run Error Correction Model (ECM) analysis shows that the production variable has a significant relationship to molasses exports at a level of 0.01 percent. When there is an increase in molasses production by 1 percent, it will increase molasses exports by 0.0319332 percent with a p-value of 0.000 < 0.01. According to Nainggolan et al. (2021), production is one factor that affects a country's commodity exports. Increased production will affect export supply. This study is by Hamzah & Santoso (2020), where the positive coefficient value indicates a unidirectional relationship between the production and export variables.

The exchange rate has a negative relationship with Indonesia's molasses exports. Every 1 percent increase in the exchange rate will reduce molasses exports by 1.550387 percent. The Indonesian exchange rate is significantly related to molasses exports with a p-value of 0.0299 < 0.05. Mardhiah et al. (2020) state that if there is a depreciation of the exchange rate, it will increase export demand while the exchange rate appreciates, it will reduce exports. It causes commodity prices in exporting countries to be cheaper

when the exchange rate depreciates, so the demand for molasses will increase. When the Rupiah exchange rate weakens against the US Dollar, this will result in export volumes because domestic commodities will become cheaper for importing countries (Mejaya Saleh et al., 2016; Hamzah & Santoso, 2020).

In this study, the inflation variable has a positive relationship to molasses exports of 0.290727 with a p-value of 0.0899 < 0.1. Every 1 percent increase in inflation will increase exports by 0.290727 percent. The finding that the effect of inflation on exports is significantly positive is the same as the findings (Kartini & Utomo, 2018; Wijayanti et al., 2021). Contrary to the theory, an increase in inflation causes the price of goods to rise and cannot compete in the international market so commodity exports will fall. The resulting R-squared value is 0.392469, which means 0.392 percent of the independent variable can explain the dependent variable of 39.2 percent. There is a possibility of an imbalance in the short run, so *error correction* (ECT) is needed. The equation is used in the short term with the added error variable (-1). The results of the short-run equation can be seen in Table 8.

Table 8. Estimation results of Short-Run Error Correction Model

Variable	Coefficient	Probability
Constanta	0.006565	0.9469
Molasses production	0.248712	0.0000***
Indonesia's GDP	0.425450	0.8848
Molasses export price	1.084571	0.1447
World molasses price	0.107487	0.0736*
Exchange rate	-1.274083	0.0530*
World palm oil price	-0.069955	0.9369
Inflation	0.258258	0.0368**
ECT(-1)	-0.801059	0.0000***
R-Squared = 0.607804		
Adjusted R-Squared = 0.553708		

** significant at 0.1%, ** significant at 0.05%, *** significant at 0.01%*

The Error Correction Model (ECM) test results in the short-run production variable significantly affect molasses exports with a p-value of 0.000 < 0.01. The coefficient on the production variable is positive, and it can be said that when molasses production increases by 1 percent, it will increase molasses exports by 0.248712. The increase in domestic production increases the supply of domestic goods so that domestic and foreign supply will also increase. Exports will also increase (Hakiki & Asnawi, 2019).

The world molasses price variable has a positive and significant relationship in the short run. When the world molasses price increases by 1 percent, the molasses export will increase by 0.107487 with a p-value of 0.0736 < 0.1. The relationship between world prices and the volume of exports of a commodity is that if the commodity price in the global market is greater than the price in the domestic market, the number of commodities exported will increase. Oktavian & Maulana (2019) show that world prices positively affect Indonesian coffee bean exports. The greater the influence of world prices, the exports will also increase.

The Rupiah exchange rate variable in the short run is negative, which means that in the short run, an increase in the exchange rate will reduce exports by 1.274083 and significantly by 0.1 percent. This study is the same as that of Setyorani (2018), which states that the exchange rate has a negative value and significantly impacts exports. The exchange rate depreciation will reduce commodity prices in exporting countries to

increase molasses exports (Aziziah & Setiawina 2021). The inflation variable has a significant effect in the short run with a p-value of 0.0368 < 0.05. Inflation is positively related to molasses export of 0.258258. It shows that an increase in inflation of 1 percent will increase exports by 0.0258258. High and low inflation rates will determine commodity prices in a country. An increase in prices can cause state goods to be unable to compete in the international market and a decline in exports (Dewi 2018). Seen from the R-squared value of 0.607804, 61 percent of the independent variables in the model can explain the variation of the dependent variable.

Molasses are one of the potential products that provide an excellent opportunity to be utilized domestically and exported to the global market. This opportunity will continue to increase with molasses as an industrial raw material. Sugarcane-producing countries have used molasses in various derivative products that have added value. One of them is Brazil processing molasses into bioethanol which makes Brazil one of the largest bioethanol producing countries in the world. In addition, China uses molasses to produce *Monosodium Glutamate* (MSG), which China produces 55 percent of the world's MSG needs.

Based on the results of the analysis that has been carried out, molasses production has a significant effect on export supply. The government should respond to the increase in molasses production to encourage the growth of downstream molasses by expanding sugarcane plantations, improving production technology, and processing the molasses industry. In addition, it increases farmers' interest in producing sugar cane to impact molasses production. The policy to expand the sugarcane agroforestry program is momentum in creating new production centers that impact increasing competitiveness.

The dominance of one type of molasses product is not recommended for long-run trading performance Indonesia's tendency to export molasses in its raw form. If the price falls, it will impact the income of sugarcane farmers because the main export share of Indonesian molasses is still in the form of natural products, so the impact will directly affect farmers. The development of molasses derivative products is needed so that it is not only a primary product, but it is necessary to make efforts to shift from the primary sector to the molasses processing sector. In addition, it is necessary to limit the export of molasses because many farmers sell molasses in raw form, which has low added value. It makes molasses price stable, and domestic molasses absorption can be utilized in other derivative products. These utilization activities provide considerable added value and reduce pollution caused by the sugar industry.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The results of the ECM analysis show that in the long run, international trade, molasses production, exchange rates, and inflation have a significant effect on Indonesia's molasses export supply. However, Indonesia's GDP, molasses export prices, world molasses prices, and world palm oil prices have no significant effect. In the short run, molasses production, world molasses prices, exchange rates, and inflation significantly affect molasses export supply, while Indonesia's GDP, molasses export prices, and world palm oil prices have no significant effect.

Recommendations

This study recommends that strategic efforts are needed to develop molasses into finished products for domestic needs and can be exported to various potential countries.

To support the industry made from molasses, the government needs to expand sugarcane plantations and revitalize factories and build sugarcane processing factories that are directly integrated with sugarcane plantations so that molasses can be processed directly.

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Effect of economic integration and trade facilitation on Intra-manufacturing export among ECOWAS member states

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Abstract

Institutional trade tariffs and non-tariff barriers are major constraints to exporters and importers. It affects many developing countries' trade flows and intra-trade performance, including ECOWAS member states. From the classical economic background, the economic problems of international macroeconomics can be examined from the position of trade costs. It further states that low trade facilitation policies such as high tariffs and non-tariff barriers alone can account for a 10% loss in a national income. From these backgrounds, the study assesses the interrelation of economic integration and trade facilitation in ECOWAS and how the member states have performed in intra-manufacturing export. Using the general method of moments (GMM) with instrumental variable (IV) estimation on a dynamic model with panel data from 15 members to analyse how regional economic integration and trade facilitation relationship promote intra-regional manufacturing exports. The findings reveal that trade facilitation in ECOWAS member states is below the world average. Due to high bureaucratic processes, thus, are high costs of exporting/importing. Again, the econometric analyses reveal economic integration significantly promotes trade facilitation in member states and can influence intra-manufacturing exports in ECOWAS. At the same time, manufacturing production has a direct and significant role in manufacturing exports. Some policy recommendations that would help facilitate trade and improve manufacturing production and intra exports in the ECOWAS sub-region were made.

Keywords: *Economic integration, Gravity model, Trade facilitation, Trade flows*

JEL classification: C23, F10, F43, O47, O55

INTRODUCTION

Exporting primary products represent about 80% of the total exports of many African countries, including ECOWAS member states. The fall in long-term prices, the decline of the terms of trade, and the instability of the commodity market are the main constraints to growth and poverty reduction for African countries (Sakyi et al., 2018).

Commodity exports are affected by fluctuations in prices and demand in the short term and the fall in terms of trade in the medium and long term. Commodities are also

often characterised by fierce price competition, whereby productivity gains are generally passed on to consumers rather than benefiting producers.

Contrary to the fragility of the commodity-dependent African economies, the manufacturing activities in developed countries that derive resources from commodity imports enjoy many static and dynamic economies of scale, generating higher revenue for countries that export manufactured goods. Africa`s overdependence on exports of lower value-added commodities has caused its production intensity to decline and increase its poverty rate, putting enormous pressure on the households and government budgets.

Again, trade between ECOWAS countries has been relatively stagnant over time due to the homogeneity of export products, which are basically primary products; 11.5%, 12. 8%, 10.1%, 12.5% and 12.9% in 2002, 2007, 2012, 2017 respectively with high decrease for 2020 due to COVID 19. Over-reliance on exports of similar commodities and the weak processing capacity of ECOWAS countries prevailed, making North America's and Europe's favorite trade partners and reduced intra trade in the region, even with its economic integrations.

The ECOWAS region is not only a net importer due to its weak supply response, importing highly dynamic products (higher-priced manufactured products), results into trade losses and fluctuations in growth. ECOWAS member states exports to the Europe union stood at 34.3%, 35.7%, 23.2%, 27.2% and 26,9% in 2002, 2007, 2012, 2017 respectively and decline in 2020 due to COVID 19, its imports were 55.1%, 46.6%, 49.8%, 42.0%, 36.4% and 37.2 % in 2002, 2007, 2012, 2017 respectively and increase marginally in 2020 due to import of COVID 19 vaccine (ECOWAS Trade Data and World Trade Indicators). The transfer of productivity gains caused by the weak production capacity in Africa has made African economies vulnerable to changes in demand and has become a victim of world trade. (Africa trade initiative 2019).

The problem of trade cost takes a crucial position in economic development. It decides relative prices, consequently determining production and trade patterns. Trade costs include transportation, trade policies, information, government procedures, contract enforcement, and marketing costs for all the resources needed to transport products from one place to another (Anderson & Van Wincoop, 2004).

Obstfeld & Rogoff (2001) state that the economic problems of international macroeconomics can be examined from the position of trade costs. Olayiwola *et al.*, 2015 state that the cost of trade in the national economy determines the distribution of surplus and the cost of adjusting policies and shocks between regions and country. However, international trade costs have received less empirical attention in determining its impact on Africa and sub-regional integration.

The previous literature mainly assumed that trade frictions within countries are negligible in the absence of other policy tools such as trade barriers and exchange rates that hinder the flow of goods and services between countries (Agnosteva et al., 2019). Until recently, studies have increasingly shown that even in advanced economies such as China, Canada, and the United States intra-country trade costs can be high (Olayiwola et al., 2015; Agnosteva et al., 2019). Of note is that the distribution of trade costs within a country affects the trajectory of regional development, thus, reducing the incentive for countries to implement regional commitments (Olayiwola et al., 2015).

Given the unsatisfactory performance of the ECOWAS member states' regional economic integration (REI) in promoting intra-manufacturing regional trade to date, questions such as "what is the effect of REI and trade facilitation on intra-manufacturing regional trade is a contested issue. From this background, this study

main objective is to examine the effects of economic integration and trade facilitation on intra-manufactured export performance among ECOWAS member states.

The following questions are put forward to achieve the study's objectives: What are the effects of regional economic integration and trade facilitation on intra manufacturing export performance among ECOWAS member states? And Can the relationship between REI and trade facilitation increase intra manufacturing export performance among ECOWAS member states?

Therefore, the study will be of great significance to the following groups of people; Policymakers assess how the integration process in West Africa affects their respective economies and what measures can be taken to accelerate this process. Scholars and researchers who work on similar research topics will find the literature of this study crucial to the progress of their research field. Current and potential investors will use the results of this study to evaluate potential investment opportunities and how favourable is the investment environment in the ECOWAS region. The West-African Parliament, the ECOWAS Secretariat, and other stakeholders will find the study helps to guide the establishment of support and empowerment for legislative tasks on trade facilitation.

Following the introductory section, is section 2. Literature review on the concepts, theories, and empirical reviews. Section 3: reveals the study methodology and statistics. Section 4: Present the analysis of result, interpretation of the results, and the discussion of the result. Section 5: Summarise the study, conclusions, and recommendations

LITERATURE REVIEW

Regional Economic Integration (REI)

Regional economic integration is the process that leads to no discrimination between national economies. It is an agreement among countries in a geographic region to reduce, and ultimately remove, tariff and non-tariff barriers for the free flow of goods and services between each other. Regional integration is a tool for driving the growth and increasing the well-being of any county, helping create regional value chains that increase economic efficiency (Sakyi et al., 2018).

There are different methods and approaches to regional integration, trade has traditionally been the major objective of regional integration and the major driving factor. The objectives of regional economic integration are; to increase in well-being of any county and reduce the economic inequalities of integrating countries by the creation of a larger market, fostering competition, and enabling economies of scale, regional economic integration increases innovation, reduces inputs and consumer prices, helps specialization of economies and motivate the development of regional production activities.

For developing and least developed countries, regional economic integration is the major driver of poverty reduction, social equality, and economic divergence through trade and investment cooperation. Again, regional economic integration is the major driver of intraregional trade, thus, increasing employment activities and redistribution of benefits for growth and country prosperity. Increased regional economic integration leads to economic performance and fewer economic inequalities (Olayiwola et al., 2015).

Trade facilitation

Trade facilitation has become a substantive item within WTO trade round negotiations. It is frequently referred to in supply chain security initiatives and is a

feature within many customs modernisation programs. Trade facilitation is also significant within wider aid-for-trade and capacity-building initiatives (WTO 1998).

Trade facilitation is largely used by institutions that seek to improve the regulatory interface between government bodies and traders at national borders. The WTO definition: 'The simplification and harmonization of international trade procedures' where trade procedures are the 'activities, practices and formalities involved in collecting, presenting, communicating and processing data required for the movement of goods in international trade' (WTO 1998).

The fundamentals of trade facilitation are transparency, simplification, coordination, and standardization (National Board of Trade, Sweden (2017)

a) Transparency with inside authorities increase the openness and accountability of government and administrative actions. It involves disclosing information so that the public can easily access and use the information. This information includes; general applicable laws, regulations and administrative decisions, budgets, procurement, and meetings. Where possible, regulatory information should be released and disseminated before implementation so that stakeholders can notice and make necessary changes. In addition, relevant stakeholders and the public should be invited to participate in the legislative process and express their opinions on the proposed law before the legislation.
b) Simplification removes all unnecessary elements and repetitions in trade procedures, processes, etc. It should be based on an analysis of the status quo of "As-Is" situation.
c) Harmonization is the unification of national procedures, operations, and documents with international conventions, standards, and practices. It can come from adopting and implementing the same standards as REI member countries, as part of a regional integration process, or the result of trade decisions.
d) Standardization is formulating internationally recognized practices and procedures, documents, and information formats for all parties. Then use standards to adjust and ultimately harmonize practices and methods. In order to realize these principles, full cooperation between government authorities and the private sector community is imperative.

The supply chain

Activities promoted and carried out under the general heading of trade facilitation tend to focus on customs administration. Although customs are a key player in trade facilitation, it is not enough to focus solely on these institutions and their processes. Trade facilitation should cover the entire trade environment, participants, and processes involved in the transaction. The international supply chain point of view should be taken. The supply chain includes all the activities necessary to produce goods and deliver them to final consumers. These activities include purchasing raw materials, preparing transportation, applying for import licenses, preparing customs clearance documents, customs clearance, payment, and delivery to consumers. The supply chain involves the seller and the buyer, at least two parties. The supply chain involves many different aspects. They can be private sector traders, transport operators, service intermediaries, or public sector regulators. From the supply chain perspective, you can see and understand all possible processes and interconnections. It provides a framework for logically connecting different participants, procedures, and requirements in the trading environment picture. By emphasizing dependencies, it is obvious that improvements have been made along the chain, but changes in one area can easily be offset by stagnation in other areas.

There are many variations in the supply chain. Therefore, from the supply chain perspective, a theoretical model needs to simplify its complexity and be used as a reference model.

The Buy, Ship and Pay (BSP) model developed by UN/CEFACT is an example of this model. It represents the supply chain as a series of trading processes that can be grouped into top-level domains for purchasing, shipping, and payment.

The supply chain barriers model of economic regional integration focus on removing or reducing tariffs with third countries or regions. However, the key gains of regional economic integration are; increased well-being of member states and the creation of a larger market that can be achieved when trade barriers are reduced. It leads to increased market access and helps the gains of economic integration, meaning that improving intraregional trade is important to remove supply chain barriers, which are more significant impediments to trade than import tariffs.

The World Economic Forum lists four main types of supply chain barriers which are:

i. Lack of transport infrastructure is the inadequate and good road network, rail, sea, and air transportation networks that increase the costs and impediments massively to moving goods and persons across borders.
ii. Non-tariff measures are safety and sanitary requirements, technical standards, and goods additional regulations that increase importing or exporting compliance costs.
iii. Border administrations are inefficient border control and burdensome or non-transparent import or export procedures.
iv. Business environments are discriminated against, unstable regulatory environment, physical security issues along the way supply chain.

Figure 1 reveals supply value chains cost, making it imperative for policymakers to understand trade facilitation as a tool for all countries to break supply value chain barriers by incorporating policies aimed at facilitating trade into their long-term development agenda. Making the promotion of trade facilitation measures a key imperative for the 2013 World Trade Organization (WTO) trade facilitation agreement that will speed up the clearance and movement of goods across borders globally. Trade facilitation involves all arrangements to increase border and transport efficiency and reduce transaction costs relating to trade flows.

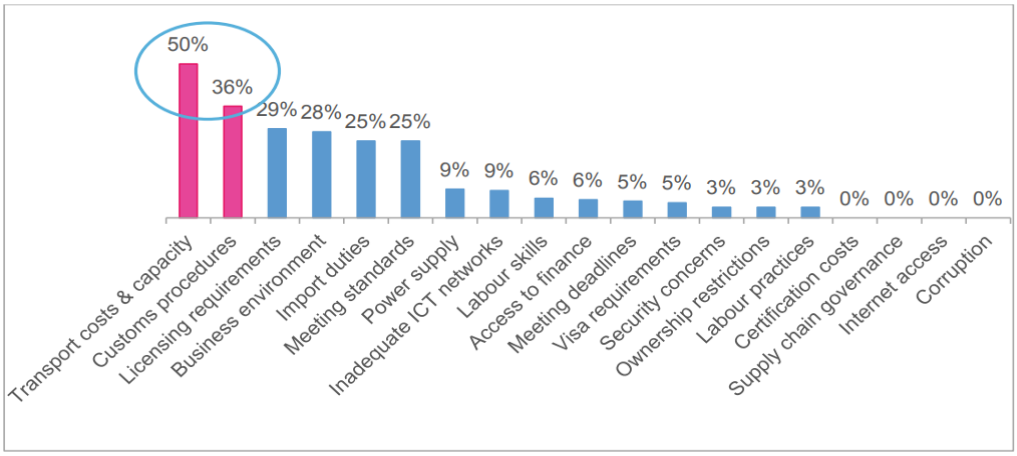

Figure 1. The main barriers in Supply value chains
Source: OECD/WTO Aid for Trade Questionnaire 2018.

The trading environments are complex, which provides a broad space for trade facilitation. It is easy to calculate 60 or more different exchange procedures (Grainger 2007a) for goods and services, vehicles that transport goods (ships, planes, and trucks),

or their operators (drivers, seafarers, and crew). Control objects include income collection, protection and safety, environment and health; consumer protection; and trade policy. In most countries, an important part of these controls will be carried out by the customs or under customs supervision.

Table 1: International trade related regulatory activity

Regulatory measures	Activity
Revenue Collection	Collection of Customs duties, excise duties, and other indirect taxes; payment of duties and fees; management of bonds and other financial securities
Safety and Security	Security and anti-smuggling controls; dangerous goods; vehicle checks; immigration and visa formalities; export licenses
Environment and Health	Phytosanitary, veterinary and hygiene controls; health and safety measures; CITES controls; ships' waste
Consumer Protection	Product testing; labelling; conformity checks with marketing standards (e.g., fruit and vegetables)
Trade Policy	Administration of quota restrictions; refunds; suspensive regimes

Source: Grainger 2007

Commercial arrangements inside global trade aren't any much less complex. The global movement of products consists of several operational steps before export, including packaging, storage, transport, port entry, customs procedure, and loading to ships. Once arrived within the destination port, operations consist of off-loading, storage, launch from the port and customs clearance, transport to the client, unpacking, after-income services (assembly, warranties, and guarantees), etc. Depending on the buying and selling phrases among client and seller, contractual obligations for the operations can lie with one of the opposite party, or it could be cut up everywhere alongside the manner relying on the Incoterms used (ICC 1999)

Theoretical framework

The "gravity equation," according to Narayan & Nguyen (2016), has been employed as the econometric estimation of the ex-post partial (or direct) impacts of economic integration agreements, national borders, currency unions, language, and other measures of trade costs on bilateral international trade flow. In specifying the equation, two major variables explaining bilateral trade flow between trade partners are usually considered: the economic strength of a country (variable GDP) and geographical proximity (variable distance). From the theoretical and empirical literature reviews for this study, the following conceptual framework is used for the study.

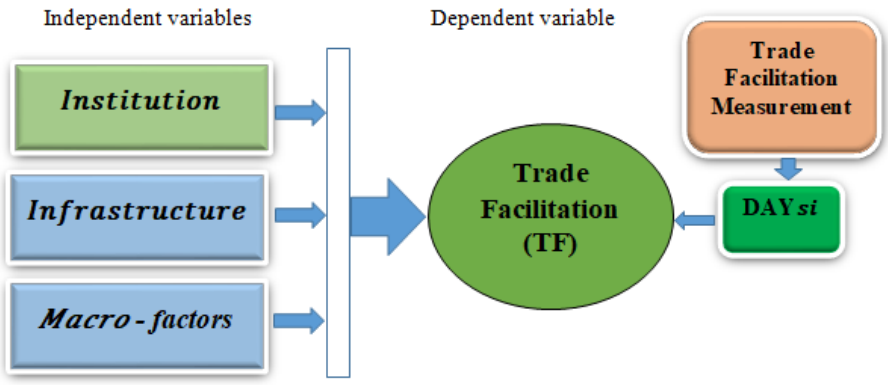

Figure 1. The conceptual framework or model of the study

Empirical measure of trade facilitation and economic integration.

This work does not intend to prove any of the previous propositions. Still, it has the objective of examining the interrelationship between regional economic integration and trade facilitation on the performance of manufacturing exports in West Africa.

Safaeimanesh & Jenkins (2021) estimate the potential annual economic gain from trade facilitation by the Economic Community of West African States (ECOWAS). A partial equilibrium welfare economics framework employs sets of export supply and import demand elasticities for each country derived using a general equilibrium estimation method of the gravity model.

The annual economic welfare gains resulting from the reduction of high trade compliance costs for the region are estimated to be between US$1.6 billion to US$2.7 billion (2019 prices). This is between 0.24% and 0.42% of the combined GDPs of these countries. The welfare gain is between 6% and 10% of the combined governments' budgets assigned for education and is between 33% and 58% of their budgets allocated for health. In the absence of reform, these inefficient practices waste equal between 15% and 26% of the annual net official development assistance these countries receive. The finding implies that the implementation strategies of reforms do not look at countries specific development of the political economy of trade facilitation reform.

In another study, Akinlo & Okunlola (2021) look at Sub-Saharan Africa's trade openness, institutions, and economic growth. The research investigates the interactive effect of trade openness and institutional quality on economic growth in sub-Sahara Africa. The sample consists of 38 sub-Saharan African countries and covers 1986 to 2015. Pooled OLS, fixed effect, and dynamic GMM were used as estimation techniques. The study found that corruption, government stability, law and order, and bureaucratic quality as institutional quality variables harm trade and economic growth. The interaction of trade openness and institutional quality variables positively impacted economic growth. This finding implies that policymakers must pay attention to institutional quality and trade openness in the region. The policymakers must introduce policies that simultaneously target institutional quality development and enhance trade openness.

Despite many studies on trade facilitation and economic integration in West Africa, few econometric methods quantify the effect of trade facilitation and economic integration on trade flows among the ECOWAS member states. However, Safaeimanesh & Jenkins (2021), Osabuohien et al. (2019), and Olayiwola et al. (2015) used econometric methods to quantify the effect of trade facilitation on trade flows in Africa. Specifically, Olayiwola et al. (2015) use the system general method of moments (GMM) with instrumental variable (IV) estimation on a dynamic model of panel data from 15 ECOWAS member states to analyze how trade facilitation and regional economic integration affected intra-regional agricultural exports, trade facilitation is proxy by the required processing days and documents, found that a 1% decline in the number of days to process the export of agriculture commodities correlated with an expansion of approximately 0.07% of agricultural exports. They state that Trade facilitation measures would decrease border and documentary compliance time and costs of international trade administration. Regional economic integration and trade facilitation are comprehensive, integrated approaches to reducing the complexity and cost of the trade transactions process, thereby enhancing the trade flow efficiency, transparency, and predictability of international trade.

The major fallout from the extant studies reviewed is that the issue of trade facilitation and economic integration has not been related to manufacturing export

performance with a focus on ECOWAS members. This study stands to address the fallout. However, the study will be limited to the potential impact of economic regional integration and trade facilitation on intra-manufacturing export performance, specifically the intra-trade improvement through border and transport efficiency, the number of documents required to export, cost to export, time to export, cost to import, time to import, and the distance to frontier. According to the World Bank Doing Business reports, the major reason for these trade facilitation variables is that ECOWAS member countries have one of the highest bureaucracies and custom procedures. These shortcomings have somehow contributed to the knowledge gap in the literature, thus warranting a study on the effect of economic integration and trade facilitation: the case for intra-manufacturing export performance in West Africa

METHODS

Model specification

As specified by Olayiwola et al. (2015) and modified experimental research baseline model for analysis of country i's trade facilitation (TF, proxied by the days required to process imports or exports) – as a function of political institutions, infrastructure services, and general economic conditions – can be specified as:

$TF = day_{si} = f(Institution, Infrastructure, Macro)$ …….(1)

Where:

TF = Trade Facilitation proxied by one of the key indicators – number of days taken to process exports (xdays) or imports (mdays) by country i.

Institution = Political institutional factors proxied by the rule of law index and control of corruption index. Data on political institutions will be sourced from the World Governance Indicators (WGI).

Infrastructure services = Service infrastructure measured by number of internet users per 100 inhabitants and telephone lines (fixed + mobile) per 100 inhabitants. Data on Service infrastructure will be sourced from the World Development Indicators (WDI), including electricity production/consumption as one of the infrastructure indicators.

Macro = Macroeconomic factors measured by Per capita Real Gross Domestic Products (PCRGDP). Data on macroeconomic factors will be sourced from the World Development Indicators (WDI).

In more explicit form, equation (1) in its static form is decomposed into the number of days taken to process exports or imports equations and may be re-written as follows:

$xdays_{it} = \delta_0 + \delta_1 institution_{it} + \delta_2 infrastructure_{it} + \delta_3\, macro_{it} + \in$ …… (2)

$mdays_i = \beta_0 + \beta_1 institution_{it} + \beta_2 infrastructure_{it} + \beta_3\, macro_{it} + \varepsilon$ ……(3)

Where:

$xdays_{it}$= days to process exports of country *i* to country *t*;

$mdaysit$= days to process imports of country *i* from country *t*; and

$\in and\ \varepsilon$ are error terms assumed to be.

On a priori ground, we expect: that $\delta_j < 0$ and $\beta_k < 0$. (where j, k=1,2,3), i.e., processing days go down with better political institutions, infrastructure services, and economic conditions.
Other variables are as previously defined. Dynamically this becomes

$$xdaysit = \delta_0 + \delta_1 xdays_{i,t-1} + \delta_2 institution_{it} + \delta_3 infrastructure_{it} + \delta_4\ macro_{it} + \epsilon \ldots\ldots (4)$$

$$mdaysi = \beta_0 + \beta_1 mdays_{i,t-1} + \beta_2 institution_{it} + \beta_3 infrastructureit + \beta_4 macroit + \varepsilon \quad \ldots(5)$$

It is also expected, following theoretical relationships: $\delta_j < 0$ and $\beta_k < 0$. (where j, k =1,2,3,4), i.e., that processing days also go down with higher processing days in the previous period.
The baseline model for analysis of manufacturing exports (measured as a percentage of a country's GDP[1]) is a function of the country's manufacturing production, political institutions, infrastructure services, regional integration, and trade facilitation (xdays) can be specified as:

$$manex = f\ (integration, institution, infrastructure, TF, manpdtn) \ldots\ldots\ldots\ldots(6)$$

Where:

manex	= manufacturing export and measured as a percentage of country i GDP
I$ntegration$	= trade integration variable and is proxy as an intra-regional export share of the country I
institutions	= political institution variable and is proxied by the regulatory quality (RQ) indicator for the country I
TF	= trade facilitation variable which is proxied here by the number of days taken to process exports (xdays).

This is because the emphasis is on the influence of trade facilitation on manufacturing export; manex is the annual manufacturing production of the country I; $infrastructure$ remains as previously defined.

In more explicit form, eq (6) in its static and dynamic forms may be re-written r as follows:

$$manex_{it} = \gamma_0 + \gamma_1 integration_{it} + \gamma_2 institution_{it} + \gamma_3 infrastructure_{it} + \gamma_4 TFit + \gamma_5 manpdtnit + \varphi \ldots\ldots (7)$$

$$manex_{it} = \pi_0 + \pi_1 manex_{it-1} + \pi_2 integration_{it} + \pi_3 institution_{it} + \pi_4 infrastructure_{it} + \pi_5 TF_{it} + \pi_6 manpdtnit + \omega \ldots\ldots(8)$$

For manufacturing exports of country *i* to country *t* in year *y*; where φ and ω are error terms assumed to be randomly and normally distributed.

In terms of theoretical relationship, we expect: $\gamma_0, \gamma_1, \gamma_2, \gamma_3, \gamma_5 > 0$; and $\gamma_4 < 0$ and $\pi_0, \pi_1, \pi_2, \pi_3, \pi_4, \pi_6 > 0$; and $\pi_5 < 0$, i.e., that exports go down with *xdays* but up with everything else.

Scope and data of the Study

Data for the period 2016–2020 will be used to achieve the study's objectives, the reason for the 2016 trade facilitation measure of the WTO came into effect in 2015. In achieving the study's objectives, the study uses the current data on trade facilitation variables of the World Bank Doing Business Database (DBD) for the sample of 15 West-African countries.

DBD provides comprehensive cross-country data for useful information relating to trade facilitation. Most trade facilitation indicators are directly related to border and transport efficiency. Namely, time to export, the cost to export, the number of

documents required to export, time to import, cost to import, and the number of documents required to import are used. As several authors have shown (Ogundipe et al., 2014; Olayiwola et al., 2015; Sakyi et al., 2017), these indicators have a key role in the international trade and intra manufacturing export performance of countries. For robust results of the study and these indicators, an institution is the political-institutional factors proxy by the rule of law index and control of corruption index.

Data on political institutions are sourced from the World Governance Indicators (WGI). Service infrastructure is measured by internet users per 100 inhabitants and telephone lines (fixed + mobile) per 100 inhabitants. Data on Service infrastructure are sourced from the World Development Indicators (WDI). Efforts were made to include electricity production/consumption as one of the infrastructure indicators; however, the data for most ECOWAS members over the study period were not available. Macroeconomic factors are measured by Per capita Real Gross Domestic Products (PCRGDP). Data on macroeconomic factors are sourced from the World Development Indicators (WDI).

Table 2. Definition of variables and data source

Variables	Definitions	Sources
GDP_{it}	Exporting country's GDP measured in million US$ at time *t*	WDI
GDP_{jt}	Importing country's GDP measured in million US$ at time *t*	WDI
$Polity2_{it}$	Polity2 score in country i at time t	WGI
$Polity2_{jt}$	Polity2 score in country j at time t	WGI
Doc $export_{it}$	Number of document required to export from country i at time *t*	WBDBD
$Time\_export_{it}$	Number of days required to export from country *i* at time *t*	WBDBD
Cost to $export_{it}$	Cost to export from country *i* at time *t*	WBDBD
Doc_import_{it}	Number of document required to import from country *i* at time *t*	WBDBD
$Time\_import_{it}$	Number of days required to import from country *i* at time *t*	WBDBD
Cost to $import_{it}$	Cost to import from country *i* at time *t*	WBDBD
RTA_{ijt}	Dummy variable with value 1 if *i* and *j* belong to the same RTA at time t, 0 otherwise	CEPII
WTO_{ijt}	Dummy variable with value 1 if *i* and *j* belong to the WTO at time t, 0 otherwise	CEPII
$Contiguity_{ij}$	Dummy variable with value 1 if *i* and *j* share a land border, 0 otherwise	CEPII
Com. $currency_{ijt}$	Dummy variable with value 1 if *i* and *j* use the same currency, 0 otherwise	CEPII
$Distance_{ij}$	Geographical distance between country *i* and *j* in km	CEPII

Note: CEPII, Centre d'Etudes Prospectives et d'Informations Internationales; GDP, gross domestic product; RTA, Regional Trade Agreement; WBDBD, World Bank Doing Business Database; WTO, World Trade Organization. Higher values of the trade facilitation indicators imply better outcomes or improved levels.

Model estimation techniques

As used by Olayiwola et al. (2015), the gravity model is modified as the empirical tool to analyse the effects of REI and trade facilitation on intra manufacturing exports in the ECOWAS region. The gravity model is most used to explain trade flows between countries, trade flow from supply potential (proxy by manufacturing exports ratio to GDP) of the exporting states to the market demand potential (proxy by real GDP) of the importing states, and the trade cost (proxy by days and numbers of documents needed to export and import) between the exporting and importing countries.

Classically, the gravity model shows GDP and distance variables augmented with observable trade cost variables (trade agreements, days, and numbers of documents needed to export and import) (Sandberg et al., 2006). Anderson & van Wincoop's (2003) emphasis is on Multilateral Resistance Term (MRT) within bilateral trade. The MRT states bilateral trades between two or more countries are not determined only by the bilateral variables between the two countries but in relation to the position of the two countries in global trade. MRTs are an unobserved variable and are difficult to

capture. The study uses the dyadic fixed effects to control for the MRT (Feenstra, 2004) cited in Sakyi et al., (2019). The fixed effects also control for unobserved time-invariant heterogeneity that is likely to correlate with trade flows as well as trade cost variables (Sakyi et al., 2019). To take these econometric problems, the study specifies an empirical baseline model.

$$\ln (X_{ijt}) = \pi_{ij} + \pi_{t} + \beta lnM_{it} + \gamma lnM_{jt} + aD_{ij} + \delta TF_{ijt} + \varepsilon_{ijt} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Where X_{ijt} measures trade flow between countries *i* and *j* at time *t*; α_{ij} is the dyadic country fixed effects; α_t are the time dummies; ε_{ijt} is the error term, and $M_{[i(j)t]}$ is the vector of monadic variables of the exporter (importer) in the gravity equation, and they consist of GDP, MRT, and Infrastructure. Included in the set of monadic variables are also political indicators that can affect trade flows,

Concerning political variables, the study uses continuous variables that can show the intensity of these variables rather than the use of dummy variables that show less variation. These include combined political institution (regulatory quality (RQ)) proxy by the rule of law index or control of corruption index as indicators (Marshall *et al.*, 2017). $D_{[ij(t)]}$ is the vector of dyadic time-invariant (variant) variables, consisting of the distance between *i* and *j*, indicator variables that equal one if *i* and *j* share a contiguous border, have a common language, have a common currency and are both members of Regional Trade Agreements, WTO/General Agreement on Tariffs and Trade. For the dyadic variables, the use of dyadic fixed effects (α_{ij}) in the baseline equation controls for them, thus, differenced away in the gravity model estimation. TF_{ijt} is a vector of the different measures of trade facilitation indicators.

The next major econometric problem is zero flows in trade measurement data. Regularly, a high percentage of zero trade flows come up in the statistical sum-up due to small trade volumes or values between countries, which leads to selection bias if the problem is not taken care of. Studies on trade flow among African countries often develop a selection bias problem (Sakyi et al., 2019). Afesorgbor (2017) states nil flows in trade data of about 55% of countries sample. It is believed in trade flows study that looking trade flow from distant past gives selection bias outcomes. To eliminate the selection bias problem, trade flows that spanned a more current period (2016–2021) are used for the study, eliminating zero flows from the study data set.

Another major econometric problem is the multidimensionality of trade facilitation indicators (time to export, cost to export, the number of documents required to export, time to import, cost to import, and the number of documents required to import) and distance to frontier (dtf) variables [time to export (dtf), the cost to export (dtf), the number of documents required to export (dtf), time to import (dtf), the cost to import (dtf) and the number of documents required to import (dtf)] these variables are strongly correlated with one another. So, to eliminate or reduce multidimensionality, the Principal component analysis (PCA) approach is used in addition to the variables in each equation separately looked at by providing composite indicators of trade facilitation.

The first principal composite indicators are; time to export, cost to export, and the number of documents required to export ($borderx_{pcao}$). Second, principal composite indicators are; time to export (dtf), the cost to export (dtf), and the number of documents required to import (dtf) ($borderx_{pcadtfo}$). Third, principal composite indicators are; time to import, cost to import, and the number of documents required to import ($borderm_{pcad}$). Fourth, principal composite indicators are; time to import (dtf), the cost to import (dtf), and the number of documents required to import (dtf) ($bordermdtf_{pcad}$).

The principal component scores will be normalized to a scale of 0–10 using min-max transformation with higher values corresponding to better trade facilitation outcomes. The correlation coefficients will show the degree of correlation between the constructed composite index and the corresponding trade facilitation variables. The number of principal components will be selected using the Kaiser criterion of eigenvalue greater than one.

Again, in using the Generalized Methods of Moments (system GMM). The problem of endogeneity in dynamic panel models is always a major problem. Instrumental Variable (IV) estimation is majorly used as a tool to deal with the problem. But, the IV estimation method is only useful if the instruments are good. In other words, the instruments must be strongly correlated with the potential endogenous variables. They must be genuinely exogenous to the model to over-identify the model to allow tests for homogeneity and excludability. The two commonly used methods in IV estimation are the Two-Stage Least Squares (TSLS) and the Generalized Methods of Moments (GMM). The GMM method produces identical results to TSLS for just identified models but can give more precise estimates with over-identified models. Besides, the GMM method uses internal instruments, unlike the TSLS method, where there is a need to search for suitable external instruments. Therefore, the GMM method of IV estimation will be considered appropriate for estimation in this study. Equations (2, 3, and 7) will be estimated using the panel fixed effect estimator, and equations (4, 5, and 8) will be estimated using the system Generalized Methods of Moments (system GMM).

RESULTS AND DISCUSSION

In this section, the study presents the results of data analysis. The section begins with a summary of descriptive statistics to check the quality of the data set. All the variables were transformed into logarithms to correct for heteroscedasticity. It should be noted that higher values of the trade facilitation variables give better trade facilitation outcomes.

Table 3. Summary statistics

Variables	Observed	Mean	Standard deviation	Min	Max
Economic and political variables					
Exports (million)	13,311	40.263	201.416	0.161	4228.212
Imports (million)	16,222	39.733	225.567	3.121	5432.666
GDP_o (million)	21,108	33,617.000	78,327.510	115.162	488,258.500
GDP_d	21,012	33,710.030	79,009.800	115.172	488,258.500
$polwil_o$	21,540	1.891	4.050	–7	10
$polwil_d$	21,540	1.861	4.051	–7	10
Trade facilitation variables					
$docexp_o$	23,360	7.517	1.804	4.000	14.000
$timexp\_o$	23,360	30.830	14.358	10.000	78.000
$costexp_o$	23,360	1755.187	1089.500	463.000	6615.000
$docimp_d$	23,350	8.979	2.736	5.000	21.000
$timeimp_d$	23,350	37.253	18.123	9.000	102.000
$costimp_d$	23,350	2192.378	1527.325	577.000	9025.000
Other trade cost variables					
Distance	23,720	3635.242	1923.225	162.182	9772.055
Contiguity	23,720	0.074	0.262	0.000	1.000
Common language	23,720	0.448	0.497	0.000	1.000
Common currency	23,720	0.078	0.269	0.000	1.000
RTA	23,720	0.188	0.391	0	1

Table 3. shows the summary of descriptive statistics for the data used in the study. From the estimation results, it is evident that all trade facilitation variables have positive and small mean values and small standard deviations, except the macro variable with large positive and large mean values and large standard deviations, these suggestions that the errors that may be due to these estimates of all trade facilitation are within the acceptable limit. Finally, the skewness results suggest that all the variables are negatively skewed. It could be inferred from the result that the summary statistic(s) for the data series are fairly okay. The data set reveals no zero flows but missing values treated as missing observations rather than zero flows. Therefore, the study does not need to use the Poisson pseudo maximum likelihood estimator.

The PCA is a straightforward approach for creating new indexes and linear composites of the original ones. To ensure that higher values of trade facilitation indicators represent better outcomes, we rescaled all the six trade facilitation indicators to range from 0 to 10 using the min-max transformation. This transformation is not only important for the PCA, but it also facilitates the comparison of the trade facilitation indicators with the other variables used in the study

Table 4. Principal component analysis of trade facilitation indicators

	Eigen value	Proportion explained	Primary variables	Eigen vectors	Correlation coefficients	Bartlett (*p-value*)
Export costs ($borderx_{pcao}$)	1.666	0.624	Time to export Cost to export Number of documents to export	0.638 0.622 0.434	0.911 0.823 0.605	0
Export costs ($borderxdtf_{pcao}$)	2.111	0.682	Time to export (dtf) Cost to export(dtf) Number of documents required to export(dtf)	0.647 0.609 0.459	0.908 0.875 0.659	0
Import costs ($borderm_{pcao}$)	2.132	0.696	Time to import Cost to import Number of documents to import	0.633 0.602 0.510	0.899 0.877 0.735	0
Import costs ($bordermdtf_{pcao}$)	2.305	0.755	Time to import(dtf) Cost to import(dtf) Number of documents required to import(dtf)	0.619 0.603 0.504	0.918 0.895 0.749	0

The principal component scores are normalized to a scale of 0–10 using min-max transformation with higher values corresponding to better trade facilitation outcomes. The correlation coefficients reveal the degree of correlation between the formulated composite index and the corresponding trade facilitation variables. The number of principal components is selected by the Kaiser criterion of eigenvalue greater than one.

The study provides the economic interpretation of the resulting coefficients of the estimated gravity model. The results are revealed in Tables 4, 5, and 6.

Table 5 reveals the results from border and infrastructure efficiency indicators (time to export, cost to export, the number of documents required to export and time to import, cost to import, the number of documents required to import). The PCA indices indicators ($borderx_{pcao}$ and $borderm_{pcad}$) for the exporting and importing countries.

Table 5. Exports model for trade facilitation indicators

Variables	1 lnexports	2 lnexports	3 lnexports	4 lnexports	5 lnexports	6 lnexports	7 nexports	8 lnexports
$lngdp_o$	0.313* (0.157)	0.301** (0.156)	0.297* (0.153)	0.290* (0.155)	0.298* (0.157)	0.301** (0.156)	0.299* (0.153)	0.297* (0.155)
$lngdp_d$	0.296* (0.127)	0.294* (0.127)	0.296* (0.126)	0.285* (0.126)	0.292* (0.128)	0.298* (0.127)	0.294* (0.126)	0.295* (0.126)
$polwil_o$	–0.0306* (0.0136)	–0.0244* (0.0136)	–0.0264* (0.0133)	–0.0237** (0.0134)	–0.0313* (0.0135)	–0.0264* (0.0132)	–0.0297* (0.0134)	–0.0230** (0.0136)
$polwil_d$	0.0222** (0.0129)	0.0223** (0.0130)	0.0226** (0.0130)	0.0227** (0.0130)	0.0242** (0.0130)	0.0234** (0.0131)	0.0215** (0.0129)	0.0215** (0.0130)
$InPolS_o$	–0.189** (0.0992)	–0.196* (0.0999)	–0.188** (0.0967)	–0.194** (0.0988)	–0.188** (0.0996)	–0.197* (0.0989)	–0.194** (0.0989)	–0.196** (0.0994)
$InPolS_d$	0.0860 (0.0695)	0.0860 (0.0690)	0.0879 (0.0695)	0.0859 (0.0692)	0.0862 (0.0693)	0.0872 (0.0694)	0.0933 (0.0691)	0.0800 (0.0692)
$borderx_{pcao}$				0.135*** (0.0415)				0.135*** (0.0415)
$borderm_{pcad}$								–0.0196 (0.0355)
$costexp_o$			0.165*** (0.0474)				0.164*** (0.0472)	
$costimp_d$							–0.0593* (0.0295)	
$timexp_o$		0.0656** (0.0375)				0.0658** (0.0376)		
$timeimp_d$						–0.00454 (0.0332)		
$docexp_o$	0.0334 (0.0227)				0.0334 (0.0227)			
$doctimexp_o$					0.0225 (0.0288)			
Constant	–4.608 (4.749)	–4.026 (4.712)	–7.221 (4.589)	–5.305 (4.720)	–4.530 (4.746)	–4.050 (4.722)	–6.266 (4.765)	–5.246 (4.732)
Observations	8,678	8,678	8,678	8,678	8,678	8,678	8,678	8,678
R^2	0.039	0.039	0.041	0.041	0.040	0.040	0.042	0.040
Number of $pair_{id}$	1933	1933	1933	1933	1915	1915	1915	1915
Dyadic fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: standard errors in parentheses, ***p < 0.01, **p < 0.05, * p < 0.1.

Table 6 reveals only the infrastructure efficiency indicators [time to export (dtf), cost to export (dtf), the number of documents required to export (dtf), time to import (dtf), cost to import (dtf), the number of documents required to import (dtf)] and the PCA indices of these indicators ($borderxdtf_{pcao}$ and $bordermdtf_{pcad}$) taking into account, only exports-related trade facilitation indicators (time to export, cost to export, the number of documents required to export), exports-related infrastructure efficiency indicators [time to export (dtf), the cost to export (dtf), the number of documents required to export (dtf)] and the PCA indices of these indicators ($borderxdtf_{pcao}$ and $borderxdtf_{pcao}$).

Table 6. Exports model for infrastructure indicator

Variables	1 lnexports	2 lnexports	3 lnexports	4 lnexports	5 lnexports	6 lnexports	7 nexports	8 lnexports
$lngdp_o$	0.313* (0.157)	0.301** (0.156)	0.297* (0.153)	0.290* (0.155)	0.298* (0.157)	0.301** (0.156)	0.299* (0.153)	0.297* (0.155)
$lngdp_d$	0.296* (0.127)	0.294* (0.127)	0.296* (0.126)	0.285* (0.126)	0.292* (0.128)	0.298* (0.127)	0.294* (0.126)	0.295* (0.126)
$polwil_o$	–0.0306* (0.0136)	–0.0244* (0.0136)	–0.0264* (0.0133)	–0.0237** (0.0134)	–0.0313* (0.0135)	–0.0264* (0.0132)	–0.0297* (0.0134)	–0.0230** (0.0136)
$politywil_d$	0.0222** (0.0129)	0.0223** (0.0130)	0.0226** (0.0130)	0.0227** (0.0130)	0.0242** (0.0130)	0.0234** (0.0131)	0.0215** (0.0129)	0.0215** (0.0130)
$InPolS_o$	–0.189** (0.0992)	–0.196* (0.0999)	–0.188** (0.0967)	–0.194** (0.0988)	–0.188** (0.0996)	–0.197* (0.0989)	–0.194** (0.0989)	–0.196** (0.0994)
$InPolS_d$	0.0860 (0.0695)	0.0860 (0.0690)	0.0879 (0.0695)	0.0859 (0.0692)	0.0862 (0.0693)	0.0872 (0.0694)	0.0933 (0.0691)	0.0800 (0.0692)
$borderx_{pcao}$				0.135*** (0.0415)				0.099*** (0.0322)
$borderm_{pcad}$								0.0347 (0.0335)
$costexp_o$			0.665*** (0.0479)				0.0628*** (0.0200)	
$costimp_d$							0.0309 (0.0192)	
$timexp_o$		0.0456** (0.0370)				0.0658** (0.0376)		
$timeimp_d$						–0.00454 (0.0332)		
$docexp_o$	0.0334 (0.0227)				0.0334 (0.0227)			
$doctimexp_o$					0.00225 (0.0288)			
Constant	–4.635 (4.757)	–4.022 (4.722)	–2.154 (4.762)	–3.233 (4.712)	–4.424 (4.745)	–4.047 (4.720)	–3.262 (4.764)	–3.236 (4.730)
Observations	8,678	8,678	8,678	8,678	8,678	8,678	8,678	8,678
R^2	0.038	0.038	0.040	0.040	0.038	0.038	0.041	0.040
Number of $pair_{id}$	1963	1963	1963	1963	1945	1945	1945	1945
Dyadic fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses, ***p < 0.01, **p < 0.05, *p < 0.1. Higher values of the trade facilitation variables imply better facilitation outcomes.

Finally, Table 7 reveals the coefficients of variables of interest and the economic interpretation, which suggest trade facilitation in the country of origin of export of any ECOWAS member state has a positive economic and statistically significant effect on exports among ECOWAS member states.

Table 7. Exports models for both trade facilitation and infrastructure indicators

Variables	1 lnexports	2 lnexports	3 lnexports	4 lnexports	5 lnexports	6 lnexports	7 nexports	8 lnexports
$lngdp_o$	0.313* (0.157)	0.301** (0.156)	0.297* (0.153)	0.290* (0.155)	0.298* (0.157)	0.301** (0.156)	0.299* (0.153)	0.297* (0.155)
$lngdp_d$	0.296* (0.127)	0.294* (0.127)	0.296* (0.126)	0.285* (0.126)	0.292* (0.128)	0.298* (0.127)	0.294* (0.126)	0.295* (0.126)
$bordpolity_{2o}$	–0.0306* (0.0136)	–0.0244* (0.0136)	–0.0264* (0.0133)	–0.0237** (0.0134)	–0.0313* (0.0135)	–0.0264* (0.0132)	–0.0297* (0.0134)	–0.0230** (0.0136)
$bordpolity_{2d}$	0.0222** (0.0129)	0.0223** (0.0130)	0.0226** (0.0130)	0.0227** (0.0130)	0.0242** (0.0130)	0.0234** (0.0131)	0.0215** (0.0129)	0.0215** (0.0130)
$InPolS_o$	–0.189** (0.0992)	–0.196* (0.0999)	–0.188** (0.0967)	–0.194** (0.0988)	–0.188** (0.0996)	–0.197* (0.0989)	–0.194** (0.0989)	–0.196** (0.0994)
$InPolS_d$	0.0860 (0.0695)	0.0860 (0.0690)	0.0879 (0.0695)	0.0859 (0.0692)	0.0862 (0.0693)	0.0872 (0.0694)	0.0933 (0.0691)	0.0800 (0.0692)
$borderx_{pcao}$								0.099*** (0.0322)
$borderm_{pcad}$							0.0628*** (0.0200)	
$costexp_o$						0.0414 (0.0224)		
$costimp_d$					0.0247 (0.0178)			
$timexp_o$				0.135*** (0.0415)				
$timeimp_d$			0.165*** (0.0414)					
$docexp_o$		0.665*** (0.0479)						
$doctimexp_o$	0.0334 (0.0227)							
Constant	–4.608 (4.749)	–4.026 (4.712)	–7.221 (4.589)	–5.305 (4.720)	–4.530 (4.746)	–4.050 (4.722)	–6.266 (4.765)	–5.246 (4.732)
Observations	8,678	8,678	8,678	8,678	8,678	8,678	8,678	8,678
R^2	0.038	0.038	0.040	0.040	0.038	0.038	0.041	0.040
Number of $pair_{id}$	1963	1963	1963	1963	1945	1945	1945	1945
Dyadic fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors in parentheses, ***p < 0.01, **p < 0.05, *p < 0.1. Higher values of the trade facilitation variables imply better facilitation outcomes.
Source: Authors' computations.

The revelation is back by PCA indices in all tables. For the magnitude of PCA indices, the coefficient of the infrastructure efficiency indicator indicates that a one-point scale improvement in infrastructure efficiency in any ECOWAS member state exporting leads to a 13.5% (11%) increase in trade flows with ECOWAS member states importing.

It is important to note that the reduced export costs positively affect exports within trade facilitation and the infrastructure indicators. The coefficient of the infrastructure indicator reveals a 1% reduction in trade costs by ECOWAS member states exporting leads to a 16.5% (6.3%) increase in trade flows with ECOWAS member states importing, which in agreement with (Olayiwola et al. 2015; Sakyi. et al. 2019). The positive effect of trade flows has a multiplier effect on infrastructure

indicators. Reducing the time and the number of documents required to export positively influences trade flows between the exporting and importing countries.

However, in contrast to the positive effect of infrastructure efficiency at the border of the exporting country, improving infrastructure at the border of the importing countries does not increase export from the country of origin to the destination country (Tables 4 and 5 for the importing). This could be because ECOWAS member states focus more on trade facilitation that promotes exports to imports with various export promotion and integration strategies to increase exports. In conclusion, promoting trade facilitation at the border of the exporting ECOWAS member states has a positive multiplier on facilitating intra- ECOWAS member states' trade.

The political variables reveal significant positive effects in agreement with Yu (2010), who argues that high democratic countries would have better-developed institutions, stronger intellectual property protection, and higher consumer protection rights that would translate into high-quality and competitive products favorable for exports. However, the results from the Political stability index show democratization in the exporting country may increase trade costs, in effect reducing bilateral export. This could be due to the cost of democracy. Democracy is expensive for ECOWAS member states, and trade taxes are a major source of revenue for most ECOWAS member states. With democracy expense, ECOWAS member states may charge higher export tariffs, discouraging exports. Finally, conflict in an exporting country has a negative effect on its trade export flows.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The study examined the effect of trade facilitation on intra-manufacturing export trade performance among ECOWAS member states using the gravity model. Annual data covering five years of the period 2016–2020 for a sample of 15 ECOWAS member states. Trade facilitation indicators (time to export, cost to export, number of documents to export, time to import, cost to import, number of documents required to import), their corresponding infrastructure indicators and other composite indices formulated from these indicators using PCA.

The results reveal that trade facilitation and economic integration in ECOWAS have a vital role in promoting intra-manufacturing exports among ECOWAS member states. Improvements in trade facilitation policy will boost intra-manufacturing exports among ECOWAS member states. The three trade facilitation variables and infrastructure indicators influence the real cost of export and import across borders. It is a key driver of the performance of intra-manufacturing exports among ECOWAS member states. The control variables in the study (GDP, democracy, and political stability also have significant effects on intra-manufacturing exports among ECOWAS member states.

Recommendations

Policymakers should formulate policies that would improve trade facilitation substantially in ECOWAS member states. Trade facilitation indicators are at very low levels in member states compared to other regions of the world. Trade facilitation policies can reduce the real costs of trading across borders of member states.

Also, as a matter of deliberate policy, ECOWAS Commission and the ECOWAS parliament need to assist member states with ineffective legislation on the policy that will combine the Trade facilitation policies and ECOWAS industrialization policy

initiatives to promote manufacturing integration and production and trade within the region.

Since the study finds economic integration and trade facilitation to be a significant influencer of manufacturing exports, an effort to improve economic integration and trade facilitation in the region will be needed to increase manufacturing exports in the ECOWAS sub-region significantly.

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The impact of macroeconomic indicators on carbon emission in Indonesia

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Abstract

The advancement of the industrial sector in economic activities can negatively impact the environment. Inefficient use of natural resources causes environmental damage in almost all countries. Environmental damage caused by economic activities becomes a crucial issue. Hence, the main purpose of this research is to estimate the impacts of macroeconomic indicators on increasing CO_2 emissions in Indonesia with time-series data from 1970 to 2016. The macroeconomic indicators used in this research were broad money, foreign direct investment, value-added manufacturing, and international trade. The analysis method was ARDL-ECM (*Autoregressive Distributed Lag-Error Correction Model*) for long-term and short-term analysis. The main findings in the long term value-added manufacturing and international trade have positive effects on the formation of CO_2 emissions. In contrast, foreign direct investments have significant but negative effects at the 10% significance level of CO_2 emissions. In the short term, only value-added manufacturing and international trade variables have significantly influenced the formation of CO_2 emissions in Indonesia. In contrast, foreign direct investments have been proven to be insignificant. Broad money in both the long and short term is insignificant to CO_2 emissions. Based on these findings and changing climatic conditions, it is necessary to have economic development policies that reduce emissions to preserve the environment and human civilization in the long term.

Keywords: *CO_2 emissions, Foreign direct investment, Value-added manufacture*

JEL Classification: F21, O4, Q5

INTRODUCTION

Economic activities around the world require energy as a raw material. Energy is used as the economy's foundation to stimulate investment and technological progress to create new job opportunities, strengthen the industry, and sustain economic growth (Tong et al., 2020). Industrialization is proven to grow the world economy but disrupts environmental sustainability. The use of energy in industrialization affects the environment, such as air pollution and global warming through carbon dioxide (CO_2) emissions. Azwar (2019) stated that the increase in CO_2 emissions is in line with industrialization. Both developed and developing countries face this condition, Bashir et al. (2019) mentioned that Indonesia is faced with maintaining economic growth by

minimizing environmental damage. As a country with abundant natural wealth, Indonesia has a high level of energy consumption as the use of natural resources in economic activities is limited to achieving economic development and environmental sustainability (Prawoto & Basuki, 2020). Ideally, economic growth is balanced with environmental preservation and renewable and non-renewable resources.

Several previous studies highlighted economic development but did not pay attention to the balance of nature. Chontanawat (2020) found cointegration and causality between CO_2 emissions, energy consumption, and ASEAN economic performance indicating environmental damage in ASEAN countries. Hdom and Fuinhas (2020) showed the negative impact of GDP, renewables, and hydropower on increasing CO_2 emissions in Brazil. A study in Indonesia by Azwar (2019) showed a positive effect of economic growth on CO_2 emissions, especially heat production and electricity. Tong et al. (2020) identified the relationship between CO_2 emissions and economic growth in E7 countries (Brazil, India, Indonesia, Mexico, People's Republic of China, Russia, and Turkey), showing no cointegration between energy consumption, CO_2 emissions, and economic growth in Indonesia, the People's Republic of China, Mexico, and Turkey. In line with a study by Shahbaz et al. (2020) in the UK, energy consumption and financial development contribute to environmental pollution, but CO_2 emissions can still be controlled through research and development expenditure.

The progress of the economic development sector is ideally balanced with the efficiency of energy use in the industrial sector because the challenges ahead will be more serious along with the increase in the use of power generation and transportation. The Indonesian government is serious about managing environmentally friendly industries and is committed to reducing CO_2 emissions (Bashir et al. (2019). According to World Bank data, CO_2 emissions (kg per 2010 US$ of GDP) in Indonesia continued to increase from 1970 to 2016, as did CO_2 emissions (metric tons per capita). This condition is directly proportional to the economic development in Indonesia.

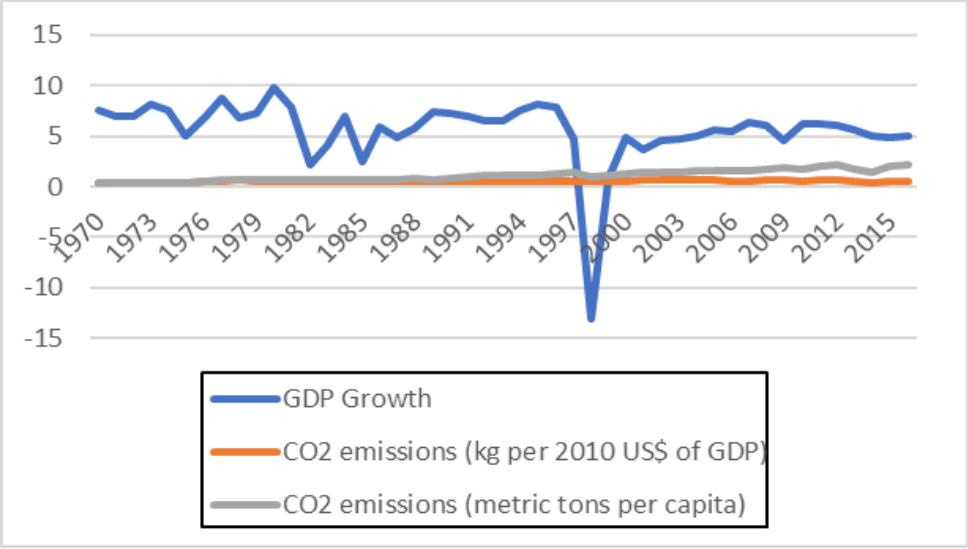

Figure 1. Indonesia's CO_2 emissions and economic growth
Source: World Bank, 2021

Environmental sustainability has now become an international concern. Improving the quality of human life through progressive development requires a better environmental quality. There are still few studies analyzing the effect of economic

activity as proxied by macroeconomic indicators with the risk of increasing CO_2 emissions. Hence, this study examined broad money, foreign direct investment, manufacturing value-added, and international trade on increasing CO_2 emissions in Indonesia from 1970 to 2016. This study contributed to the literature in estimating macroeconomic indicators on increasing CO_2 emissions in Indonesia with long-term and short-term analysis affecting policies in a long-term low-emissions economic development strategy.

METHODS

This study aimed to estimate the effect of macroeconomic indicators such as broad money, foreign direct investment, manufacturing value-added, and trade openness on CO_2 emissions in Indonesia for the period 1970 to 2016. The data used were secondary data from the World Bank. High economic activity is reflected in the success of the industrial sector in Indonesia and stable macroeconomic fundamentals. This study used the Autoregressive Distributed Lag-Error Correction Model (ARDL-ECM), where estimates were made in the short and long term. ARDL is a long-term econometric estimation approach to seeing the effect of variables by getting the effect value consistently through the lag of the dependent and independent variables.

The analysis begins with a data stationarity test where the ARDL estimation does not pay attention to whether the data is in I(0) or I(1). Then, the best lag determination, ARDL estimation, cointegration test, Bound Testing, long-term analysis, and short-term analysis. The last stage is to ensure robustness with Cusum and CusumQ tests. The test model used follows the study of Zubair, Samad & Dankumo (2020):

$$lnCO_{2t} = \beta_0 + \beta_1 BM_t + \beta_2 FDI_t + \beta_3 lnMVA_t + \beta_4 lnTRADE_t + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

CO_2 shows CO_2 emissions from liquid fuel consumption (kt) as the dependent variable. The independent variables used were BM (broad money, % of GDP), FDI (foreign direct investment, net inflows, % of GDP), MVA (manufacturing value-added, constant 2010 US$), and TRADE (exports of goods and services, constant 2010 US$). CO_2 emissions, manufacturing value-added, and trade were transformed into natural logarithms. As for the long-term estimation between CO_2 emissions and the influencing variables developed by Pesaran (2001) :

$$\begin{aligned}\Delta lnCO_{2t} = {} & \alpha + \beta_1 lnCO_{2t-1} + \beta_2 BM_{t-1} + \beta_3 FDI_{t-1} + \beta_4 lnMVA_{t-1} + \beta_5 lnTRADE_{t-1} \\ & + \sum_{i=1}^{p} \delta_{1i} \Delta lnCO_{2t-1} + \sum_{i=0}^{q} \delta_{2i} \Delta BM_{t-i} + \sum_{k=0}^{q} \delta_{3k} \Delta FDI_{t-k} \\ & + \sum_{m=0}^{q} \delta_{4m} \Delta lnMVA_{t-m} + \sum_{o=0}^{q} \delta_{5o} \Delta lnTRADE_{t-o} \\ & + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)\end{aligned}$$

Furthermore, the estimated Error Correction Model (ECM) can explain the imbalance between phenomena and actual events. Hence, adjustments need to be made due to differences in actual phenomena encountered between times. This study used the following model:

$$\Delta lnCO_{2t} = \alpha + \sum_{i=1}^{p} \theta_{1i} \Delta ln\, CO_{2t-1} + \sum_{j=1}^{q} \varphi_{1j} \Delta BM_{t-j} + \sum_{j=1}^{q} \varphi_{2j} \Delta FDI_{t-j} + \sum_{j=1}^{q} \varphi_{3j} \Delta lnMVA_{t-j} + \sum_{j=1}^{q} \varphi_{4j} \Delta lnTRADE_{t-j} + {}^{\gamma}ECT_{t-1} + \varepsilon_t \quad \ldots\ldots (3)$$

RESULTS AND DISCUSSION

The first stage in estimating the study model was the variable stationarity test. Stationarity testing is important for time series data considering that a variable is called stationary if the variable has long-term equilibrium. The stationary variable has a constant mean and variance within a certain value, and the covariance between two periods is only the difference between the two periods. Stationarity testing was carried out using the Augmented Dickey-Fuller test and the Phillips Perron test. The stationarity test is important to ensure cointegration between variables. The ARDL method does not recommend stationary data on I(2). Based on the results of the ADF test, CO_2 emissions, broad money, foreign direct investment, and trade openness were stationary at I (1), only the manufacturing value-added variable was stationary at I(0) and also I(1). Based on the Phillips Perron test, CO_2 emissions and manufacture value-added were stationary at I(0) and I(1), while broad money, foreign direct investment, and trade openness were stationary at I(1). Based on the results, all variables met the non-stationary criteria in I(2), so the ARDL test can be performed.

Table 1. Results of variable stationarity test

Variables	Augmented Dickey-Fuller				Phillips Perron			
	Level		1st Difference		Level		1st Difference	
	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Intercept	Trend & Intercept
CO_2	-2.278	-3.060	-6.695	-7.113	-3.071	-2.848	-7.544	9.906
	(0.183)	(0.127)	(0.000)***	(0.000)***	(0.036)**	(0.188)	(0.000)***	(0.000)***
BM	-1.463	-1.167	-3.794	-3.878	-1.668	-0.904	-3.794	-3.888
	(0.543)	(0.905)	(0.006)***	(0.021)**	(0.440)	(0.946)	(0.006)***	(0.020)**
FDI	-3.192	-2.616	-8.864	-8.791	-3.205	-3.171	-8.841	-8.773
	(0.027)	(0.275)	(0.000)***	(0.000)***	(0.026)	(0.103)	(0.000)***	(0.000)***
LMVA	-3.852	-0.509	-4.295	-5.457	-3.664	-0.529	-4.294	-4.993
	(0.005)***	(0.979)	(0.001)***	(0.000)***	(0.008)***	(0.978)	(0.001)***	(0.001)***
LTRADE	-1.111	-2.758	--7.189	-7.145	-1.117	-2.917	-7.189	-7.150
	(0.704)	(0.219)	(0.000)***	(0.000)***	(0.701)	(0.167)	(0.000)***	(0.000)***

*Note: ***, ** and * are significant levels of 1%, 5% and 10%, respectively.*

In the second stage of ARDL testing, the best model was ARDL (2, 3, 4, 2, 4). Based on these tests, several independent variables were significant. Lag 1 of CO_2 and lag 2 of CO_2 significantly influenced CO_2 emissions with a p-value of 5%. Lag 2 and lag 3 of broad money significantly influenced the increase in CO_2 emissions with p values of 5% and 1%, respectively. Lag 3 of foreign direct investment also significantly influenced CO_2 emissions with a p-value of 5%. Manufacturing value added had a significant influence on CO_2 emissions, and lag 2 of trade and lag 4 of trade had a significant influence with a p-value of 5% and 1%. Based on the results, economic activity impacts environmental quality in Indonesia. CO_2 emissions in Indonesia tend to be high due to the continuous use of natural resources. It is also exacerbated by irresponsible land clearing for industrial purposes. This condition demands regulatory improvements in opening new industries to preserve Indonesia's nature to be utilized in the long term.

Table 2. ARDL estimation

Variable	t-Statistic	Std. Error
L CO_2 (-1)	2.559	0.161**
L CO_2 (-2)	-2.164	0.182**
BM	-1.102	0.006
BM(-1)	0.052	0.008
BM(-2)	2.643	0.008**
BM(-3)	-3.118	0.006***
FDI	0.788	0.012
FDI(-1)	-0.224	0.013
FDI(-2)	-0.503	0.013
FDI(-3)	-2.325	0.012**
FDI(-4)	-1.344	0.012
LMVA	2.684	0.280**
LMVA(-1)	-0.551	0.388
LMVA(-2)	-1.146	0.248
LTRADE	0.606	0.151
LTRADE(-1)	-1.794	0.137
LTRADE(-2)	2.725	0.155**
LTRADE(-3)	-1.590	0.126
LTRADE(-4)	3.481	0.106***
C	-4.398	1.297***
Adjusted R-squared	0.985	
S.E. of regression	0.059	
F-statistic	148.131	
Prob(F-statistic)	0.000	

Note: the lag optimal of ARDL is ARDL (2, 3, 4, 2, 4)
*Note: ***, ** and * are significant levels of 1%, 5% and 10%, respectively.*

Bound Test was used to see cointegration between variables. If the value of F-statistics is greater than the upper bounds I(1) value, then there is cointegration showing a long-run relationship among the variables. On the other hand, if the F-value is less than the lower bound I(0), there is no cointegration among the variables. In the table, the F-statistic was 7.9 or higher than the I1 Bound value, so it can be concluded that there was cointegration between CO_2 emissions, broad money, foreign direct investment, manufacturing value-added, and trade openness in Indonesia from 1970 to 2016.

Table 3. Bound testing

Test Statistic	Value	k
F-statistic	7.927	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.50%	3.25	4.49
1%	3.74	5.06

Based on long-term estimates (see Table 4), empirically, broad money had no influence on CO_2 emissions in Indonesia during the study. The three independent variables had a significant influence on CO_2 emissions during the study. Foreign direct investment had a significant and negative influence on CO_2 emissions in Indonesia. It means the increase in foreign direct investment will not have any implications for the formation of CO_2 emissions in Indonesia during the observation period. This condition

is different from a study by Zubair et al. (2020) that there is a two-way causality between CO_2 emissions and foreign direct investment in Nigeria. Manufacturing value added and trade openness had a positive and significant influence on CO_2 emissions in Indonesia. It proves empirically that industrialization and openness of the economy will trigger an increase in CO_2 emissions in Indonesia. This phenomenon indicates the need for management in the industrial sector and international trade, not only output-oriented but also low-emissions. Indonesia has a major trading partner contributing to increasing the country's foreign exchange reserves so that special incentives are needed to empower economic actors who care about the environment. Empirically, manufacturing value-added and international trade in the long term encourage the formation of CO_2 emissions to be addressed with economic policies considering the capacity and use of renewable resources by controlling the rate of environmental damage. Another finding in Indonesia by Azwar (2019) showed that the electricity sector and heat production as a driver of economic growth significantly and positively influenced CO_2 emissions in the long term.

Table 4. Long-Run estimation

Variables	t-statistic	Std.error
BM	-0.866	0.002
FDI	-1.896	0.024*
LMVA	2.933	0.087***
LTRADE	3.797	0.117***
C	-5.686	1.021***

*Note: ***, ** and * are significant levels of 1%, 5% and 10%, respectively.*

The environmental Kuznets curve explains the inverse U relationship between economic development and environmental degradation (Dasgupta et al. 2002). The Kuznets hypothesis explains the high probability of environmental damage due to activities to realize economic growth. It arises because the production process is a priority, so it does not focus on environmental aspects. Along with economic development, humans are made aware of environmental conditions, causing a turning point where economic growth is output-oriented and maintains quality and environmental sustainability (Shaharir & Alinor, 2013). Yandle et al. (2004) stated that economic development started in the agricultural sector, where pollution was still relatively low, then switched to the industrial sector requiring more people, capital, and natural resources, resulting in higher pollution and environmental damage. Furthermore, high economic growth makes people aware that wisdom is still needed to manage natural resources efficiently in order to remain sustainable.

Bimanatya & Widodo's (2018) study found unidirectional causality between coal consumption and economic performance in the short term and unidirectional causality between oil consumption on CO_2 emissions in the long term. Nugraha & Osman (2018) also identified energy consumption, industrial value-added, CO_2 emissions, and aggregate consumption had a significant influence on the output of the agricultural sector and the service sector in Indonesia. Bashir et al. (2019), using VECM, found a short-term causality between CO_2 emissions and energy consumption. No causality was found between human capital, state income, and energy consumption per capita on CO_2 emissions per capita. Still, an increase in CO_2 emissions was found due to energy consumption, human resources, and economic growth in Indonesia. Azwar (2019) found that high CO_2 emissions in Indonesia are caused by electricity and heat production. Prawoto & Basuki (2020) identified the effect of investment, exchange rates, the value

of trade, and industrial added value on Indonesia's economic growth in the long and short term, while CO_2 emissions and oil consumption in the long term influenced Indonesia's economic performance.

Based on the estimation results, in the short term, broad money and foreign direct investment had no influence on CO_2 emissions in Indonesia during the study period. However, manufacturing value-added and international trade had a significant and positive influence on CO_2 emissions in Indonesia in the short term. It means the higher the trade openness and industrial progress, the higher the CO_2 emission in Indonesia. It is in line with a study by Shahbaz et al. 2020) in the UK where environmental damage is caused by financial development. In contrast to Prawoto & Basuki's (2020) study in Indonesia, exchange rates, investment, trade, and industrial value-added influenced long-term and short-term economic growth, but CO_2 emissions and oil consumption did not influence economic growth in the long term. In Indonesia, Bashir et al. (2019), there was no influence of economic growth, energy consumption, and human resources on CO_2 emissions. Nuansa & Widodo (2018) also stated that environmental damage in Indonesia is caused by development only pursuing the economic sector. Negative and significant ECT (-1) had a coefficient value of 1.07297, showing the difference between CO_2 emissions with a balance value of 1.07297 so that it was adjusted within 1 year. As a developing country, Indonesia consistently continues to increase economic output, but ideally also pays attention to environmental aspects to create economic growth in line with maintaining environmental quality.

Table 5. Short-Run estimation

Variables	Coefficient	t-statistic	Std.error
D(BM)	-0.008	-1.613	0.005
D(FDI)	0.002	0.199	0.013
D(LMVA)	0.607	2.3197	0.262**
D(LTRADE)	0.399	2.916	0.137***
ECT(-1)	-1.073	-3.158	0.339***
C	-0.016	-0.670	0.024
Adjusted R-squared	0.268	0.268	
F-statistic	4.007		
Prob(F-statistic)	0.005		

*Note: ***, ** and * are significant levels of 1%, 5% and 10%, respectively.*

Chontanawat (2020) found increasing energy consumption in economic activities to increase CO_2 emissions. Hdom & Fuinhas (2020) found a two-way relationship between international trade and energy production in Brazil, where emissions of pollution and international trade positively influenced economic output. On the other hand, hydropower, GDP, and renewables negatively influenced CO_2 emissions in Brazil. Shahbaz et al. (2020) identified the impact of industrialization on the UK economy by analyzing R&D expenditures, economic growth, energy consumption, and financial development allegedly causing CO_2 emissions. It shows that the cointegration between CO_2 emissions and influencing factors with energy consumption and financial development is proven to disturb the environmental balance, while R&D expenditures can control CO_2 emissions. A study in the Philippines by Lim et al. (2014) showed a bidirectional causality between oil consumption and economic output, and a unidirectional causality between CO_2 emissions and the Philippines' economic performance. A study in E7 (Brazil, India, Indonesia, Mexico, People's Republic of China, Russia, and Turkey) by Tong et al. (2020) found no cointegration between

energy consumption, economic growth, and CO_2 emissions in Indonesia, Mexico, Turkey, and China. This study showed short-term causality between energy consumption and CO_2 emissions in all E7 members except Indonesia and causality between economic output and CO_2 emissions in Brazil, Mexico, China, and India. This study also showed causality between economic growth and energy consumption in India, Indonesia, Brazil, Mexico, and China, as well as causality between CO_2 emissions and energy consumption in all E7 member countries.

A robustness test for the ARDL method can be performed with the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ). Based on the Cusum and CusumQ tests, the variable had significance at the 5% confidence level, indicating parameter stability.

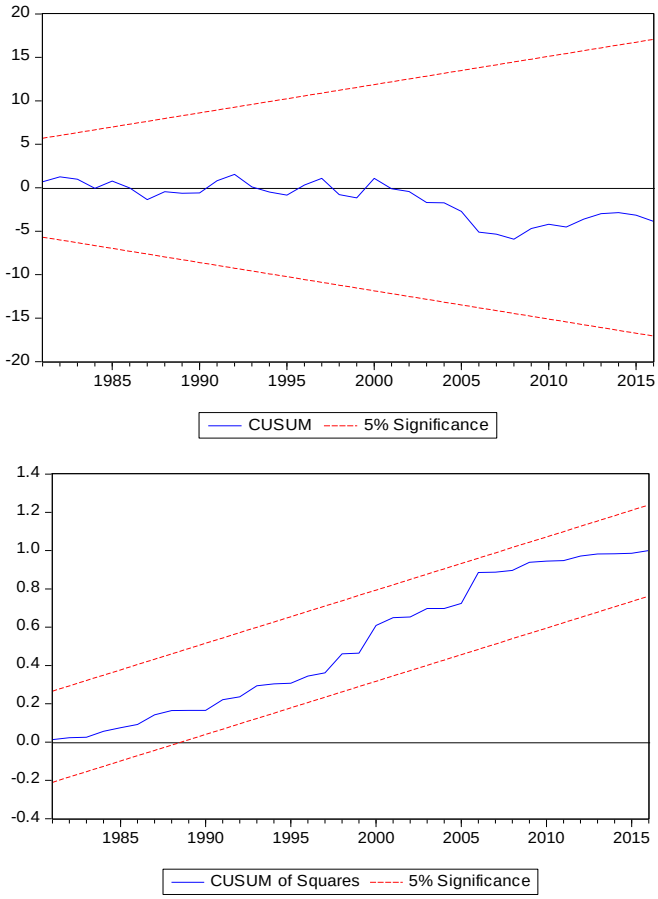

Figure 2. Cusum & CusumQ Test

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Industrial progress supports the economy in many countries globally, so it cannot be denied that environmental conditions are disturbed. Humans use natural resources as a factor of production and use technology that can negatively affect environmental sustainability. The use of renewable and non-renewable natural resources is at the heart of the economy. Global warming, air pollution, damage to ecosystems, to CO_2 emissions are evidence of environmental disruption. It is very important to study the

impact of economic activities on CO_2 emissions. This study found the positive influence of manufacturing value-added and international trade on CO_2 emissions in Indonesia's long term and short term. High economic activity causes environmental damage. Foreign direct investment negatively influenced CO_2 emissions in the long term, while broad money was insignificant. In the short term, foreign direct investment and broad money were insignificant. Based on Cusum and CusumQ tests, the model was stable and consistent.

Recommendations

The policy recommendations are: 1) the importance of regulations on the use of natural resources and environmentally friendly energy, 2) the synergy of relevant institutions in Indonesia to create clarity on sanctions for violating the law, 3) increase research and development related to CO2 emissions, 4) mitigation and energy-saving applications for sustainable development in Indonesia.

The limitation of this research is the use of CO_2 emission data is still limited nationally and does not include data analysis at the provincial or city level. Thus, for further research, it may be possible to conduct more comprehensive research that analyzes the impact of macroeconomics indicators on CO_2 emissions that represent the real conditions in regions of Indonesia.

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