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ANALYSING SHORT RUN AND LONG RUN RELATIONSHIP BETWEEN INDUSTRIAL PRODUCTION LEVEL AND SELECTED MACROECONOMIC VARIABLES IN MALAYSIA THROUGH ARDL APPROACH

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Abstrak: This paper investigates the short run and long run relationship between industrial production index, interest rate, consumer price index, money supply, exchange rate, inflation rate and dummy health crisis in Malaysia. The sample period is monthly data, which is from January 2013 until December 2023, and the time series are subjected to various shortcomings such as unit root test, bound test, and the data were first tested for their residuals. The results reveal that there is evidence for a stable long-run relationship between the industrial production index, interest rate, consumer price index, money supply, exchange rate, inflation rate and dummy health crisis, and substantial short run interactions among them. Also, this paper indicates the trend analysis of industrial production index and all selected macroeconomics variables. Not only that, but the most import things also that the article try to investigate is the effect of the selected macroeconomics variables towards the industrial production index in Malaysia.

Kata kunci: Industrial, Production, Index, Interest, Rate

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INTRODUCTION

An economy is a broad collection of interconnected production, consumption, and trade activities that help to determine how scarce resources are distributed. For the Manufacturing, Mining, and Electricity Sectors, the Industrial Production Index (IPI) is a measure of the rate of change in the production of industrial commodities in real terms over time. The interest rate is a proportion of the principle, which is the amount borrowed, that a lender charges a borrower. An annual percentage rate (APR) is used to express the interest rate on a loan (APR).

The Consumer Price Index (CPI) is a weighted average of prices for a basket of goods and services, such as transportation, food, and medical care. On any given day, the money supply refers to the entire quantity of cash and other liquid assets in a country's economy. An

exchange rate is the value of a country's currency in respect to the currency of another country or economic zone. The decrease of a currency's buying power over time is known as inflation.

In this study, it will study about the macroeconomics variable such as interest rate, CPI, money supply, exchange rate and inflation rate affected the IPI during time series January 2013 until December 2023.

LITERATURE REVIEW

This study article looked at numerous publications on the subject to examine the literature and research on industrial production index. However, several studies have discovered that research is mostly focused on emerging nations outside of Asia, with little attention paid to developing countries like Malaysia. As a result, the focus of this research will be on Asia's emerging countries, specifically Malaysia, Indonesia and Singapore, and key links will be studied using time series data.

Chao (1962) said that a set of index numbers meant to track variations in the volume of physical output of an economy's industrial sector over time is known as an index of industrial production. One of the most difficult parts of creating such an index is integrating a variety of physical output metrics of commodities generated by diverse industries in each year of the research period in a meaningful fashion. To be more explicit, one measures the changes in physical output for individual commodities before aggregating them to illustrate the quantity variation for the industrial sector by applying a set of weights to the component series. The weights, or weighting technique, used here will display the relative importance of the component series in terms of their contributions to or influences on total industrial output quantity variation.

While Davis (2003) said, because of the relative scarcity of yearly data on agriculture, merchant and wholesale trades, and select services, creating a consistent and comprehensive measure like GNP for the pre-Civil War years may be impossible. A correctly defined index of industrial production, on the other hand, should be a good predictor of the country's economic health. This is because non-industrial occupations, such as farmers, merchants, and the building trades, have historically provided demand directly to the industrial sector. Food processing, for example, is inextricably linked to agricultural output.

According to Wei (2008), rising interest rates will reduce investment, which will have an impact on production. This is because, according to their findings, the connections between the deposit rate and the industrial production index and the stock market are positive and statistically significant. It was concluded that China's monetary policy had a favourable influence on the Chinese economy and stock markets.

According to Chien (1990), a rise in the nominal currency interest rate owing to a rise in the predicted real interest rate would lead to a rise in the currency's spot value, as demand for currency-denominated assets would rise. While Li and Khurshid (2015) said that rate and investment have a favourable link in the long run, it may be concluded. Investment will be boosted if the interest rate is lowered. However, it is also noted that, while interest rates have an impact on investment, it is a little one. Aside from the interest rate, there are a slew of other factors that influence investment, including market size, economic development, investment climate, and preferential policies.

According to Mahmoud (2015), CPI and growth have a favourable and substantial association in certain of these nations. Moderate inflation will boost output and productivity. When the manufacturers see a large profit, they will boost their output. The results of their research found that the granger causality test proved that CPI granger causes Mauritania's growth but not the other way around. This recognizes that any change in the pricing level will cause Mauritania's economy to fluctuate.

According to Sarel (1995), the CPI can have a nonlinear influence on economic development, but only when it is crucial 108. The CPI has no influence on growth when the index is below this level and may even have a tiny positive effect. While from Okwanya, Moses and Pristine (2015) in their study, the withdrawal of the subsidy has no substantial influence on the CPI, implying that the poor are unaffected. However, because the return to original equilibrium is gradual and modest, high prices may have a long-term influence on the economy.

According to Yang and Shafiq (2020), money supply (MS) and inflation are linked. On the one hand, both the money supply and inflation have an impact on the country's economic development (Van, 2019). Inflation continues to rise when the money supply expands, but only in the long run. In the near run, however, a constant rise in the money supply has little effect on inflation. As a result, money supply and inflation are intimately linked, and money supply influences the country's economic development.

According to Babatunde and Shuaibu (2011), even in the face of repeated and comprehensive economic reform packages, inflationary pressure produced by a large money supply has been one of the key reasons that has continually hampered Nigeria's ability to achieve sustainable growth. Increases in the money supply cause output to rise in the same proportion as the increase in money supply, leaving actual balances constant. Because the money supply will not vary, this will have no effect on the equilibrium condition. When this happens, the model is said to be money neutral. This means that changes in the money supply have no impact on production.

According to Habib, Mileya and Stracca (2017), the direction of possible reverse causation, or a positive relationship between growth and real exchange rate appreciation, works against finding negative and significant coefficients for the impact of exchange rates on growth, according to one argument in defence of OLS regressions of economic growth on the real exchange rate.

According to Adeniran, Yusuf and Adeyemi (2014), the outcome demonstrates that the exchange rate has a favourable influence on economic growth. The effect of interest rates and inflation rates on economic growth, however, is inverse. As a result, the lower the amount of growth, the greater the interest rate and the rate of inflation. While according to Akpan and Atan (2011), there is little indication of a substantial direct association between exchange rate movements and production growth, according to the findings. In fact, monetary variables have had a direct impact on Nigeria's economic growth.

Sitthiyot (2000) have said before that higher inflation tends to slow rather than stimulate economic growth in the long term because it creates more uncertainty and reduces the efficacy of the price system's operation. Price stability, they added, is one of the most critical factors in promoting economic growth. Industrial countries should not disregard a negative association just because it is statistically insignificant from a policy viewpoint. Instead, industrial countries

should strive towards a rate of zero inflation to ensure that inflation does not stifle economic progress.

According to Datta and Mukhopadhyay (2011), short-run inflation has a significant negative impact on economic growth, but long-run economic growth causes inflation to alter (positively). According to them, whether inflation has an impact on economic growth is determined by how it impacts savings and investment. Some economists believe inflation promotes economic growth and that inflation and growth have a favourable relationship. While Sidrauski (1967) observed that an increase in inflation (owing to the expansion of the money supply) had no impact on the steady-state capital stock. As a result, neither output nor growth are harmed.

According to Acikgoz and Gunay (2020), the Turkish economy, like that of many other countries, will be destroyed in the short term, but if Turkey can control the virus quickly, it will be able to achieve long-term growth with an accelerating rise in manufacturing exports, tourism revenue, and foreign investment. They also mentioned Covid19 threads like prolonged contraction, bankruptcies, and higher unemployment rates, insufficient supply chain, oil price volatility, massive drop in consumer spending and business investment, banking crisis, massive public deficits, more travel restrictions, more custom restrictions, food inflation, more failed countries, and trade policies. This shown that the pandemic Covid19 has a significant impact on economic development and productivity.

According to Song and Lin (2010), the economic slowdown in the United States will have a significantly more negative impact on its outbound tourism to Asia than on other source markets, suggesting that the economic crisis will have a modest influence on its outbound tourism to Asia. The empirical findings demonstrate that the present financial crisis will have a major negative impact on Asian tourist arrivals and tourist spending outside Asia. Long-haul markets for arrivals in Asia, such as Europe and North America, will be hit hard. When a crisis has an impact on tourism, it's safe to assume that it will also have an impact on global economic growth. Inbound and outbound tourist demand estimates in Asia is influenced by economic growth and pricing fluctuations, both of which are linked to the present economic crisis.

In conclusion, this chapter has addressed what the industrial production index is and past research on the elements that influence it. The objective of this study review is to assist the reader in comprehending the many parts of the research on economic growth and its determining variables in three Asian countries: Malaysia, Indonesia, and Singapore. This is relevant because many persons with hearing loss have a distinct perspective on the elements that influence economic development and productivity. The researchers' approach or methods for developing the study's forecasting model will be described in the next section.

DATA AND METHODOLOGY

The general model for Malaysia is as below:

$$IPI_{Mt} = \alpha_0 + \alpha_1 INTR_{Mt} + \alpha_2 CPI_{Mt} + \alpha_3 M2_{Mt} + \alpha_4 EXCR_{Mt} + \alpha_5 INFR_{Mt} + \alpha_6 DUMMY_{Mt} + \varepsilon_{Mt}$$

Were,

IPI = Industrial production index base year 2010 at time t in log form

$INTR$ = Interest rate at time t in log form
CPI = Consumer price index base year 2010 at time t in log form
$M2$ = Money supply at time t in log form
$EXCR$ = Exchange rate at time t in log form
$INFR$ = Inflation rate at time t in log form
$DUMMY$ = Dummy health crisis at time t in log form
α_0 = Constant
α_1 = Slope coefficient
ε = Error term
t = Time series data from January 2013 to December 2023

One of the unofficial findings on data flow that might help you understand the data's history and volatility. The data is from the past or is outdated. This information gives us a glimpse into the future. As a result, understanding the flow of data translation is essential. There are a few techniques to describing the analysis data patterns by comparing lower peak, higher peak, and important phenomena of the scenario economy crises through time.

Using a unit root test, the stationary data is found. David Dickey and Wayner Fuller created the Augmented Dickey-Fuller (ADF) Test. If the time series data is not stationary on the added level, I(0), the stationary data can be obtained by utilizing the first difference, I(1), or second difference, I(2) (2). The cointegration test is used to see if two economic variables are linked in the long run. The cointegration test was made popular by Engle and Granger (Gujrati, 2004). The procedure for performing a cointegration test is an important part of building and estimating a dynamic model (Eagle, Granger, 1987). The cointegration test will co-integrate two or more non-stationary time-series variables if the combination is linear throughout time, even if the individual variables are not stationary.

At the first stage, the existence of the long-run relation between the variables under investigation is tested by computing the Bound F-statistic (bound test for co-integration) to establish a long-run relationship among the variables. This bound F-statistic is carried out on each of the variables as they stand as an endogenous variable while others are assumed as exogenous variables. Finally, if a long run relationship exists, the Error Correction Model (ECM) (M,I,S-1) is used to obtain the short run dynamic coefficient via the error correction model, where ECM (M,I,S-1) denotes the correction mechanism in stabilising the model's disequilibrium, also known as the speed of adjustment or feedback effect (Uko, A. K. & Nkoro, E., 2016).

In this part, hypothesis testing the short-run relationship among the Autoregressive Distributed Lag (ARDL) co-integration technique underlying variables leads to assessing the link between the forcing variable(s) in the ARDL model. Current values of the underlying variable(s) from the ARDL model are used to do this. Because the variables are co-integrated, they must have Granger causality in at least one direction. Sargan (1964) was the first to develop ECM, which was later improved by Engle and Granger (1987) and became very popular. To investigate the direction of causality between the variables, the Error Correction Model-based Granger causality test is used.

RESEARCH FINDINGS

From Table 1, it was present a result of ADF test for Malaysia. This test's null hypothesis is basically predicated on the assumption that the data series has a unit root. Consequently, the table's result shows a mixture of stationary data at the level form and also stationary data at the first difference type across all random walks.

Table 1: The Result of Augmented Dickey Fuller (ADF) Test for Selected Macroeconomic Variables Affecting Industrial Production Index (IPI) in Malaysia

Period	Data Series	At Level			At First Difference		
		Pure (None)	Without Trend	With Trend	Pure (None)	Without Trend	With Trend
MALAYSIA	**IPI**	0.255059(12) (0.7585)	-2.014965(12) (0.2802)	-2.047882(12) (0.5689)	-2.193280(12) (0.0278)	-2.201298(12) (0.2070)	-2.454844(12) (0.3499)
	INTR	-0.749687(12) (0.3898)	-9.100128(12) (0.00001)	-9.473624(12) (0.00001)	-8.612761(12) (0.00001)	-8.602690(12) (0.00001)	-7.645331(12) (0.00001)
	CPI	0.198606(12) (0.7423)	-10.31129(12) (0.00001)	-11.38745(12) (0.00001)	-7.715843(12) (0.00001)	-7.690415(12) (0.00001)	-7.657860(12) (0.00001)
	M2	0.710743(12) (0.8675)	-5.565752(12) (0.00001)	-10.71310(12) (0.00001)	-7.644902(12) (0.00001)	-7.667586(12) (0.00001)	-7.642140(12) (0.00001)
	EXCR	-0.166704(12) (0.6242)	-10.70099(12) (0.00001)	-11.12153(12) (0.00001)	-8.112397(12) (0.00001)	-8.079025(12) (0.00001)	-8.045361(12) (0.00001)
	INFR	-0.682274(12) (0.4197)	-1.736478(12) (0.4106)	-2.602303(12) (0.2801)	-9.714423(12) (0.00001)	-9.695868(12) (0.00001)	-5.304932(12) (0.0001)

Table 2 shows that for the model of Malaysia which tend to exercise the data series, all of the computed F-statistic values seem to be significantly higher than the upper bound critical value.

Table 2: F-Statistic for Co-integration Relationship

Test Statistic	Value	Significance Level	Bound Critical Value	
			I(0)	**I(1)**
Malaysia model F-statistic	6.626236	1.0%	3.15	4.43
		2.5%	2.75	3.99
		5.0%	2.45	3.61
		10%	2.12	3.23

Table 3 present the long-run coefficients must be produced based on the ARDL model's long-term predictions. From table below, Malaysia's independent variables present that if increased or decreased 1% of IPI, it will affect the independent variables.

Table 3: Long-run ARDL Estimation

Dependent variable IPI					
The Long-run coefficient estimates					
Period	Variable	Coefficient	Std. error	t-statistic	Prob.
Malaysia Model	Constant	-0.010997	0.268260	-0.040994	0.9674
	IPI	-0.524329	0.086274	-6.077481	0.00001
	INTR	-0.011058	0.022640	-0.488423	0.0
	CPI	0.256885	0.060962	4.213826	0.00001
	M2	0.174221	0.056505	3.083282	0.0025
	EXCR	0.092371	0.065954	1.400522	0.1639
	INFR	-0.007329	0.028713	-0.255257	0.7990
	DUMMY	-0.048853	0.012059	-4.051085	0.0001

Next, Table 4 calculated ARDL cointegration short-run error correction model (ECM) for a full model of Malaysia shows the coefficient estimates for all lagged first differenced variables. The short-run coefficients didn't lend themselves to much interpretation. All of these illustrate how all the variables are adjusted dynamically. Co-integration will be indicated by a negative and substantial coefficient of ECT.

Table 4: The ARDL Co-integration Short-run – Error Correction Model (ECM)

Malaysia Model				
Variable	Coefficient	Std. Error	t-statistic	Prob
C	-0.001462	0.002474	-0.590923	0.5563
ECT(-1)	-0.468212	0.062797	-7.456011	0.0000
D(IPI(-2))	0.229614	0.068305	3.361573	0.0012
D(IPI(-3))	0.134603	0.068051	1.977955	0.0514
D(IPI(-6))	0.043447	0.061495	0.706516	0.4819

D(IPI(-7))	0.042699	0.089671	0.476173	0.6353
D(IPI(-8))	-0.164139	0.084322	-1.946564	0.0551
D(IPI(-9))	-0.153336	0.093964	-1.631862	0.1067
D(IPI(-11))	-0.557661	0.078192	-7.131919	0.0000
D(INTR(-2))	0.016787	0.012197	1.376390	0.1726
D(INTR(-3))	0.012472	0.015592	0.799931	0.4261
D(INTR(-4))	0.009620	0.017977	0.535151	0.5940
D(INTR(-5))	0.112321	0.076351	1.471107	0.1452
D(INTR(-6))	0.057152	0.069274	0.825019	0.4118
D(INTR(-8))	0.109492	0.079927	1.369909	0.1746
D(INTR(-10))	0.146133	0.091242	1.601602	0.1132
D(CPI(-3))	1.082296	0.505164	2.142463	0.0352
D(CPI(-4))	-1.178646	0.529142	-2.227466	0.0288
D(CPI(-6))	0.948026	0.473914	2.000418	0.0489
D(CPI(-9))	0.763484	0.481748	1.584821	0.1170
D(CPI(-11))	-0.139128	0.181653	-0.765900	0.4460
D(M2(-3))	1.058488	0.508873	2.080063	0.0408
D(M2(-4))	-1.430246	0.480450	-2.976887	0.0039
D(M2(-5))	-0.007767	0.016677	-0.465741	0.6427
D(M2(-6))	0.809709	0.462244	1.751690	0.0837
D(M2(-9))	0.759411	0.482687	1.573300	0.1196
D(EXCR(-1))	-0.100662	0.073881	-1.362500	0.1769
D(EXCR(-2))	-0.088398	0.068369	-1.292965	0.1998
D(EXCR(-4))	0.131870	0.197344	0.668224	0.5059
D(EXCR(-8))	-0.018282	0.012113	-1.509353	0.1352
D(EXCR(-10))	-0.005344	0.014311	-0.373442	0.7098
D(EXCR(-11))	-0.144025	0.181482	-0.793604	0.4298
D(INFR(-2))	-0.088044	0.038852	-2.266122	0.0262
D(INFR(-7))	-0.026527	0.038124	-0.695818	0.4886
D(INFR(-11))	0.081380	0.046588	1.746782	0.0846
D(DUMMY(-1))	-0.049834	0.016775	-2.970715	0.0039
D(DUMMY(-2))	0.013524	0.014304	0.945511	0.3473
D(DUMMY(-3))	-0.056468	0.015628	-3.613343	0.0005
D(DUMMY(-4))	-0.125034	0.014627	-8.548404	0.0000
D(DUMMY(-6))	0.093131	0.019779	4.708589	0.0000
D(DUMMY(-7))	0.037531	0.019101	1.964849	0.0529
Adjusted R-squared	0.783279			
S.E. of regression	0.013209			
F-statistic	11.75231			
Prob(F-statistic)	0.000000			
Durbin-Watson stat	1.788868			

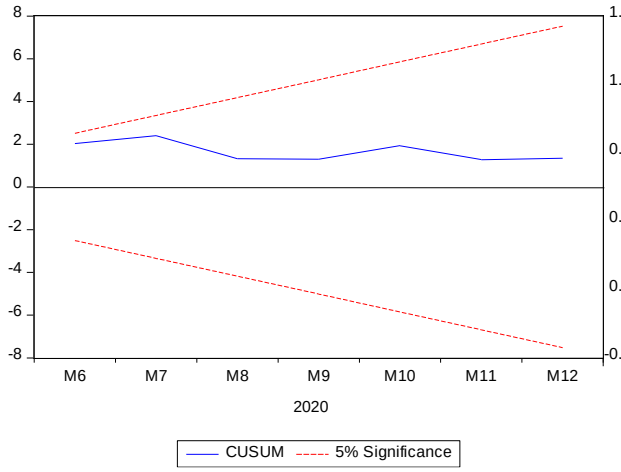

Figure 1: Plot of Cumulative sum (CUSUM) test of recursive residuals for Malaysia full model

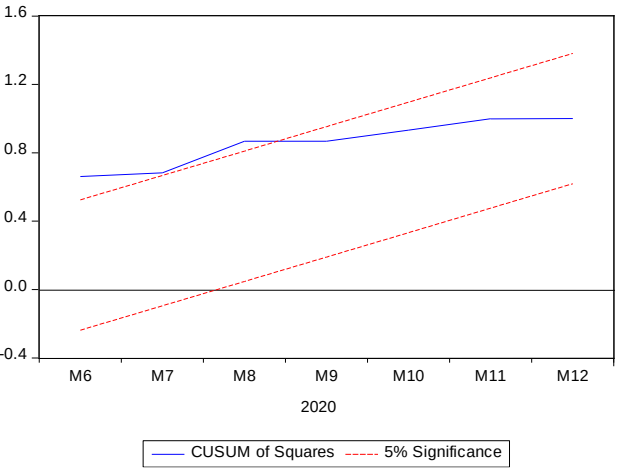

Figure 2: Plot of Cumulative sum square (CUSUMSQ) test of recursive residuals for Malaysia full model

CONCLUSION

First, the ADF unit root tests proved that Malaysia became integrated of different orders which is 1(0) and 1(1) time series data. Thus, it can be further tested of co-integration. The main objective of this study was to investigate the existence co-integration of the variables in the short run model. The F-statistic value for Malaysia is 6.626236, and this F-statistic value was higher than the bound critical values I(1), confirmed there is a co-integrating relationship among the variables by applying the critical values of Pesaran et. al (2001). For the long run, all of the data for Malaysia have an impact to IPI if increased or decreased 1% of the independent variables data.

Looking forward on ECT, the ECT for the Malaysia periods exhibits an expected negative sign, which is highly significant, indicating that, industrial production index, interest rate, consumer price index, money supply, exchange rate, inflation rate and dummy are co-integrated.

On the last part of finding, which is diagnostic test, by employing CUSUM to test the stability condition, that the long run parameters of the CUSUM test for Malaysia varied. It will, however, remark that the changes in movement appear to be exceeding the long-run 5% critical constraint. Consequently, the null hypothesis will be rejected since the data reveal that there is no long-run association between variables because the coefficients are not stable in any of the targeted samples — Malaysia.

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