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RELATIONSHIP BETWEEN INFLATION AND OTHER MACRO ECONOMICS FACTORS: COMPARATIVE STUDY OF GERMANY, JAPAN AND NEW ZEALAND

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ABSTRACT

One of the major concerns in different countries today is to manage inflation and to manage the resources according to it. Even though there are many factors that affect economic growth that can affect inflation, the concern of this research is regarding Consumer Price Index. The first objective of this study is to investigate the relationship between the consumer price index and Agricultural Land, Urban Population, Trade, Military Expenditure, Primary Energy Consumption, Natural Gas Flaring, and Oil–Refining Capacity. This study includes time series data from 1980 to 2020. Johansen's cointegration method is used to find cointegration, and the significance of long-run and short-term variables is tested. The findings of this study conclude that in the case of Germany, normalized coefficients show consumer price index, Agricultural Land, Military Expenditure, Oil Refining Capacity, and Primary Energy Consumption have a positive and significant impact, Whereas Trade, Natural Gas Flaring, and Urban Population has a negative and significant impact on consumer price index. On the other hand, Japan normalized coefficients show that consumer price index, Agricultural Land, and Primary Energy Consumption have a negative and significant impact. Whereas Military Expenditure, Oil Refining Capacity, Trade, Natural Gas Flaring, and Urban Population have a positive and significant impact on the consumer price index, if we talk about New Zealand, their long run coefficient shows that the normalized coefficients show that consumer price index, Oil Refining Capacity, Trade, and Urban Population has negative and significant impact Whereas Military Expenditure, Primary Energy Consumption, and Natural Gas Flaring has a positive and significant impact on consumer price index. Similarly, the results of the Germany-adjusted coefficients show that Military Expenditure and Urban Population have a positive significant, while primary consumption and trade have a negative relationship with the consumer price index. According to Japan and New Zealand, Oil Refining Capacity has a significant and positive relationship with the consumer price index in the short run. The study, therefore, recommends that the governments of New Zealand, Germany, and Japan should take more initiatives to increase their urban population and trade because these activities help to decrease the inflation in New Zealand, Germany, and Japan.

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INTRODUCTION

The long-term objective of the economic strategy in every country is to achieve long-term economic growth while maintaining stable prices. As a result, fiscal policy aimed at increasing productivity and monetary policy aimed at maintaining price stability must be efficiently coordinated and implemented. Maintaining long-term economic expansion and price stability simultaneously can be difficult for legislators. Despite Keynesian theory, other economic notions emphasize that mild inflation is a growth stimulant (Mubarik, 2005). Increasing prices for products and services is the overall state of the economy, which is reflected in increased inflation (Sugihyanto, 2021). Because the buying power of individuals will decline as a result of rising prices for products and services, fewer people will be able to afford to buy the products and services that are no longer produced, which would reduce producer investment. Producers' investment will reflect economic growth if it declines, as will the nation's income. According to Ophanides and Solow (1990), there are three outcomes that CPI may have on output and growth: (i) none; (ii) positive; and (iii) negative. Wai (1959) and Bhatia are two studies that did not find any compelling scientific proof for either a favorable or adverse link between inflation and economic growth. Tobin (1965) presupposed that money might replace capital and invented the Tobin Effect, which is the idea that inflation positively affects growth. Fisher (1993), Barro (1995), Bruno and Easterly (1995), and many others discuss the Anti-Tobin Effect, which is the term used to describe the detrimental effect of inflation on development. The consumer price index is one of the most closely watched price statistics used by different governments in different countries. The consumer price index is used as an indicator of inflationary trends, and it is being observed because a slight impact on CPI may have a divergent impact on different variables. For example, the increase in CPI determines the rate at which different payments to Social Security recipients will rise each year. We will calculate the same impact between the consumer price index and the change in Agricultural Land, Urban Population, Trade, Military Expenditures, Primary Energy Consumption, Natural Gas Flaring basis, and oil on refining capacity basis. The main cause of our study today is to find the cointegration between these dependent and independent variables.

The easiest definition of inflation is overall increases in the price of products and services within a country. For the past few years, inflation has been a problem faced by developed and under-developing economies. This study is conducted between the countries, namely Germany, Japan, and New Zealand, because, as we see below table for the past 20 years, these three countries also faced an inflation problem. In the case of Germany, according to www.aboutinflation.com, inflation was approximately 7% in 1974-75 while in the same years, according to www.aboutinflation.com inflation in Japan touch to the figure of 24% which is too high on the other hand, according to take-profit.org, Newzeland also face this issue in recent few years. This study examines the relationship between Inflation dependent variables and Independent Variables are taken as Agricultural Land - %age of GDP (AL), Urban Population (UP), Trade- %age of GDP (T), Military Expenditure- %age of GDP (ME), Primary Energy Consumption (PEC), Natural Gas Flaring (NGF) and Oil –Refining Capacity (ORC).

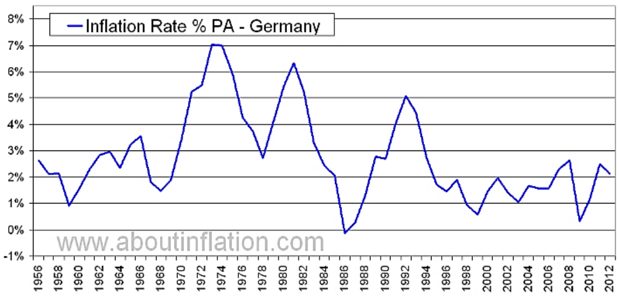

Figure 1. Germany Inflation rate for past few years.

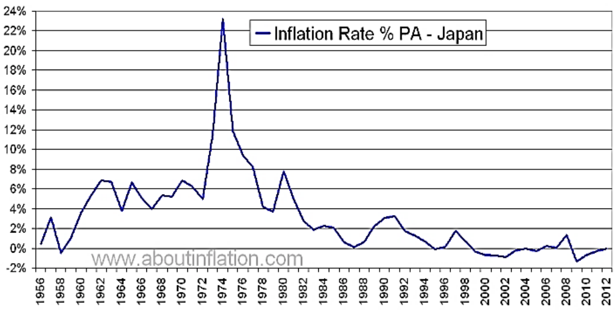

Figure 2. Japan Inflation rate for past few years.

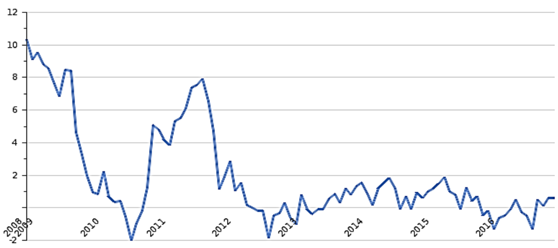

Figure 3. Newzealnd inflation rate for past few years.

The below section contains the studies that have already been conducted by various authors and have proven their stances through different techniques using econometrics. Previously the studies that have been conducted show a relationship between inflation and economic growth or within different variables holding the relationship between long-run and short-run phenomena.

Oil prices, energy usage, and economic development have all had a substantial impact on Malaysian inflation rates discovered in the study by Talha et al. (2021). Adaramola and Dada (2020) analyze the relationship between inflation and macroeconomic factors and conclude that inflation and the real exchange rate have a considerable negative influence on economic growth, but interest rates and money supply have a positive impact on economic growth. Ahmad (2022) examines the relationship between inflation and economic growth; the findings of this study conclude that there is a negative and significant relationship between inflation and economic growth in Pakistan. BEDADA et al. (2020) examine the relationship between inflation and macroeconomic factors and conclude that there is a positive and significant relationship between CPI and money supply, real GDP, and total budget deficit. Milenković et al. (2020) examine the relationship between inflation and GDP, government expenditure, unemployment, and taxes and conclude that there is a positive and significant relation exists between inflation and said variables.

Tien (2021) analyzes the relationship between inflation and GDP and concludes that a negative relationship exists between inflation and GDP. Al-Mutairi et al. (2020) examine the relationship between inflation and imports, GDP, Exchange rate, and money supply in Kuwait. The findings of this study conclude that there is a positive relation between inflation with imports and money supply, while there is a negative relation between GDP and exchange rate. Fisher (1993) has proven the relationship between inflation and economic growth. In this study, the data set consists of several macroeconomic variables, including consumer price index, Agricultural Land, Urban Population, Trade, Military Expenditure, Primary Energy Consumption, Natural Gas Flaring, and oil refinery capacity. Fisher argued that inflation distorts prices and effect the efficiency of the allocation of resources, and has a negative impact on economic growth. Barro (1997) has also shown a relationship between inflation and economic growth. Motley (1994) also included the inflation/consumer price index in his model to show the relationship between GDP and the consumer price index. Khan and Senhadji (2001) analyzed the relationship between the same variables in industrial and developing countries. They have used the techniques used by Chan and Tsay (1998) and Hansen (1999) with the help of new econometric techniques. Their results have shown that inflation rates above a specific level have a significant and negative effect on growth. There is also evidence that has supported the findings of Mundell (1963) and Tobin (1965) of a positive relationship between growth and inflation. Similar findings are also of Gosh & Philips (1998), with the relationship showing positive results once the inflation rate is less than 2-3%. Xiao (2009) proved that the said variables are positively related to the above three quarter's lags. He used the same multivariate cointegration method that we have used for this assignment. Christoffersen and Doyel (1998), on the other hand, have detected that below 13% inflation rate, there is no relationship between the two variables.

The objective of this study is to find the relationship between CPI and other independent variables (Agricultural Land - %age of GDP (AL), Urban Population (UP), Trade- %age of GDP (T), Military Expenditure- %age of GDP (ME), Primary Energy Consumption (PEC), Natural Gas Flaring (NGF) and Oil –Refining Capacity (ORC)) in both long and short run using Johansen Multivariate Cointegration Technique.

METHODOLOGY

Data source

Our study is based on three countries: Japan, New Zealand, and Germany. For our analysis in the current study, we will use annual data that covers 1980 to 2020 and collect all data from WDI and the British Petroleum website. CPI, agriculture land, urban population, Trade, and Military expenditure, are collected from WDI, and variables like Primary Energy Consumption, Natural Gas Flaring basis, and Oil on refinery capacity basis are taken from the British Petroleum statistical review of the World Energy Databank.

Method

We download all data from WDI and the British petroleum website and take that data in Excel after applying transformation approaches. Then, we take that data in E-views (find Correlation, VIF, descriptive table and following the lead of Chimobi (2010). We estimate the results by applying the Johansen cointegration method provided by Johansen (1988) and Johansen and Juselius (1990), along with Long run and short run results.

Model of study

$$(CPI) = \beta_0 + \beta_1 AL_t + \beta_2 UP_t + \beta_3 TRD_t + \beta_4 ME_t + \beta_5 PEC_t + \beta_6 NGF_t + \beta_7 ORC_t + \mathcal{E}_t \quad (1)$$

This model is also used by Bedada et al. (2020) in their study.
Here,
Y= Inflation of Japan, New Zealand, and Germany
α = refers to each entity's unidentified intercept.
AL = Agriculture Land (% of Land Area) of Japan, New Zealand, and Germany
UP = Urban population (Total) of Japan, New Zealand, and Germany
T = Trade (% of GDP) of Japan, New Zealand, and Germany
ME = Military expenditure (% of GDP) Japan, New Zealand, and Germany
PEC = Primary energy consumption (Exajoules) of Japan, New Zealand, and Germany
NGF = Natural gas flaring (Billion cubic meters) of Japan, New Zealand, and Germany
ORC = Oil refining capacity (Thousand barrels daily) of Japan, New Zealand, and Germany
Ɛ = refers to the error term

The values are based on percentages of GDP and are on their constant value, which presidents the relative forms of the variables taken natural Logs taken on the values. We are using the entire variable in log form because when we use a variable in log form, then the unit of all variables becomes the same, and they are easily comparable with the rest of the world, and we easily interoperate them. Now we calculate the results of each country separately and, in the end, combine the results of all three as a summary. Table 1 presents variable names along with their log form version and proxy of Variables.

Log transformed model is present below:

$$Ln(CPI) = \beta_0 + \beta_1 Ln(AL)_t + \beta_2 Ln(UP)_t + \beta_3 Ln(TRD)_t + \beta_4 Ln(ME)_t + \beta_5 Ln(PEC)_t + \beta_6 Ln(NGF)_t + \beta_7 Ln(ORC)_t + \mathcal{E}_t \quad (2)$$

Bedada et al. (2020) also used this model style in their study.

Table 1. Variables description.

Variables	Log form	Proxy of variable	Data source
Consumer price index (2010 = 100)	LNCPI	CPI (2010 = 100)	WDI from 1980 to 2020
Agricultural Land (% of Land Area)	LNAL	(% of Land Area)	WDI from 1980 to 2020
Urban Population	LNUP	Total	WDI from 1980 to 2020
Trade (% of GDP)	LNT	(% of GDP)	WDI from 1980 to 2020
Military Expenditure (% of GDP	LNME	(% of GDP)	WDI from 1980 to 2020
Primary Energy Consumption	LNPEC	Exajoules	British Petroleum from 1980 to 2020
Natural Gas Flaring	LNNGF	Billion cubic meters	British Petroleum from 1980 to 2020
Oil - Refining Capacity	LNORC	Thousand barrels daily	British Petroleum from 1980 to 2020

RESULTS AND DISCUSSION

The findings and their explanation are carried out in this section. We are starting with a descriptive statistics table of Germany, Japan, and New Zealand variables. Tables 2, 3, and 4 represent descriptive stats of Germany, Japan, and New Zealand. In the case of Germany, the empirical results estimated in Table 2 which show that the probability value of the natural log of consumer price index, Agricultural Land, Primary Energy Consumption, and Natural Gas Flaring are all insignificant. As all these variables show insignificance, it is concluded that these factors are normally distributed except Military Expenditure, Oil Refining Capacity, and Trade, and empirical results estimated in the table of Japan show that the probability value of the natural log of Agricultural Land, Military Expenditure, Oil Refining Capacity, Primary Energy Consumption, Trade, Natural Gas Flaring and Urban Population are all insignificant and show the attribute of normal distribution except Inflation on the other hand in case of New Zealand all variable is insignificant and show normal distribution except CPI and primary energy consumption.

After discussing the descriptive statistic now, we are discussing VIF Tables 5, 6, and 7, which appear below. Table 5 shows the magnitude of variance inflation factors among the independent variables that we have taken for our study. The results show that where the VIF value is less than 10 by using the formula [1/1 – r2] the independent variables show no Multicollinearity between them. Tables 5 and 7 show that the VIF value of the LNME and LNUP in Germany and LNGF in New Zealand has Multicollinearity with a value of VIF greater than 10. As there are almost all the variables of all three countries have no Multicollinearity among them, so we go further to find the stationary of the variables by finding the trend.

Table 2. Descriptive statistics (Germany).

Germany	LNCPI	LNAL	LNME	LNNGF	LNORC	LNPEC	LNT	LNUP
Mean	4.42075	4.58331	0.48353	7.86536	7.72338	2.65406	4.08315	17.92083
Median	4.45084	4.59281	0.32995	7.87012	7.69894	2.66173	4.10981	17.93666
Maximum	4.73116	4.67208	1.11248	8.01117	8.13798	2.73771	4.48226	17.98079
Minimum	3.95464	4.52618	0.06357	7.66261	7.60986	2.49412	3.70320	17.84866
Std. Dev.	0.22376	0.03968	0.36327	0.08230	0.12253	0.05338	0.29081	0.04291
Skewness	-0.3883	0.30898	0.75258	-0.31403	2.03075	-0.60105	0.13529	0.45818
Kurtosis	1.95460	2.03144	1.90623	2.22550	6.89813	3.42663	1.33163	1.75300
Jarque-Bera	2.89757	2.25497	5.91398	1.69864	54.13902	2.77954	4.88017	4.09096
Probability	0.23486	0.32385	0.05198	0.42771	0.00000	0.24913	0.08715	0.12932
Sum	181.250	187.91	19.8247	322.4797	316.6587	108.8164	167.4090	734.7538
Sum of Sq. Dev.	2.00282	0.06299	5.27854	0.27093	0.60051	0.11397	3.38291	0.07366
No. of Observations	41	41	41	41	41	41	41	41

Table 3. Descriptive statistics (Japan).

Japan	LNCPI	LNAL	LNME	LNNGF	LNORC	LNPEC	LNT	LNUP
Mean	4579317	4.595689	0.058002	8.4885	8.406877	2.956898	3.182039	18.4541
Median	4.612136	4.592452	0.056741	8.49205	8.440259	2.974271	3.202584	18.4182
Maximum	4.658562	4.630781	-0.00318	8.689645	8.638171	9.109114	3.622511	18.5726
Minimum	4.345915	4.567743	0.108001	8.096131	8.097095	2.672115	2.760662	18.3039
Std. Dev.	0.079057	0.01332	0.022919	0.148297	0.138301	0.133163	0.272781	0.09511
Skewness	-1.37725	0.669972	0.087898	0.572385	0.748233	0.631049	0.038322	0.04968
Kurtosis	3.84806	3.75116	2.888062	2.787085	3.196154	2.29298	1.581239	1.43483
Jarque-Bera	14.1903	4.03114	0.0742	2.31621	3.891387	9.57515	3.44871	4.20183
Probability	0.000829	0.133244	0.96358	0.314081	0.142888	0.167366	0.178288	0.12234
Sum	187.752	188.4233	-2.378096	348.0285	344.682	121.2328	130.4636	756.621
Sum of Sq. Dev.	0.250002	0.007097	0.0210011	0.821358	0.765092	0.709299	2.976383	0.36185
No. of Observations	41	41	41	41	41	41	41	41

Table 4. Descriptive statistics (New Zealand).

New Zealand	LNCPI	LNAL	LNME	LNNGF	LNORC	LNPEC	LNT	LNUP
Mean	4.27790	4.59697	0.51002	4.78647	4.58283	-0.32493	4.04303	15.01393
Median	4.34378	4.59713	0.48202	4.87666	4.57471	-0.22378	4.05865	15.01500
Maximum	4.75531	4.64172	1.10618	5.18514	4.90975	-0.07261	4.22708	15.29894
Minimum	3.15556	4.56656	0.10533	4.24980	4.11087	-0.76519	3.79019	14.76988
Std. Dev.	0.41514	0.01943	0.28937	0.28903	0.27221	0.20292	0.08354	0.15705
Skewness	1.10859	0.52346	0.29235	0.41551	-0.40913	-0.89144	-0.34534	0.01328
Kurtosis	3.48221	2.86848	1.83847	1.66110	2.26600	2.52559	4.25088	1.84746
Jarque-Bera	8.79514	1.90194	2.88886	4.24220	2.06420	5.81469	3.48798	2.27046
Probability	0.01231	0.38637	0.23588	0.11990	0.35626	0.05462	0.17482	0.32135
Sum	175.39390	188.4759	20.91067	196.24520	187.8960	-13.32195	165.76410	615.57090
Sum of Sq. Dev.	6.89376	0.01510	3.34938	3.41477	2.96398	1.64708	0.27918	0.98655
No. of Observations	41	41	41	41	41	41	41	41

Table 5. VIF (Germany).

Germany	LNCPI	LNAL	LNME	LNORC	LNPEC	LNT	LNNGF	LNUP
LNCPI	-							
LNAL	10.9874	-						
LNME	8.8382	4.8399	-					
LNORC	1.467	1.5018	1.2846	-				
LNPEC	3.1395	2.1213	1.9121	1.077	-			
LNT	5.393	5.7498	2.7871	1.1398	2.5837	-		
LNNGF	1.7996	1.9889	1.2227	1.1081	2.4518	3.027	-	
LNUP	14.2676	5.3703	11.9157	1.1864	2.7532	4.0373	1.4735	-

Table 6. VIF (Japan).

Japan	LNCPI	LNAL	LNUP	LNT	LNME	LNPEC	LNNGF	LNORC
LNCPI	-							
LNAL	1.045747	-						
LNME	1.015802	1.006826	-					
LNORC	1.348268	1.119771	1.228386	-				
LNPEC	2.766558	1.004672	1.034014	1.000125	-			
LNT	1.015558	1.616209	1.006665	1.419214	1.014537	-		
LNNGF	1.000651	1.123006	1.291291	2.139104	1.380488	2.035103	-	
LNUP	2.167622	1.397163	1.080310	1.975619	1.309421	1.866348	1.259397	-

Table 7. VIF (New Zealand).

New Zealand	LNCPI	LNAL	LNUP	LNT	LNME	LNPEC	LNNGF	LNORC
LNCPI	-							
LNAL	1.213195	-						
LNME	6.066952	1.048981	-					
LNORC	9.753997	1.178318	5.332569	-				
LNPEC	14.573760	1.202303	7.313196	6.088941	-			
LNT	1.032647	1.003948	1.000122	1.064113	1.001036	-		
LNNGF	4.276423	1.033576	8.858147	4.751390	7.973598	1.002653	-	
LNUP	6.128520	1.026861	7.150512	7.432255	7.007823	1.022203	11.392595	-

After discussing the VIF table, now order of integration are present in Table 9, 10, and 11, which are attached below, and the criteria used to accept or reject the null hypothesis are present in Table 8. The data that we have picked is for 40 years (1980-2020), which shows that there is a trend in our data. We have applied two tests to find the unit root at the level and the first difference, Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and NG Perron (NGP). At the level, the null hypothesis of NGP shows that the series is non-stationary, and the alternative hypothesis is stationary, whereas KPSS test results show us that at the level, the null hypothesis is the series is stationary, and the alternative hypothesis is non-stationary. The trend shows us that in the case of all three countries, Germany, Japan, and New Zealand, Ng-perron results show that the natural log of CPI, natural log off AL, natural log of ME, natural log of ORC, natural log of PEC, natural log of T, and the natural log of NGF are non-stationery at the level because their calculated value correspondent to their critical value is greater at 10% significance level. Hence, we accept the null hypothesis that series is non-stationary, and KPSS also presents evidence of non-stationary in the case of all variables because their test value is greater than their critical value at a 1% significance level. Hence, we reject the null hypothesis that the series is stationary and accept the alternative hypothesis that the series is non-stationary. In the case of the First difference, all variables of Germany, Japan, and New Zealand are stationary. So in the case of all three countries, Germany, Japan, and New Zealand, our data series has the same order of integration, which is 1, and our data becomes spurious. To exclude spuriousness from the data, we apply Johansen and Juselius multivariate co-integration method. Table 9, 10, and 11 gives us values at the level and at the first difference of both KPSS and NG Perron tests.

Table 8. Hypothesis used in unit root test.

Null hypothesis for KPPSS	Alternative hypothesis for KPSS
• Series is stationary • Series has no unit root	• Series is non stationary • Series has no unit root
Null hypothesis for NG-Perron	**Alternative hypothesis for NG-Perron**
• Series is non- stationary • Series has a unit root	• Series is stationary • Series has no unit root

Table 9. Unit root test (GERMANY).

NG Perron - Test at Level				NG Perron - Test at First Difference			
Variables	t-statistics	PV (10%)	Decision	Variables	t-statistics	PV (10%)	Decision
LNCPI	0.87209	-5.7	Non-Stationary	D(LNCPI)	-6.35311	-5.7	Stationary
LNAL	0.06394	-5.7	Non-Stationary	D(LNAL)	-15.0144	-5.7	Stationary
LNME	-0.38031	-5.7	Non-Stationary	D(LNME)	-9.02116	-5.7	Stationary
LNORC	-1.96762	-5.7	Non-Stationary	D(LNORC)	-9.57917	-5.7	Stationary
LNPEC	2.05339	-5.7	Non-Stationary	D(LNPEC)	-6.81553	-5.7	Stationary
LNT	-0.13709	-5.7	Non-Stationary	D(LNT)	-29.0696	-5.7	Stationary
LNNGF	1.54086	-5.7	Non-Stationary	D(LNNGF)	6.25757	-5.7	Stationary
LNUP	-0.15489	-5.7	Non-Stationary	D(LNUP)	-10.6032	-5.7	Stationary

KPSS - Test at Level				KPSS - Test at First Difference			
Variables	t-statistics	PV (1%)	Decision	Variables	t-statistics	PV (1%)	Decision
LNCPI	2.089171	0.739	Non-Stationary	D(LNCPI)	0.625734	0.739	Stationary
LNAL	1.994948	0.739	Non-Stationary	D(LNAL)	0.273119	0.739	Stationary
LNME	1.808487	0.739	Non-Stationary	D(LNME)	0.530705	0.739	Stationary
LNORC	0.841014	0.739	Non-Stationary	D(LNORC)	0.439707	0.739	Stationary
LNPEC	1.723406	0.739	Non-Stationary	D(LNPEC)	0.144117	0.739	Stationary
LNT	1.991265	0.739	Non-Stationary	D(LNT)	0.113637	0.739	Stationary
LNNGF	1.450897	0.739	Non-Stationary	D(LNNGF)	0.125246	0.739	Stationary
LNUP	1.961975	0.739	Non-Stationary	D(LNUP)	0.150588	0.739	Stationary

Table 10. Unit root test (Japan).

NG Perron - Test at Level				NG Perron - Test at First Difference			
Variables	t-statistics	PV (10%)	Decision	Variables	t-statistics	PV (10%)	Decision
LNCPI	0.03476	-5.7	Non-Stationary	D(LNCPI)	6.09174	-5.7	Stationary
LNAL	-2.12559	-5.7	Non-Stationary	D(LNAL)	-13.6302	-5.7	Stationary
LNME	-2.24111	-5.7	Non-Stationary	D(LNME)	-14.8353	-5.7	Stationary
LNORC	1.0491	-5.7	Non-Stationary	D(LNORC)	-18.2063	-5.7	Stationary
LNPEC	-1.14019	-5.7	Non-Stationary	D(LNPEC)	-9.27234	-5.7	Stationary
LNT	-3.56188	-5.7	Non-Stationary	D(LNT)	-28.2713	-5.7	Stationary
LNNGF	-0.30085	-5.7	Non-Stationary	D(LNNGF)	-7.66027	-5.7	Stationary
LNUP	-5.00984	-5.7	Non-Stationary	D(LNUP)	-8.39261	-5.7	Stationary
KPSS - Test at Level				KPSS - Test at First Difference			
Variables	t-statistics	PV (1%)	Decision	Variables	t-statistics	PV (1%)	Decision
LNCPI	1.486609	0.739	Non-Stationary	D(LNCPI)	0.00781	0.739	Stationary
LNAL	0.813255	0.739	Non-Stationary	D(LNAL)	0.131088	0.739	Stationary
LNME	0.248105	0.739	Non-Stationary	D(LNME)	0.06626	0.739	Stationary
LNORC	1.263771	0.739	Non-Stationary	D(LNORC)	0.196959	0.739	Stationary
LNPEC	0.93767	0.739	Non-Stationary	D(LNPEC)	0.002716	0.739	Stationary
LNT	1.181337	0.739	Non-Stationary	D(LNT)	0.208853	0.739	Stationary
LNNGF	0.836362	0.739	Non-Stationary	D(LNNGF)	0.653323	0.739	Stationary
LNUP	2.078367	0.739	Non-Stationary	D(LNUP)	0.369451	0.739	Stationary

Table 11. Unit root test (New Zealand).

NG Perron - Test at Level				NG Perron - Test at First Difference			
Variables	t-statistics	PV (10%)	Decision	Variables	t-statistics	PV (10%)	Decision
LNCPI	0.04914	-5.7	Non-Stationary	D(LNCPI)	9.15488	-5.7	Stationary
LNAL	2.26518	-5.7	Non-Stationary	D(LNAL)	-20.7939	-5.7	Stationary
LNME	-0.6403	-5.7	Non-Stationary	D(LNME)	-17.0376	-5.7	Stationary
LNORC	-0.01035	-5.7	Non-Stationary	D(LNORC)	-22.8047	-5.7	Stationary
LNPEC	0.32388	-5.7	Non-Stationary	D(LNPEC)	-9.26296	-5.7	Stationary
LNT	2.90522	-5.7	Non-Stationary	D(LNT)	-23.1937	-5.7	Stationary
LNNGF	-0.32138	-5.7	Non-Stationary	D(LNNGF)	-6.35574	-5.7	Stationary
LNUP	1.13379	-5.7	Non-Stationary	D(LNUP)	-15.026	-5.7	Stationary
KPSS - Test at Level				KPSS - Test at First Difference			
Variables	t-statistics	PV (1%)	Decision	Variables	t-statistics	PV (1%)	Stationary
LNCPI	1.849085	0.739	Non-Stationary	D(LNCPI)	0.039994	0.739	Stationary
LNAL	4.596973	0.739	Non-Stationary	D(LNAL)	0.077703	0.739	Stationary
LNME	1.980315	0.739	Non-Stationary	D(LNME)	0.49723	0.739	Stationary
LNORC	1.918596	0.739	Non-Stationary	D(LNORC)	0.0689	0.739	Stationary
LNPEC	1.867982	0.739	Non-Stationary	D(LNPEC)	0.591802	0.739	Stationary
LNT	4.043027	0.739	Non-Stationary	D(LNT)	0.138858	0.739	Stationary
LNNGF	1.974411	0.739	Non-Stationary	D(LNNGF)	0.21291	0.739	Stationary
LNUP	2.113256	0.739	Non-Stationary	D(LNUP)	0.190107	0.739	Stationary

The empirical results of Tables 12 and 13 reports the long-run cointegrating relation between CPI and their factors in the case of Germany, Japan, and New Zealand. The multivariate cointegration approach gives us two results: one in the form of a trace test and the other in the form of a maximum Eigenvalue test. The calculated value of our trace is found to be greater than

5% of its correspondence critical value, and we reject the null hypothesis and accept the alternative hypothesis and conclude that evidence of cointegration is present between dependent and independent variables up to the maximum value of six or at most 6 for Germany while eight or at most 6 for Japan and three or at most 3 for New Zealand, our maximum Eigenvalue test results shows that the calculated value of our Eigenvalue test is found to be greater than its correspondence critical value at 5% critical value and we reject the null hypothesis and accept alternative hypothesis and conclude that evidence of cointegration is present between dependent and independent variables at most 3 for Germany while at most 6 for Japan and at most 3 for New Zealand. This means that the natural log form of the dependent variable Consumer price indexes cointegrated with the natural log form of all other independent variables (Agricultural Land, Urban Population, Trade, Military Expenditure, Primary Energy Consumption, Natural Gas Flaring, and Oil Refining Capacity).

Table 12. Johansen cointegration test.

Germany

Trace test

Null hypothesis	Alternative hypothesis	Trace test	Critical value 0.05 significance level	Probability value
r = 0	r = 1	285	159	0.00
r ≤ 1	r = 2	193	125	0.00
r ≤ 2	r = 3	196	95	0.00
r ≤ 3	r = 4	91	69	0.00
r ≤ 4	r = 5	52	47	0.01
r ≤ 5	r = 6	30	29	0.04
r ≤ 6	r = 7	11	15	0.17
r ≤ 7	r = 8	1	3	0.30

Maximum Eigenvalue Test

Null hypothesis	Alternative hypothesis	Trace test	Critical value 0.05 significance level	Probability value
r = 0	r = 1	91	52	0.00
r ≤ 1	r = 2	57	46	0.00
r ≤ 2	r = 3	45	40	0.01
r ≤ 3	r = 4	38	33	0.01
r ≤ 4	r = 5	22	27	0.19
r ≤ 5	r = 6	18	21	0.10
r ≤ 6	r = 7	10	14	0.17
r ≤ 7	r = 8	1	3	0.30

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level.
Max-Eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level.

JAPAN

Trace test

Null hypothesis	Alternative hypothesis	Trace test	Critical value 0.05 significance level	Probability value
r = 0	r = 1	409.1262	159.5297	0
r ≤ 1	r = 2	277.9115	125.6154	0
r ≤ 2	r = 3	187.8953	95.75366	0
r ≤ 3	r = 4	111.0247	69.81889	0
r ≤ 4	r = 5	67.43216	47.85613	0.0003
r ≤ 5	r = 6	32.7767	29.79707	0.022
r ≤ 6	r = 7	11.46413	15.49471	0.1845
r ≤ 7	r = 8	0.21286	3.841466	0.6445

Maximum Eigenvalue Test

Null hypothesis	Alternative hypothesis	Trace test	Critical value 0.05 significance level	Probability value
r = 0	r = 1	131.2147	52.36261	0
r ≤ 1	r = 2	90.01614	46.23142	0
r ≤ 2	r = 3	76.87065	40.07757	0
r ≤ 3	r = 4	43.59252	33.87687	0.0026
r ≤ 4	r = 5	34.65546	27.58434	0.0052
r ≤ 5	r = 6	21.31257	21.13162	0.0472
r ≤ 6	r = 7	11.25127	14.2646	0.1421
r ≤ 7	r = 8	0.21286	3.841466	0.6445

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level.
Max-Eigenvalue test indicates 6 cointegrating eqn(s) at the 0.05 level.

Table 13. Johansen cointegration test.

New Zealand				
Trace test				
Null hypothesis	Alternative hypothesis	Trace test	Critical value 0.05 significance level	Probability value
r = 0	r = 1	233.3181	159.5297	0
r ≤ 1	r = 2	163.4875	125.6154	0
r ≤ 2	r = 3	102.9371	95.75366	0.0146
r ≤ 3	r = 4	61.56429	69.81889	0.1905
r ≤ 4	r = 5	37.72823	47.85613	0.314
r ≤ 5	r = 6	19.88922	29.79707	0.4304
r ≤ 6	r = 7	8.325924	15.49471	0.4312
r ≤ 7	r = 8	0.143446	3.841466	0.7049
Maximum Eigenvalue Test				
Null hypothesis	Alternative hypothesis	Trace test	Critical value 0.05 significance level	Probability value
r = 0	r = 1	69.83064	52.36261	0.0004
r ≤ 1	r = 2	60.55037	46.23142	0.0008
r ≤ 2	r = 3	41.37284	40.07757	0.0355
r ≤ 3	r = 4	23.83606	33.87687	0.4676
r ≤ 4	r = 5	17.83902	27.58434	0.5086
r ≤ 5	r = 6	11.56329	21.13162	0.5911
r ≤ 6	r = 7	8.182478	14.2646	0.3604
r ≤ 7	r = 8	0.143446	3.841466	0.7049

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level.
Max-Eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level.

After discussing the Johansen Cointegration test. Further, to find out the cointegration between dependent and independent variables, we are going to calculate long-run and short-run variables. We calculate normalized and adjusted coefficients given in Table 14 and 15: if we talk about Germany, normalized coefficients show that Agricultural Land, Military Expenditure, Oil Refining Capacity, and Primary Energy Consumption has a positive and significant impact on the consumer price index of our Results are matched with Schurleet al. (2012), Starret al. (1984) and Arinze(2011), whereas Trade, Natural Gas Flaring, and Urban Population have a negative and significant impact on consumer price index, our results are similar with the studies of Joshi and Acharya (2010). This means that an increase in Agricultural Land or Military Expenditure or Oil Refining Capacity or Primary Energy Consumption by 1% will increase Inflation by 1.064, 0.050, .266, and 1.141, respectively. By increasing independent variables like Trade, Natural Gas Flaring, and Urban Population by 1%, they will decrease the consumer price index by.127, .259, and 1.77, respectively. The results also show that the impact on Oil Refining Capacity is the most among all variables upon the consumer price index. On the other hand, Japan normalized coefficients show that consumer price index, Agricultural Land, and Primary Energy Consumption have a negative and significant impact. Military Expenditure, Oil Refining Capacity, Trade, Natural Gas Flaring, and Urban Population positively and significantly impact the consumer price index. This means that an increase in Agricultural Land or Primary Energy Consumption by 1% will lead to a decrease in the consumer price index by 7.1902 and 0.7300, respectively. Whereas, by 1% increase in independent variables like Military Expenditure, Oil Refining Capacity, Trade, Natural Gas Flaring, and Urban Population will increase CPI by1.0319, 0.1258, 0.0725, 0.6081, and 1.0115, respectively. The result also shows that the impact on Agricultural Land is the most among all variables on the consumer price index. If we talk about New Zealand, the normalized coefficients show that the consumer price index, Oil Refining Capacity, Trade, and Urban Population have a negative and significant impact. In contrast, Military Expenditure, Primary Energy Consumption, and Natural Gas Flaring positively and significantly impact the consumer price index. Change in the consumer price index does not impact Agricultural Land in the longer run. This means that by 1% increase in Oil Refining Capacity, Trade, and Urban Population will decrease CPI by 1.7258, 4.2798and 1.6338, respectively. Whereas an increase in independent variables like Military Expenditure, Primary Energy Consumption, and Natural Gas Flaring by 1% will lead to an increase in CPI by 1.7309, 4.0811, and 2.4002, respectively. The result also shows that the impact on trade is the most among all variables upon the consumer price index in New Zealand.

Table 14. Johansen multivariate cointegration approach (long run results).

Normalized Coefficients (New Zealand)			Normalized Coefficients (Germany)			Normalized Coefficients (Japan)		
Dependent Variable: LNCPI			Dependent Variable: LNCPI			Dependent Variable: LNCPI		
Independent Variables	Coefficients	Decision	Independent Variables	Coefficients	Decision	Independent Variables	Coefficients	Decision
LNAL	-2.523323 -2.86255 [-0.88150]	Insignificant	LNAL	1.064444 -0.15728 [6.76803]	Significant	LNAL	-7.190277 -0.35451 [-20.2822]	Significant
LNME	1.730967 -0.35439 [4.88434]	Significant	LNME	0.050647 -0.0235 [2.15500]	Significant	LNME	1.031963 -0.16267 [6.34372]	Significant
LNORC	-1.725823 -0.34344 [-5.02511]	Significant	LNORC	0.266834 -0.01546 [17.2634]	Significant	LNORC	0.125817 -0.04782 [2.63093]	Significant
LNPEC	4.081122 -0.52661 [7.74987]	Significant	LNPEC	1.141397 -0.06274 [18.1924]	Significant	LNPEC	-0.730058 -0.13204 [-5.52918]	Significant
LNT	-4.279866 -0.45965 [-9.31105]	Significant	LNT	-0.127051 -0.02219 [-5.72616]	Significant	LNT	0.072597 -0.02908 [2.49627]	Significant
LNNGF	2.400249 -0.42987 [5.58370]	Significant	LNNGF	-0.259288 -0.08332 [-3.11209]	Significant	LNNGF	0.60814 -0.13314 [4.56753]	Significant
LNUP	-1.633871 -0.7412 [-2.20437]	Significant	LNUP	-1.773919 -0.11821 [-15.0063]	Significant	LNUP	1.011582 -0.16441 [6.15280]	Significant
C	45.96755	-	C	19.93179	-	C	5.551229	-

After discussing the long-run coefficients, we now discuss the short-run coefficients of Germany, Japan, and New Zealand based on Johansen multivariate co-integration method are present in Table 15. The results of the Germany-adjusted coefficients based on the multivariate cointegration method show that Military Expenditure and Urban Population have a significant and positive relationship with the consumer price index in the short run. Whereas primary consumption and Trade have a negative and significant impact on the consumer price index in the short run. This means that an increase in Military Expenditure and Urban Population by 1 percent will increase the consumer price index by 2.9806 and 0.1528, respectively. On the other hand, the increase in Primary Energy Consumption and Trade by 1% wills leads to a decrease in CPI by 1.445 and 3.654, respectively. Table 15 also shows us that Agricultural Land, Oil Refining Capacity, and Natural Gas Flaring have no impact, in the short run, on the consumer price index. The results of our first-period lag term error term are also found to be significant and negative, which confirms the existence of the convergence hypothesis for the model. The value of the coefficient (-.542) is negative and between -0.5 to -0.8. The disequilibrium resulted due to any macroeconomic shock will be removed by 54% every year and will return to stable and long-term equilibrium in just two years. On the other hand, according to Japan, the results of the adjusted coefficients based on the multivariate cointegration method show that only Oil Refining Capacity has a significant and positive relationship with the consumer price index in the short run. Whereas no variable has a negative and significant impact on the consumer price index in the short run. This means that an increase of 1% in Oil Refining Capacity will increase the consumer price index by 0.7449. Table 15 also shows us that Agricultural Land, Military Expenditure, Primary Energy Consumption, Trade, Natural Gas Flaring, and Urban Population has no impact, in the short run, on the consumer price index. The results of our first-period lag term error term are also significant and negative, confirming the existence of the convergence hypothesis for the model. The value of the coefficient (-0.0937) is negative and not between -0.5 to -0.8. The disequilibrium resulted due to any macroeconomic shock will be removed by 9.3% every year and will return to stable and long-term equilibrium in 10.75 years. While in the case of New Zealand the results of the adjusted coefficients based on the multivariate cointegration method show that only Oil Refining Capacity has a significant and positive relationship in the short run with the consumer price index. Whereas Primary Energy Consumption negatively and significantly impacts the consumer price index in the short run. Which means that by an increase in 1% in Oil Refining Capacity will increase consumer price index by 0.0941 and Primary Energy Consumption will decrease consumer price index by 0.0881. Table 15 also shows us that Agricultural Land, Military Expenditure, Trade, Natural Gas Flaring, and Urban Population have no impact, in the short run, on the consumer price index.

The results of our first-period lag term error term are also found to be significant and negative, which confirms the existence of the convergence hypothesis for the model. The value of the coefficient (-0.04015) is negative and not between -0.5 to -0.8. The disequilibrium resulted due to any macroeconomic shock will be removed by 4.0% every year and will return to stable and long-term equilibrium in 25 years.

Table 15. Johansen multivariate cointegration approach (short run results).

Adjusted Coefficients (Germany) Dependent Variable: D(LNCPI)			Adjusted Coefficients (Japan) Dependent Variable: D(LNCPI)			Adjusted Coefficients (New Zealand) Dependent Variable: D(LNCPI)		
Independent Variables	Coefficients	Decision	Independent Variables	Coefficients	Decision	Independent Variables	Coefficients	Decision
LNAL	-0.114759 -0.20193 [-0.56832]	Insignificant	LNAL	0.051188 -0.03494 [1.46521]	Insignificant	LNAL	-0.007309 -0.00927 [-0.78883]	Insignificant
LNME	2.980633 -1.48916 [2.00155]	Significant	LNME	-0.149301 -0.13188 [-1.13210]	Insignificant	LNME	0.080399 -0.04442 [1.81009]	Insignificant
LNORC	0.699807 -0.76997 [0.90887]	Insignificant	LNORC	0.744946 -0.10962 [6.79572]	Significant	LNORC	0.09411 -0.04259 [2.20955]	Significant
LNPEC	-1.445688 -0.38883 [-3.71807]	Significant	LNPEC	0.048452 -0.15592 [0.31076]	Insignificant	LNPEC	-0.088189 -0.02391 [-3.68809]	Significant
LNT	-3.654411 -0.85648 [-4.26677]	Significant	LNT	-0.394122 -0.54262 [-0.72634]	Insignificant	LNT	-0.063434 -0.04811 [-1.31851]	Insignificant
LNNGF	-0.523374 -0.73174 [-0.71524]	Insignificant	LNNGF	0.015984 -0.21924 [0.07291]	Insignificant	LNNGF	-0.048177 -0.04007 [-1.20247]	Insignificant
LNUP	0.152802 -0.0558 [2.73818]	Significant	LNUP	0.00609 -0.02103 [0.28961]	Insignificant	LNUP	-0.001903 -0.004 [-0.47555]	Insignificant
ECT(t-1)	-0.542004 -0.12801 [-4.23417]	Significant	ECT(t-1)	-0.093771 -0.04563 [-2.05511]	Significant	ECT(t-1)	-0.040158 -0.01354 [-2.96551]	Significant

After discussing the long-run and short-run Cointegration now, in order to find the stability of our results, we apply error term diagnostic tests, and criteria for acceptance or rejection of the null hypothesis are present in Table 16. Table 17 shows us the tests that are performed. We have applied normality tests, serial correlation tests, heteroscedasticity tests, and stability tests. In the case of all three countries, Empirical results have displayed that the functional form is normally distributed, and VIF values have shown no Multicollinearity between the independent variable. The hypothesis of all the tests shows us that the probability value of the tests is more than 0.1; therefore, the null hypothesis is accepted, and it is concluded that there is an absence of serial correlation in the model, the variance of the error term is homoscedastic, error term follows attributes of normal distribution and stability diagnostic CUSUM and CUSUM square in Figure 4 in case of all three countries blue line are lies within confidence interval its mean all countries show the stability of mean and variance of error term it also shows error term is not structurally unstable.

Table 16. Hypothesis for diagnostics tests.

Serial correlation H0: Error term is not serially correlated	Normality test Ho: Error term is not abnormally distributed
Hetroskedasticity test Ho: variance of error term is not hetroskedastic.	Functional test Ho: functional form is not miss specified

Table 17. Diagnostic tests results.

Tests name	Germany Coefficients and Prob values	Japan Coefficients and Prob values	New Zealand Coefficients and Prob values
Serial correlation	For Lag =1 2.016 (0.1503)	For Lag =1 72.56 (0.3902)	For Lag =1 70.1874 (0.2780)
Hetroskedasticity	0.7861 (0.6038)	1.0583 (0.4113)	0.7359(0.6431)
Normality Test: Joint Jarque-Bera Test	471.15(0.2638)	463.42 (0.3209)	8.663(0.9266)

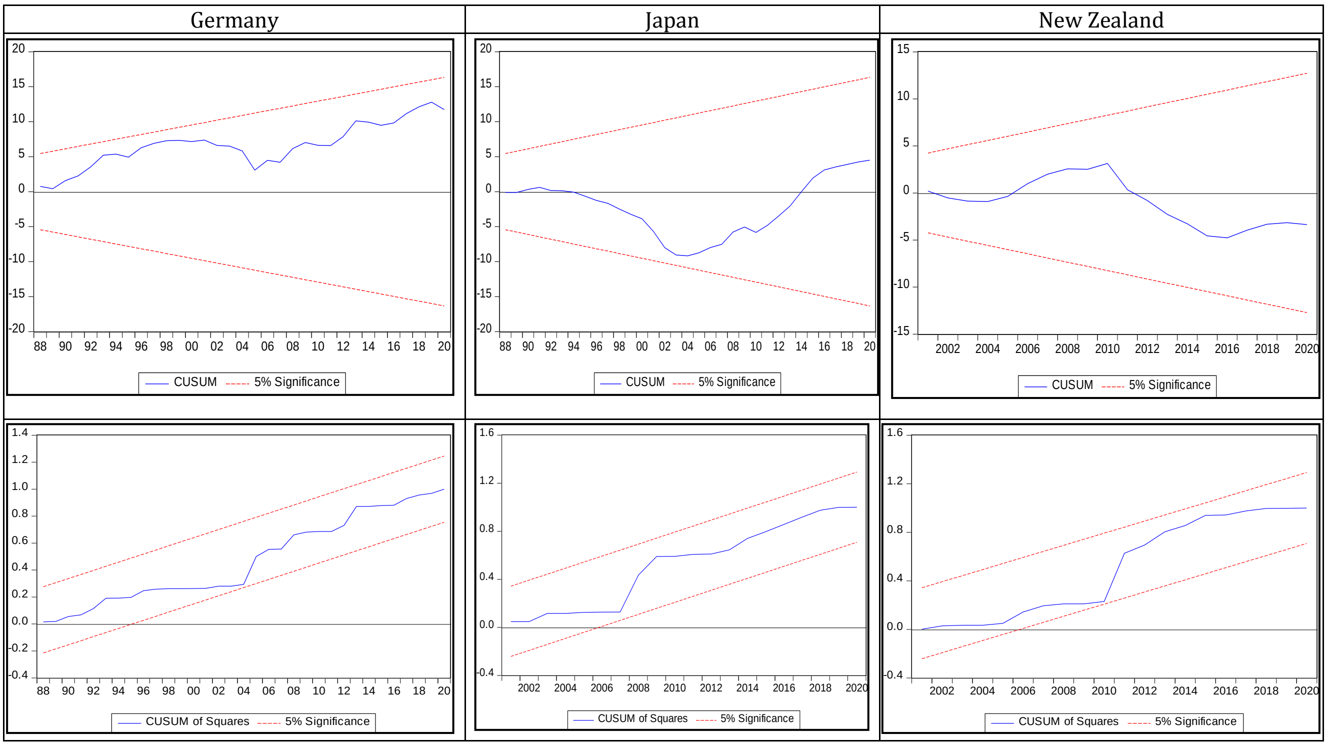

Figure 4. CUSUM.

CONCLUSIONS

In this paper, we have investigated the relationship between consumer price and Agricultural Land, Urban Population, Trade, Military Expenditure, Primary Energy Consumption, Natural Gas Flaring, and Oil Refining Capacity using a time series of data from 1980 to 2020. In this study, we have applied Johnson's multivariate cointegration approach to estimating the long-run and short-run relationship between the variables. We have observed that although the same variables were used for the same time series data for all three different countries even still the results of them are quite different. The long-run coefficients that have a positive and significant impact on the consumer price index are different in Germany from New Zealand and Japan. Similarly, the short-run coefficients are different, having positive and negative significant impacts in the said countries. If we talk about Germany, normalized coefficients show that the consumer price index, Agricultural Land, Military Expenditure, Oil Refining Capacity, and Primary Energy Consumption have a positive and significant impact, Whereas Trade, Natural Gas Flaring, and Urban Population have a negative and significant impact on consumer price index. On the other hand, Japan normalized coefficients show that consumer price index, Agricultural Land, and Primary Energy Consumption have a negative and significant impact. Whereas Military Expenditure, Oil Refining Capacity, Trade, Natural Gas Flaring, and Urban Population have a positive and significant impact on the consumer price index. If we talk about New Zeland, their long run coefficient shows that the normalized coefficients show that consumer price index, Oil Refining Capacity, Trade, and Urban Population have a negative and significant impact, Whereas Military Expenditure, Primary Energy Consumption, and Natural Gas Flaring has a positive and significant impact on consumer price index. Change in the consumer price index does not impact Agricultural Land in the longer run. We also apply diagnostic tests; all the diagnostic lm serial correlation, Heteroskedasticity, and normality, show probability values greater than 0.1, so we conclude that our variables are not serially correlated, not abnormally distributed, not heteroscedastic, and functional form is not miss specified while CUSUM and CUSUM square shows error term is not structurally unstable.

Therefore, the study recommends that governments of the above-selected countries should take more initiatives to increase their urban population and trade because these activities help decrease inflation in New Zealand, Germany, and Japan. On the other hand, decrease their focus on military expenditure and primary energy consumption because these two variables take part in the acceleration of inflation within a country.

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