Analysis of the Impact of Food Imports and Inflation on the Food Security Index in Indonesia

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Abstract. The right to obtain food is a basic right for all people. Food independence is one of the important pillars in maintaining national stability, especially in an agricultural country like Indonesia. However, in recent decades, Indonesia has faced significant challenges related to food independence, one of which is dependence on food imports. Import policies implemented by the government have a direct impact on national food independence, especially in the context of availability, accessibility, and stability of food prices. The purpose of this study is to analyze the interdependence of the Food Security Index (IKP) and inflation on food imports and to analyze the effect of import instrument shocks on the Food Security Index (IKP) in Indonesia. Research methods start with conducting assumption tests and using VECM, then shocks are carried out through Impulse Response and Variance Decompositions. The results of this study indicate an interdependence between the Food Security Index, Inflation, and Food Imports. Furthermore, a one-unit import shock causes an increase in the IKP until the fourth period, then decreases in the fifth period, and increases again in the sixth to tenth periods. Imports successfully increase the IKP indicator, albeit in relatively small amounts.

**Keywords:** Food Imports, IKP, VAR Inflation

1. Introduction

Food is a basic human need that must be met at all times, so the state must be able to guarantee its availability. The right to obtain food is a fundamental right for all people. The definition of food as regulated in Law-Law Number 18 of 2012 is everything that comes from agricultural, plantation, forestry, fishery, livestock, and aquatic products, whether processed or unprocessed, intended as food or drink for human consumption, including food additives, food raw materials, and other materials used in the process of preparing, processing, and/or manufacturing food or beverages. [1] The growing population has raised concerns about the availability of food to meet the needs of the entire community. Food availability that is lower than demand can create instability in a country's economy. In fact, the success or failure of a country's leadership can be measured by the extent to which the country's leaders are able to meet food needs as the most basic requirement.

One strategy commonly used to maintain economic stability is to import food. The dilemma faced by countries is that dependence on food imports, especially if they come from developed countries, can result in decisions on all aspects of life becoming unindependent or subject to intervention from those countries, raising concerns that the country will lose its sovereignty [2]. This concern may be valid for small and developing countries, but not for developed countries, let alone advanced countries. The growing population is one of the triggers

for increasing food consumption, compounded by the fact that most of the agricultural technology used is still simple and therefore unable to meet the rapidly growing demand for food. On the other hand, most of the population that depends on the agricultural sector for their livelihood is still classified as poor.

There is a correlation between domestic price control and food imports. Countries that import large amounts of food find it more difficult to control domestic prices. Thailand, for example, has a more advanced agricultural sector than Indonesia, making it stronger in stabilizing its currency exchange rate against the dollar and even experiencing appreciation in certain years. In contrast, Indonesia is increasingly vulnerable to exchange rate fluctuations. One reason for this is the demand for food imports. Food-exporting countries tend to be better able to control food inflation and their exchange rates [3]. Food commodities greatly affect the domestic inflation rate because domestic food consumption contributes significantly to Indonesian consumption, so it is only natural that increases in imported food prices will have a major effect on the inflation rate in Indonesia. Figure 1. shows the upward trend in the value of Indonesia's food imports from 2000 to 2004. The food commodities in question are rice, sugar, garlic, soybeans, corn, and beef.
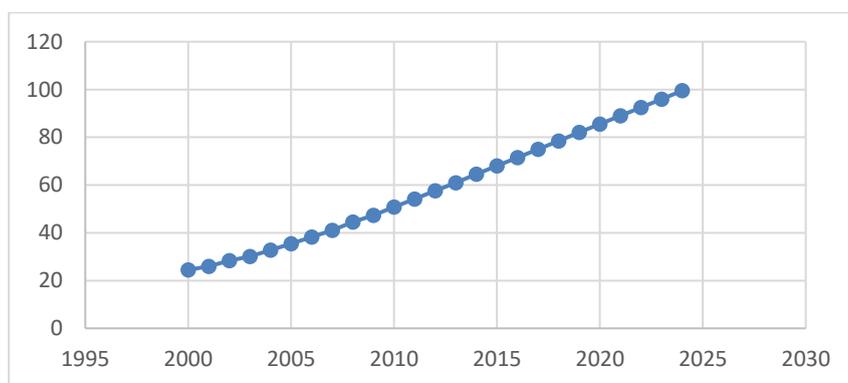
Figure 1. Value of Indonesian Food Imports ((Rp Trillion)

Figure 1. shows that there has been a consistent increase in the value of food imports in Indonesia from 2000 to 2024. Of course, this condition is caused by various factors, both internal and external. Internal factors include the growing population, the conversion of agricultural land, which has resulted in a reduction in the amount of agricultural land, the use of simple agricultural technology, which has resulted in production that is unable to keep up with consumption, and domestic trade policies, such as tariffs and quotas. External factors include international food prices, the exchange rate of the rupiah against the currencies of importing countries, and international trade policies.

Importing is actually a dilemma; the economy can be stable because of imports. Food imports can have positive and negative impacts depending on economic conditions, government policies, and community needs. The positive effects of imports can be described as follows: Fulfilling Domestic Needs: Food imports can make up for the shortfall in local food production, especially during certain seasons or when natural disasters disrupt production; Price Stability: With more supply from imports, food prices tend to be stable and affordable, especially when domestic production is insufficient; Food Product Diversification: Imports allow people to access various

types of food that cannot be produced domestically due to climate or technology limitations; Encouraging Competition: The presence of imported products can encourage local producers to improve efficiency, quality, and innovation; Reducing Dependence on Seasonal Production: Imports can ensure food availability throughout the year, despite seasonal fluctuations in local production.

Meanwhile, the negative effects of imports are: Dependence on Imported Food: Excessive dependence on imports can make a country vulnerable to price fluctuations in the global market and the policies of exporting countries; Weakening of Local Farmers: Cheaper imported food prices can reduce the competitiveness of local products, thereby affecting the income of farmers and the domestic agricultural sector; Trade Deficit: Large food imports without balanced exports can increase the trade deficit, affecting the country's foreign exchange reserves; Threat to Food Sovereignty: Dependence on imports can reduce a country's ability to meet its food needs from domestic production, thereby threatening food sovereignty. Increased Government Expenditures: The government may need to allocate a large budget for food import subsidies to ensure that prices remain affordable for the public.[4]

Food self-sufficiency is one of the important pillars in maintaining national stability, especially in an agrarian country such as Indonesia. However, in recent decades, Indonesia has faced significant challenges related to food self-sufficiency, one of which is dependence on food imports. The import policies implemented by the government have a direct impact. on national food self-sufficiency, especially in terms of food availability, accessibility, and price stability. On the other hand, these policies also have an equally important impact on local farmers, who are often the most affected by these policy changes. Although import policies have positive short-term objectives, such as maintaining price stability and ensuring food availability, their long-term impact on national food security is quite complex and requires further attention.

Food self-sufficiency and food security are concepts that have the same meaning. Food security can be measured using an index called the IKP. The National IKP plays a strategic role in measuring the achievements of food security development in a region, measuring regional performance in fulfilling government obligations, and is one of the tools used to determine regional development priorities and program intervention priorities. Specifically, the National IKP was developed with the aim of evaluating the achievements of food security and nutrition in regencies/cities and provinces, as well as providing an overview of the ranking of food security achievements in regencies/cities and provinces compared to other regencies/cities and provinces. The IKP is expected to be used as a basis for program interventions so that they are more focused and targeted. [4] There is an inverse relationship between the Food Security Index and food imports. Although food imports have a positive impact on domestic food stability, they still reduce Indonesia's food self-sufficiency. The following is an overview of the Food Security Index in Indonesia from 2012 to 2021.

Table 1. Provincial Food Security Index Rankings and Scores for 2022

Ranking	Province	IKP
1	Bali	86.19
2	Central Java	82.95
3	South Sulawesi	81.38
4	South Kalimantan	81.05
5	Special Region of Yogyakarta	80.88
6	Gorontalo	80.35
7	East Java	79.85
8	West Sumatra	79.45
9	Lampung	78.61
10	Special Region of Jakarta	78.25
11	East Kalimantan	77.65
12	West Java	76.55
13	West Nusa Tenggara	76.58
14	Central Sulawesi	75.92
15	Southeast Sulawesi	75.04
16	North Sulawesi	74.30
17	West Sulawesi	74.04
18	Banten	73.78
19	Bangka Belitung Islands	71.71
20	North Sumatra	71.22
21	North Kalimantan	71.04
22	West Kalimantan	70.81
23	Aceh	70.16
24	Central Kalimantan	69.96
25	South Sumatra	69.64
26	Jambi	69.50
27	East Nusa Tenggara	68.42
28	Bengkulu	67.99
29	Riau	67.59
30	Riau Islands	63.83
31	Maluku	60.20
32	North Maluku	58.39
33	West Papua	45.92
34	Papua	37.80

Source: [5]

In general, the Food Security Index (FSI) showed fluctuations in each province in 2022. The upward trend in the FSI was in line with the increase in food imports in Indonesia during the same year. This phenomenon is inconsistent with theory and interesting to study: what are the dominant factors affecting FSI values? How do international trade policies affect FSI values? Can internal and external factors affect FSI values? It is hoped that the results of this study will provide input for the government in formulating policies, particularly those related to import policies. Food self-sufficiency is one of the important pillars in maintaining national stability, especially in an agrarian country such as Indonesia. However, in recent decades, Indonesia has faced significant challenges related to food self-sufficiency, one of which is dependence on food

imports. The import policies implemented by the government have a direct impact on national food self-sufficiency, especially in terms of availability, accessibility, and price stability of food. On the other hand, these policies also have an equally important impact on local farmers, who are often the most affected by these policy changes. Although import policies have positive short-term objectives, such as maintaining price stability and ensuring food availability, their long-term impact on national food security is quite complex and requires further attention. The purpose of this study is to analyze the interdependence of the Food Security Index (IKP) on food imports, inflation, population, and the rupiah exchange rate, as well as to analyze the impact of import shocks on the Food Security Index (IKP), inflation, population, and the rupiah exchange rate.

2. Literature Review

2.1. The Concept of the Food Security Index

Food security is a condition in which a country's food needs are met down to the individual level, reflected in the availability of sufficient food in terms of quantity and quality, which is safe, diverse, nutritious, and affordable, and does not conflict with the religion, beliefs, and culture of the community, so that people can live healthy, active, and productive lives in a sustainable manner. Food security and nutrition development is carried out systematically by involving cross-sectors. This approach is aimed at realizing adequate food availability through domestic food production and trade; achieving stability in food availability and access through domestic food production and trade; achieving macro-meso and micro stability in food availability and access; ensuring sufficient quality (diversity and safety of food) and quantity of food consumption supported by infrastructure improvements. To achieve these conditions, macroeconomic policy support is needed to ensure economic stability and guarantee the stability of food supply and prices. In order to determine the level of food security in a region and its supporting factors, an assessment system in the form of an IKP has been developed, which refers to the definition of food security and food security subsystems. The nine indicators used in the preparation of the IKP are derived from three aspects of food security, namely availability, affordability, and utilization of food.

The FSI produced for each region is grouped into six groups based on the FSI *cut-off point* (Table 2). The FSI *cut-off point* is the sum of the multiplication of the individual indicator weight by *the* individual indicator *cut-off point* resulting from *the z-score* standardization and *distance to scale* (0-100). Regions included in group 1 are districts/cities/provinces that tend to have a higher level of vulnerability than districts/cities in the groups above them. Conversely, regions in group 6 are districts/cities/provinces that have the best food security [6].

Table 2. IKP Cut-Off Point

FSI Group	Regency	City	Province
1	< = 41,52	<=28,84	<=37,61
2	>41,52 – 51,42	>28,84 - 41,44	>37,61 – 48,27
3	>51,42 – 59,58	>41,44 – 51,29	>48,27 – 57,11
4	>59,58 – 67,75	>51,29 - 61,13	>57,11 – 65,96
5	>67,75 – 75,68	>61,13 – 70,64	>65,96 – 74,40
6	>75,68	>70,64	> 74,40

Table 3. City Indicator Weights Based on Expert Judgment

No	Indicator		Weight
Food Availability Aspect			
1	Ratio of normative consumption to net production of rice, corn, sweet potato, cassava, and sago, as well as local government rice stocks		-
		Sub Total	-
Food Affordability Aspect			
2	Percentage of population below the poverty line		0.20
3	Percentage of households with food expenditure exceeding 65% of total expenditure		0.125
4	Percentage of households without access to electricity		0.125
		Sub Total	0.45
Food Utilization Aspect			
5	Average years of schooling for women aged 15 and over		
6	Percentage of households without access to clean water		0.08
7	Ratio of population per health worker to population density		0.18
8	Percentage of stunted toddlers		0.08
9	Life expectancy at birth		0.13
		Sub Total	0.55

Source: [6]

2.2 Food Imports

Paul A. Samuelson and William D. Nordhaus are two renowned economists who have contributed greatly to the understanding of modern economics, particularly in the fields of macroeconomics and international trade. In their book entitled *Economics*, they explain that imports are goods and services produced abroad and consumed domestically. [7]

They explain that import activities cannot be separated from international trade activities and are closely related to the principle of comparative advantage. A country should import goods that cannot be produced efficiently domestically and focus its resources on producing goods with the lowest opportunity cost. In this way, the country can improve its overall economic efficiency and welfare.

In the context of the open national expenditure model, Samuelson and Nordhaus also place imports as one of the reducing components in the national income formula, namely:

Y = C + I + G + (X – M)

Explanation:
Y = National income,
C = Consumption,
I = Investment,
G = Government spending,
X = Exports,
M = Imports.
Although mathematically imports reduce GDP, in practice they can actually expand consumption, increase access to quality goods, and become an important part of global efficiency through production specialization. Samuelson and Nordhaus also state that free trade,

including imports, can provide comparative advantages for all countries involved. However, they also acknowledge that trade does not always produce fair results for all parties. In the short term, trade can create winners and losers. Therefore, the government must play a role in providing social protection and economic adjustment policies. Thus, Samuelson and Nordhaus's import theory places imports as an important component of modern economic development. Imports can be a means to meet domestic needs, increase production efficiency, and expand consumer choices. In the context of food, Samuelson and Nordhaus's import theory is relevant to explain why many countries, including Indonesia, import foodstuffs such as wheat, soybeans, sugar, and meat. These goods are imported because they cannot be produced efficiently domestically or because domestic production is insufficient to meet domestic demand. As a tropical country, Indonesia has limitations in producing wheat, which requires a subtropical climate. Therefore, imports are an economically rational solution to ensure the supply of raw materials for the food industry and the consumption needs of the community.

Importing foodstuffs is also important for maintaining price stability and availability of goods in the market. By importing from more efficient producing countries, prices can be suppressed and the public can gain access to foodstuffs at affordable prices. However, dependence on food imports also carries risks, such as international price fluctuations, global logistical disruptions, and vulnerability to food crises. This requires a long-term strategy from the government in managing national food security, through increasing domestic agricultural productivity and food diversification. [8]

Entering the peak of the harvest season in early 2025, national rice production shows a fluctuating trend from 2022 to 2025, which has a direct impact on the national rice balance. In 2022, rice production reached around 31.54 million tons, exceeding domestic consumption needs and resulting in a surplus of around 1.34 million tons. This condition kept food security relatively stable, and Bulog even stated that Indonesia did not need to import rice during that period. However, entering 2023, there was a decline in production due to the El Nino phenomenon, which reduced the harvest area. Rice production in 2023 fell to 31.1 million tons (down 1.39% from 2022). As a result, although there was still a slight surplus of 0.28 million tons in 2023 (after taking imports into account), the surplus was much smaller than in 2022. This means that domestic production was almost balanced with consumption, and the government was forced to rely on imports to cover the shortfall, especially at the end of 2023. Entering 2024, the impact of El Nino is still being felt. BPS recorded that rice (paddy) production in 2024 fell by 1.52% from the previous year. This decline was particularly significant during the early harvest period, with rice production from January to April 2024 reaching only 11.07 million tons (down 14.7% yoy). This situation caused the government to import large quantities of rice to maintain stocks (recorded rice imports reached 3.06 million tons in 2023 and surged again in 2024). However, entering early 2025, the situation took a positive turn. The early 2025 harvest is expected to be better, with rice production from January to April 2025 projected to reach 13.95 million tons, the highest in seven years. Subround I rice production in 2025 increased by 26% compared to the same period in 2024. With the increase in output in early 2025, government rice stocks can be increased and rice imports will not be carried out at the beginning of 2025 [9] .
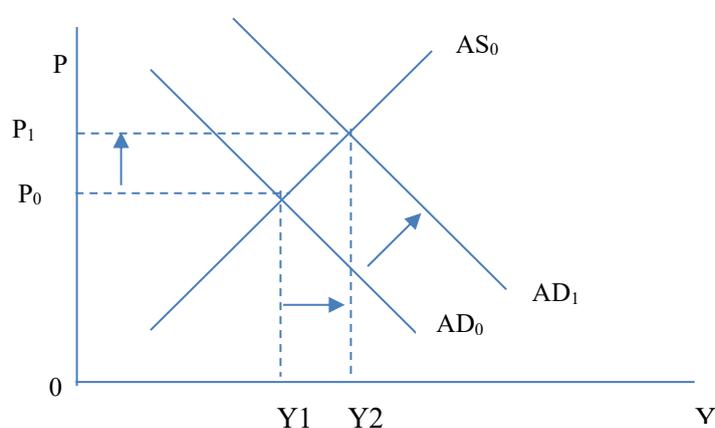
2.3 Inflation

The purchasing power of currency decreases due to inflation, which is defined as a total increase in costs. One of several reasons why prices of goods and services tend to rise is when aggregate demand grows larger than aggregate supply. Government deficits, higher bank lending rates,

and increased demand from abroad all contribute to the total mismatch between demand and supply.

Sources of inflation according to [10] . There are two types of inflation that can result from activist stabilization policies to increase high employment opportunities, namely Demand Pull Inflation and Cost Push Inflation. According to Bank Indonesia (BI), inflation arises due to pressure from the supply side (cost push inflation) and from the demand side (demand pull inflation).

a. Demand Pull Inflation

Demand inflation is inflation triggered by the interaction of long-term domestic supply and demand. This type of inflation is commonly known as Philips Curve inflation. Monetary policy is an important determinant of this type of inflation through its influence on consumption, production, and investment. Other factors that influence this type of inflation are gradual changes or shocks in fiscal policy, foreign demand, changes in consumer and producer behavior, and the level and growth of economic efficiency and productivity. Inflationary pressure from the demand side is represented by the output gap variable, which is the discrepancy between actual output and potential output, or the level of output consistent with full employment. When output is above potential output (*positive output gap),* an increase in the output gap indicates rising inflationary pressure. Conversely, when output is below potential output, an increase in the output gap means reduced deflationary pressure. The use of the *output gap* indicator is generally more representative in explaining inflationary pressure from the demand side under normal business cycle conditions. For economies in special conditions, such as stagflation or post-economic crisis, the output gap level indicator is ineffective in explaining inflationary pressure. For example, during stagflation, the output gap is negative but there is high inflationary pressure. Therefore, an additional indicator is needed, namely an increase *in the output gap*, to explain the increase in inflation amid conditions where output is lower than potential output. An illustration depicting the occurrence of demand pull inflation is presented in Figure 2. below.


Figure 2. Demand Pull Inflation

The illustration in Figure 2. explains that the economy starts at a certain point, marked by the initial price level, P0, and the initial real output level, Y0, where the point (P0, Y0) lies at the

intersection between the demand curve (AD0) and the supply curve (S0). Now, if we assume that the aggregate demand curve rises and shifts outwards to D1, this shift could be caused by various factors, such as an expansion in government spending due to, for example, a war, or an outward shift in the consumption or investment function of the private sector. Figure 2. also shows that, regardless of the source, the shift in the aggregate demand curve increases the real output level (from Y0 to Y1) and the price level (from P0 to P1). This provides an example of a phenomenon known as demand-pull inflation, which is a situation where a shift in the demand curve "pulls" the price level upward, causing inflation. However, the extent of inflation actually depends on the magnitude of the shift in the demand curve and on the characteristics of the supply curve. If the supply curve is steep, perhaps because it is close to full capacity utilization of labor, there will be a more significant increase in prices and a smaller real output response compared to a situation where the supply curve is less steep.

There are two main views on the causes of inflation from a demand perspective. First, according to the Keynesian school of thought, the main cause of inflation is an excess supply of money. Second, according to the monetarist view, inflation is caused by an increase in consumption, investment, and government spending.

b. Cost Push Inflation

Supply-side inflation, or *cost-push inflation*, is a type of inflation caused by an increase in production costs or the cost of acquiring goods and services. This type of inflation also includes supply shocks inflation, which triggers an increase in the supply price of goods. Shock factors included in this category of inflation include increases in international commodity prices, such as world crude oil prices, increases in government-regulated commodity prices, fluctuations in food prices due to climate change, and changes in the prices of imported goods due to changes in exchange rates and/or inflation in other countries. *Cost-push inflation* occurs when production costs increase, which generally results in a decline in aggregate supply. This increase in production costs is caused by rising input prices, such as increases in labor wages (e.g., Regional Minimum Wage), increases in fuel prices, and so on. An illustration of cost-push inflation is shown in Figure 3 as follows:
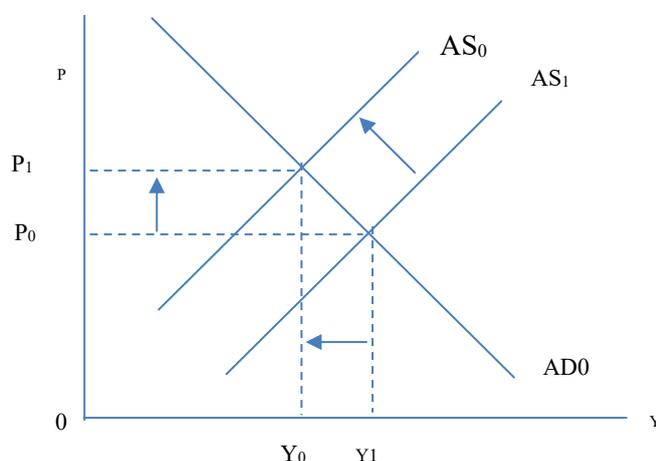

Figure 3. Cost Push Inflation

Figure 3 illustrates that although changes in aggregate demand can cause inflation, inflation can also occur even when the demand curve remains unchanged. This can happen if the aggregate supply curve shifts upward and to the left, as shown in Figure 3. Under normal circumstances, history has shown that the supply curve often shifts downward and to the right in various ways. The impact of the opposite shift in supply is illustrated in Figure 3, where the supply curve moves from AS1 to AS0, causing a price increase sometimes known as *cost-push inflation*.

c. Mixed Inflation

In practice, it is rare to encounter pure inflation, i.e., demand inflation or supply inflation occurring separately. Inflation that commonly occurs in various countries tends to be a mixture of both types of inflation, often referred to as mixed inflation. This mixed inflation occurs due to a combination of demand-pull inflation and cost-push inflation. Although initially the cause of inflation may be purely demand-pull or cost-push, as the impact of inflation on the economy begins to be felt, other factors that cause inflation contribute to it, accelerating the rate of inflation. Visually, the interaction between demand pull and cost push elements in mixed inflation can be explained through Figure 4. For example, initially, the economy has an aggregate demand curve AD1 and an aggregate supply curve AS1. With these aggregate curves, the economy is in equilibrium at a full-employment real national income level of Yf and an equilibrium price level of Yf a. However, if for some reason the aggregate supply curve shifts to AS2, the price level will rise to Yub, and *a deflationary income gap* of YuYf will occur. Seeing unemployment in the economy, the government tends to adopt monetary and/or fiscal expansion policies to reduce unemployment, which results in a rightward shift of the aggregate demand curve (AD2). As a result, employment increases, but prices also rise even higher. This triggers demands for higher wages, which in turn further increase the price level and reduce employment opportunities, forcing the government to implement expansionary policies again, and so on.
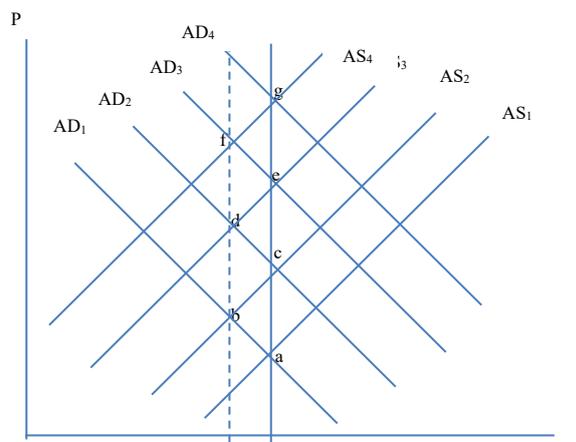
Figure 4. Mixed Inflation

The basic formula for calculating inflation is to use the Consumer Price Index (CPI). The CPI is an indicator that measures the average change in the prices of a group of goods and services traded in the consumer market over a certain period of time. The formula for calculating inflation is as follows:

$$\text{Inflation} = \frac{\text{IHK n} - \text{IHK n} - 1}{\text{IHK n} - 1} \times 100\%$$

In this formula, inflation is calculated by taking the percentage difference between the CPI for the current year and the CPI for the previous year, then multiplying the result by 100 to express it as a percentage. This provides an overview of the relative change in prices from year to year.

3. Method

The data collected is annual data from January 2000 to 2024. The research was conducted in the Indonesian region of. The data collection technique used in this study was the documentation method, using secondary data available from Susena and the National Statistics Agency.

Data Analysis Technique
This study uses the *Vector Auto Regression (VAR)* model, which is a method that treats all variables symmetrically without distinguishing between dependent and independent variables (Sims in Gujarati 2003: 848). The VAR model used is:

$$FPI_t = \alpha_0 + \alpha_1 IMP_t + \alpha_2 INF_t + \alpha_3 IMP_{t-1} + \alpha_4 INF_{t-1} + \alpha_5 FPI_{t-1}$$

Where:
FPI : Food Security Index
IMP : Imports (Rupiah)
INF : Inflation (Percent)
NT   : Exchange Rate
α_0 : Constant
$\alpha_1 - \alpha_5$: Coefficient

The VECM model is the next model used when *time series* data is not stationary at the level, but stationary in differentiated data and cointegrated, thus indicating a theoretical relationship between variables. Therefore, VECM model estimation, also known as restricted VAR, is performed. Several tests are carried out, including: stationarity test, optimal lag determination, VAR model stability test, cointegration test, impulse response function (IRF) test, and variance decomposition (VD) test. Stationarity Test: The first thing to do is to examine whether the data is stationary or not [11] . To test the behavior of the data in the study, several tests can be used, such as the *Dickey-Fuller (DF)* test, the *Augmented Dickey-Fuller (ADF)* test, and the *Phillip-Perron (PP)* test. The decision in the stationarity test is that if the absolute value of the PP statistic is greater than *the Mc Kinnnon Critical Value* (depending on the confidence level chosen, 1%, 5%, or 10%), then it can be concluded that the data is stationary [11] . If all data are non-stationary at the level, then the level VAR estimation cannot be used and the first *difference* integration degree test is performed using the PP test with a critical value of 5%. However, if the absolute value of the PP statistic is smaller than *the Mc Kinnnon Critical Value* of 5% (probability value > 0.05), then it is necessary to continue with the 2 *(nd)difference* integration degree test. If the data is stationary at the *difference* level, then the research will result in two VAR estimation options, namely VAR estimation *in difference* or VECM estimation.

Determining the Optimal Lag: In general, there are several parameters that can be used to determine the optimal lag length, including AIC *(Akaike Information Criterion),* SC *(Schwarz Criterion)*, and LR *(Likelihood Ratio)*. The optimal lag is marked with an asterisk (*). If the lag length test shows that most of the asterisks are at the same lag, then the lag length is at that lag.

VAR Model Stability Test: a VAR system is said to be stable if all unit roots have a modulus smaller than one and are all within *the unit circle* or circle on *the inverse roots of the AR characteristic polynomial*. If the model stability requirements are met, model estimation can be performed. Cointegration test: this is a continuation of the unit root test and the degree of integration test. The cointegration test is intended to determine the long-term behavior of data between related variables, whether they are cointegrated or not, as required by economic theory. In testing using Views, the guideline used is if the trace statistic value and the Max-Eigen statistic value are > 5% critical value. Impulse Response Function (IRF) test, *impulse response* analysis is used to determine the response of an endogenous variable in the VAR system to *shocks of* certain variables. The resulting response can be positive, negative, or no response. A positive response is above the horizon line and in the same direction, a negative response is below the horizon line and in the opposite direction, while no response is indicated by a graph where the response tends to be flat near the horizon line [11] . The Variance Decomposition (VD) test describes the relative importance of each variable in the VAR system   due to shocks. *Variance decomposition* in VAR aims to analyze how much a variable contributes to other variables

The data collected is annual data from January 2000 to 2024. The research was conducted in the Indonesian region of. The data collection technique used in this study was the documentation method, using secondary data available from Susenas and the National Statistics Agency.

4. Result And Discussion

a. Stationarity Test
Stationarity Test: the first thing to do is to examine whether the data is stationary or not to test the behavior of the data in the study. The processed data results, it was obtained that all data was stationary in the first difference.

Table 4. Stationarity Test Results

Variable	ADF-test Level	ADF test *1st* difference	ADF test *2nd* difference	Critical test 5%
FPI	-0.297852	-5.311143	-	-2.963972
IP	0.765949	-6.627260	-	-2.967767
INF	-0.410501	-5.679364	-	-2.963972

Source: Results of Unit Root test views 8.0

Determination of Optimal *Lag*

Based on the provisions, the optimal use of lag is three

Table 5. Optimal Lag Test Results

VAR Lag Order Selection Criteria						
Endogenous Variables: FPI IP JP NT						
Exogeneous Variables: C						
Date: 05/10/2025 Time: 17:03						
Sample 1993 2024						
Included observations: 27						
Lag	**Logl**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-113.0659	NA	0.068575	8.671538	8.863514	8.728623
1	-10.82322	166.6175	0.000117	2.283202	3.243081*	2.568624
2	6.450196	23.03123	0.000117	2.188874	3.9166657	2.702635
3	31.90861	26.40132*	7.37e-05*	1.488251	3.983937	2.230349*
4	50.26389	13.59650	0.0000106	1.313786*	4.577375	2.284222
*indicates lag order selected by the criterion						
LR: sequential modified LR Test statistic (each test level at 5% level						
FPE : Final Prediction Error						
AIC : Akaike Information Criterion						
SC: Schawrtz criterion						
HQ : Hannan-Quinn information criterion						

b. VAR Model Stability Test

Based on the results of the VAR model stability test in Table 6, it is known that the modulus value of all unit roots is < 1 and based on *the inverse roots of the AR characteristic polynomial* figure, it can be seen that all roots (illustrated with dots) are within the circle, so it can be concluded that the model specification is stable, so that the VAR estimates to be used for IRF and VD analysis are stable and valid. Next, a cointegration test will be carried out.

Table 6. Results of Model Stability Test

Roots of Characteristics Polynomial	
Endogenous Variable: FPI IP INF	
Exogenous Variable: C	
Lag Specification: 1 2	
Date: 10/05/25 Time: 17:11	
Root	Modulus
0.999897	0.999897
0.691.800 – 0.33638i	0.768050
0.691.800 + 0.33638i	0.768050
0.702037	0.702037
-0.457516	0.457516
-0.313172 -0.297016	0.431619
-0.313172 +0.297016i	0.431619
-0.29025	0.29025
No root lies outside the unit circle VAR satisfies the stability condition	

c. Cointegration Test

Table 7. Cointegration Test Results

Date : 05/10/25 Time : 17:12				
Sample (adjusted) : 1996 2023				
Included observations : 28 afer adjustments				
Trend assumption : Linier deterministic trend				
Series : FPI IP JP NT				
Lags interval (in first difference) : 1 to 2				
Unrestricted Contegration rank test (trace)				
Hypothesized No of CE (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**
None*	0.583302	59.33846	47.85613	0.0029
At most 1*	0.446891	34.82746	29.79707	0.0121
At most 2*	0.341558	18.24586	15.49471	0.0188
At most 3*	0.208447	6.545250	3.841466	0.0105
Trace test indicates 4 cointegrating eqn(s) at the level 0.05 level				
*denotes rejection of the hypothesis at tdhe level 0.05 level				
** Mackinnon-Huag-Michells (1999) p-values				
Unrestricted Cointegration Rank Test (maximum Eigenvalue)				

The cointegration test results indicate that the movements of FPI, IP, and INF have a stable or balanced relationship and similar movements in the long term.

d. Indonesian Food Security Index Model, *Vector Error Correction Model (VECM)*

Table 8. Short-Term and Long-Term VECM Estimates

Variable	Coefficient	t-statistic	Interpretation
LONG TERM			
C	-1.827831		
D (IP (-1))	-0.505835	-0.36940	Not Influential
D (INF (-1))	-0.168882	-3.26236	Influential
SHORT TERM			
CointEq1	0.009886	0.25153	Not influential
D (FPI (-1))	-0.105630	-0.45965	Not Influential
D (FPI (-2))	-0.000957	-0.00421	Not Influential
D (IP (-1))	0.153329	0.7057	Not Influential
D (IP (-2))	0.166787	0.76079	Not Influential
D (INF (-1))	0.074519	0.11029	Not Influential
D (INF (-2))	-0.709433	-1.04153	Not Influential

Source: Views 10 (Processed)

VECM estimation results with Lag-2 for the observation period 1994 - 2024, VECM model for FPI, Ipdan INF variables following the Food Security Index (FPI) model in the long term in

Indonesia, before simulation;

D(FPI) = -1.827831 - 0.505835 D (IP (-1)) -0.168882 D (INF (-1)) - ECT.
From the results of data processing using the Views program, it can be seen that in the long term, the IP variable has no effect, while the INF variable has a significant effect on FPI (Food Security Index). The coefficient for Inflation (INF) is -0.168882, meaning that a 1-unit appreciation in the Exchange Rate will result in a decrease in the Food Security Index (IKP/FPI). Meanwhile, the Food Security Index model for the short term is as follows:
D(FPI) = 0.000319 - 0.105630 D (FPI (-1)) -0.000957 D (FPI (-2)) + 0.153329 D (IP (-1)) + 0.166787 D (IP (-2)) + 0.074519 D (INF (-1)) - 0.709433 D (INF (-2))
The FPI equation model has different conditions in the long term and short term. In the long term, the import variable (IP) has no effect and inflation (INF) has an effect. In the short term, however, the import and inflation variables have no effect on the FPI variable. This condition is caused by the fact that the calculated t-value is smaller than the table t-value. The coefficient values for all variables are not discussed further because no variable has an effect in the short term.

e. Variance Decompositions
From the results of variance decomposition analysis, we can see how the variables FPI, IP, and INF contribute to FPI over ten periods. In the first period, FPI was only influenced by FPI itself. In the second period, apart from the FPI variable itself, the variable that contributed the most was INF. In the third period, the biggest contributors were FPI itself and INF. In the fourth period, the biggest contributors were FPI and INF. In the fifth period, the biggest contributor was INF. the sixth period, the largest contributor was INF; the seventh period, the largest contributor was INF; the eighth period, the largest contributor was INF; the ninth period, the largest contributor was INF; and the tenth period, the largest contributor was INF. The contributors to changes in the Food Security Index over the last ten years were FPI and INF.

f. Impulse Response Function
The impulse response function test shows how shocks to independent variables affect dependent variables. The first period of shocks that will give a large response to FPI comes from FPI itself. In the second period, the influence of FPI begins to decline, although it is still the source that gives the largest response from FPI after inflation. In the third period, the FPI response is greatest when there are shocks to the inflation variable, while the import variable gives a negative response to FPI.   The results of the impulse response function test explain that changes in FPI over ten years have a significant effect on changes in FPI itself, meaning that changes in FPI in the previous period will affect FPI now. Other variables also affect changes in FPI. For example, government spending also causes changes in FPI because government spending is one of the important variables in the formation of FPI.

5. Conclusion
In the long term, the inflation variable has a significant effect on *the Food Price Index (FPI)*, while the import variable does not affect the *Food Price Index (FPI)* variable. In the short term, all variables, namely imports and inflation, do not affect *the Food Price Index (FPI)* in Indonesia. Changes in the Food Security Index in Indonesia from period one to period ten were caused by *the Food Price Index (FPI),* with inflation being the next contributor. The shock caused by *the Food Price Index (FPI)* had the largest positive effect compared to other variables, while the inflation shock had the second largest positive effect.

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