


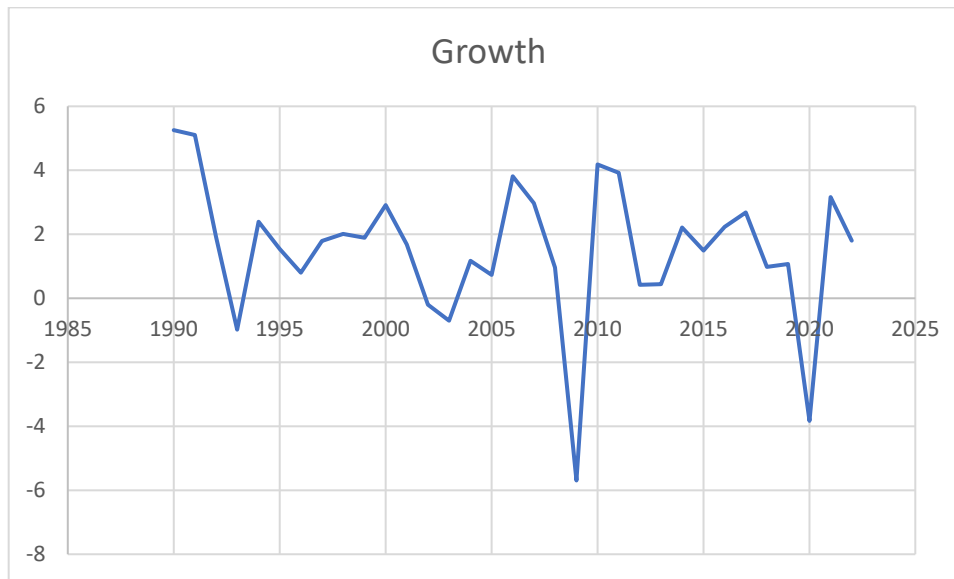
## Analysis of the Influence of Foreign Direct Investment, Inflation, Export-Import, and Exchange Rate on Economic Growth in Germany in 1990-2022

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Article Info	ABSTRACT
<p><b>Keywords:</b> Foreign Direct Investment, Inflation Export Import Exchange rate Economic Growth.</p>	<p>This study aims to analyze the influence of inflation, exports, imports, exchange rates, and foreign direct investment (FDI) that are estimated to have an effect on German economic growth between 1990-2022. To analyze the relationship between these variables, this study was conducted using time series data from the World Bank and the Error Correction Methodology (ECM), a quantitative approach used in this study. The data processing process from the World Bank uses the Eviews13 software. Based on the findings, export variables significantly and positively affect economic growth in the short term, while factors of imports, inflation, and foreign direct investment significantly and negatively affect economic growth in the long term. Although the exchange rate does not have a statistically significant impact, the exchange rate remains important when it comes to foreign investment and trade. The model used meets classical assumption tests, including normality tests, the absence of autocorrelation and heteroscedasticity, and the absence of multicollinearity in most variables.</p>
<p>This is an open access article under the <a href="https://creativecommons.org/licenses/by-nc/4.0/">CC BY-NC</a> license</p> 	<p><b>Corresponding Author:</b> Firly Meidhita Berliandini Universitas Muhammadiyah Surakarta, Surakarta <a href="mailto:b300210085@student.ums.ac.id">b300210085@student.ums.ac.id</a></p>

### INTRODUCTION

Sukirno stated that achieving a stable and high level of economic limits is not easy. This needs to be considered in relation to the ability of macroeconomic variables to solve a problem (Pradana & Soebagiyo, 2022). Therefore, the economy is basically a process of producing output using factors of production where this process as a whole compensates for the factors of production owned by the general public (Mu'arif & Soebagiyo, 2023). Simon Kuznets argues that economic growth is the long-term expansion of a country's ability to supply various economic commodities needed by society. International economic activity is accelerating in line with the era of globalization, where a country uses various strategies to increase economic growth and make its economy competitive with or better than other countries (Zsa & Zahran, 2020).



Source: World Bank

**Picture 1:** German Economic Growth Graph

Based on figure 1, it can be seen that the flow of economic growth in Germany from 1990 to 2022 has increased and decreased or is called fluctuation. In 1990 it was at the highest growth rate of 5.25 percent. Then from 1991 to 2022 it continued to experience increases and decreases or fluctuations. Economic growth is expected to increase in these uncertain conditions. Investment is inseparable from increased economic growth, as economic growth is expected to support increased infrastructure and manufacturing activity. Investments are made to support economic acceleration. In this case, foreign direct investment is usually provided in the form of technology transfer in addition to financial support. Foreign direct investment is a type of international capital flow in which businesses build and expand internationally (Narendra Bagaskara & Setyowati, 2023).

Harrod-Domar emphasized that capital formation and investment have an impact on economic growth in accordance with classical Neo-theory. If *the country's country risk* is high, it is clear how favorable a country's situation is to carry out economic activities, international investors will find more profitable investment opportunities (Atmayudi Gandhi et al., 2022). For example, the influx of foreign direct investment (FDI) boosts development by increasing productivity in host countries through new investments, technological upgrades, and improved decision-making capabilities (Gherghina et al., 2019). In 2008, Germany was ranked fifth globally in terms of gross national income, the largest economy in Europe, and the fourth largest GDP in the world. Although the global recession and eurozone crisis have hampered FDI inflows of late, Germany is still seen as an attractive country for FDI (Shilma P. Munggarani, 2022). Germany was chosen because of its status as one of the largest investors in offshore directors outside of the US, China, the UK, and Japan. In addition, as one of the largest exporters of capital in the world, Germany is considered a significant source of FDI for both developed and developing countries (Gherghina et al., 2019).

According to Milton Friedman, one of the key elements that determines the economic growth of a country is inflation (Faelasufa et al., n.d.). The correlation between inflation and growth is certainly one of the most important points of view in assessing macroeconomic conditions. Real economic activity is negatively impacted by the inflation rate as it increases uncertainty regarding the inflation rate and the rate of output growth (Radonjić & Veselinović, 2020). Although inflation can hinder economic growth, this does not mean that inflation must reach zero percent. A zero percent inflation rate not only hinders economic progress, but also leads to a recession. If this rule is able to continue, a very low inflation rate will have a significant impact on economic activity (Slamet & Hidayah, 2022).

International trade, which includes imports and exports, is one way countries can be economically involved. One of the sources of national and domestic income today is international trade (Pipit Herawati, 2023). Because the effects of imports and exports can have an impact on economic development, they are both an important part of a country's overall economy. A country's tendency to make high imports is not always detrimental because imports can encourage investment (Ngatikoh & Faqih, n.d.). For this reason, international trade needs to be increased in order to contribute to economic growth (Dwi Sinarni Putri et al., n.d.). Its products can be used to finance the import of capital goods and raw materials needed for the production cycle that will produce value-added energy. This was revealed by Purba in (Favian Ardine Agathon, 2024). A country involved in exports and imports benefits from this action, as exports can be used extensively across national borders. Meanwhile, imports allow the country to meet domestic interests that cannot be met domestically, resulting in lower prices of goods and services (Hodijah et al., 2021). There are some direct advantages of international trade such as a country can export the goods it produces in exchange for cheaper goods produced by other countries or can be called specialization (Suluh et al., n.d.).

One of the most important factors in an open economy is the exchange rate, which is the amount of domestic money needed or the amount of currency a country needs to get one unit of foreign currency (Alamsyah Putra, 2022). Exchange rate fluctuations have a real impact on economic activities by increasing external competitiveness (Krušković, 2020). According to Alagidede and Ibrahim in (Olamide et al., 2022), Because exchange rate volatility affects economic activity, it has gained popularity lately. Exchange rate volatility is a term used to describe ongoing exchange rate changes.

## METHODS

Quantitative research is applied in this kind of research. The output of numerical analysis, namely numbers processed by statistical techniques, is basically referred to as quantitative research. The study examines the impact of foreign direct investment, inflation, exports, imports, and exchange rates on German economic growth. The type of data used in this research is secondary data collected from the World Bank (*WorldBank*) over a period of 32 years starting in 1990 and ending in 2022 using the time series approach. This data is collected from World Bank statistics *and* relevant journals. The Error Correction Model (ECM)

was used to test this study. This approach was chosen because it avoids potential imbalances in time-lapse data and can simultaneously uncover short-term and long-term correlations. Based on the results of the examination, the model applied in this study can be trusted to estimate the impact of macroeconomic variables on economic growth in Germany because it generally meets the requirements of validity and feasibility in econometric analysis. Here's the long-term estimator model:

$$GROWTH_t = \beta_0 + \beta_1 FDI_t + \beta_2 INF_t + \beta_3 EXP_t + \beta_4 IMP_t + \beta_5 \log KURS_t + \varepsilon_t$$

GROWTH	= Economic Growth (%)
FDI	= Foreign Direct Investment (%)
INF	= Inflation (%)
EXP	= Export (%)
IMP	= Import (%)
KURS	= Exchange rate (US\$)
t	= Time Period
$\varepsilon$	= Error Term
Log	= Logarithm

The short-term minimization process following the approach of Domowitz and Elbadawi (1987) establishes the ECM standard as follows:

$$\Delta(GROWTH_t) = \alpha_1 \Delta(FDI_t) + \alpha_2 \Delta(INF_t) + \alpha_3 \Delta(EXP_t) + \alpha_4 \Delta(IMP_t) + \alpha_5 \Delta(KURS_t) - \lambda(GROWTH_{t-1} - \beta_0 - \beta_1 FDI_{t-1} - \beta_2 INF_{t-1} - \beta_3 EXP_{t-1} - \beta_4 IMP_{t-1} - \beta_5 \log KURS_{t-1}) + v_t$$

$\Delta$	= Differentiation Operator
$\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$	= Short-Term Regression Coefficients of FDI, INF, EXP, IMP, and KURS
$\lambda$	= Adjustment Coefficient
$v$	= Error Term

The ECM short-term estimator model is as follows:

$$\Delta(GROWTH_t) = \gamma_0 + \gamma_1 \Delta(FDI_t) + \gamma_2 \Delta(INF_t) + \gamma_3 \Delta(EXP_t) + \gamma_4 \Delta(IMP_t) + \gamma_5 \Delta(KURS_t) + \gamma_6 \Delta(FDI_{t-1}) + \gamma_7 \Delta(INF_{t-1}) + \gamma_8 \Delta(EXP_{t-1}) + \gamma_9 \Delta(IMP_{t-1}) + \gamma_{10} \Delta(KURS_{t-1}) + \gamma_{11} ECT + \omega_t$$

Information:

ECT	= Error Correction
	$(ECT_t = FDI_{t-1} + INF_{t-1} + EXP_{t-1} + IMP_{t-1} + KURS_{t-1} - GROWTH_{t-1})$
$\gamma_{11}$	= $\lambda$
$\gamma_0$	= $\lambda \beta_0$
$\gamma_1, \gamma_2, \gamma_3, \gamma_4, \gamma_5$	= $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5$
$\gamma_6$	= $-\lambda(1 - \beta_1)$
$\gamma_7$	= $-\lambda(1 - \beta_2)$
$\gamma_8$	= $-\lambda(1 - \beta_3)$
$\gamma_9$	= $-\lambda(1 - \beta_4)$
$\gamma_{10}$	= $-\lambda(1 - \beta_5)$

$\omega$  = Error Term

## RESULTS

Arifin stated in (Manik, 20 C.E.) that one of the most popular economic indicators used to characterize the success of a country in a given period of time is its economic growth. Economic growth showed higher added value compared to the previous period. GDP growth on an unchanged price basis is used to calculate economic growth, which is measured as a percentage of GDP growth from one year to the next. Economic growth measures the progress that an economy has made over time. A country's capacity to produce products and services will increase. The inclusion of quantity and quality production factors is the cause of this increase in ability (Nur et al., 2022).

**Table 1:** Econometric Model Estimation Results

$GR\bar{O}WTH_t = -1,450993 - 0,050172 FDI_t + 0,087047 INF_t + 0,960293 EKS_t$ <p>(0,7689) (0,8411) (0,0247)**</p> $-0,110555 IMP_t + 0,269256 \log(KURS)_t$ <p>(0,7858) (0,9035)</p>
$R^2 = 0,860005; DW = 1,367100; F(5, 32) = 11,16930 Prob. F(5, 32) = 0,000003$
Diagnostic test (1) Multicollinearity Test (VIF) $FDI = 3,144897; INF = 3,980707; EKS = 10,96767; IMP = 13,04490; \log(KURS) = 1,361822$ (2) Residual Normality Test (Jarque Bera) $JB(2) = 1,238600; Prob. JB(2) = 0,538321$ (3) Autocorrelation Test (Breusch Godfrey) $\chi^2(3) = 3,858787; Prob. \chi^2(3) = 0,2771$ (4) Heteroscedasticity Test (White No cross term) $\chi^2(22) = 16,49620; Prob. \chi^2(22) = 0,7905$ (5) Model Specification Test (Ramsey Reset) $F(3, 17) = 1,158557; Prob. F(3, 17) = 0,3544$

Source: *WorldBank*, processed. Description: \*significant at  $\alpha = 0.01$ ; \*\*significant at  $\alpha = 0.05$  significant at  $\alpha = 0.10$ . The number in parentheses is the p-value of the *t*-statistic.

To test the impact of foreign direct investment (FDI), inflation (INF), exports (EKS), imports (IMP), and exchange rate (SWAP) on economic growth in Germany from 1990 to 2022, the results of econometric model estimation are shown in Table 1. 86 percent of the variation in economic growth can be described by independent variables in the model, according to the value of the determination coefficient (R<sup>2</sup>) of 0.860005. There are no significant autocorrelation issues with this model, based on the Durbin-Watson (DW) value of 1.367100. The model is simultaneously significant at a high confidence level, according to the probability F of 0.000003.

Only the export and import variables indicate the possibility of multicollinearity because they have a Variance Inflation Factor (VIF) value above the threshold of 10, sourced from the

results of the multicollinearity test. It can be concluded that the residual is normally distributed because the probability value of 0.538321 which is greater than 0.05 is obtained from the residual normality test using the Jarque-Bera technique. In addition, there was no autocorrelation according to the Breusch-Godfrey test (Probability  $\chi^2(3) = 0.2771$ ), and the model had no symptoms of heteroscedasticity, which is indicated by the probability of 0.7905 obtained from the White heteroscedasticity test. With a probability of 0.3544 from the Ramsey Reset method model specification test, the model has been specified correctly. Because it meets traditional assumptions, the econometric model used in this study is credible for estimating the correlation between macroeconomic factors and German economic growth.

**Table 2:** Complete Model Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.450993	3.475208	-0.417527	0.6807
D(FDI)	-0.050172	0.168426	-0.297885	0.7689
D(INF)	0.087047	0.428479	0.203153	0.8411
D(EKS)	0.960293	0.395511	2.427981	0.0247
D(IMP)	-0.110555	0.401322	-0.275477	0.7858
D(LOG(KURS))	0.269258	2.193729	0.122740	0.9035
FDI(-1)	-0.853917	0.256084	-3.334521	0.0033
INF(-1)	-0.855565	0.423585	-2.019818	0.0570
EKS(-1)	-0.587037	0.431760	-1.359636	0.1891
IMP(-1)	-1.026337	0.520789	-1.970733	0.0628
LOG(KURS(-1))	2.756610	2.196304	1.255113	0.2239
ECT	0.822912	0.137954	5.965134	0.0000
R-squared	0.860005	Mean dependent var	-0.107775	
Adjusted R-squared	0.783008	S.D. dependent var	3.071053	
S.E. of regression	1.430571	Akaike info criterion	3.834020	
Sum squared resid	40.93064	Schwarz criterion	4.383671	
Log likelihood	-49.34432	Hannan-Quinn criter.	4.016214	
F-statistic	11.16930	Durbin-Watson stat	1.367100	
Prob(F-statistic)	0.000003			

The model of economic growth (dependent variable: D(GROWTH)) in Germany for 1991-2022 was estimated using the smallest squared regression, with 32 observations used after being corrected. The model consists of independent variables such as logarithmic exchange rates (D(LOG(KURS))), exports (D(EXP)), imports (D(IMP)), inflation (D(INF)), and changes in foreign direct investment (D(FDI)), along with delays of these variables and error correction terms (ECT). 86 percent of the variation in economic growth can be explained by variations in independent variables incorporated into the model. based on the value of the model's determination coefficient (R-squared) of 0.860005. With an Adjusted R-squared of 0.783008, the model's fit to the data is strengthened. At the same time, the independent variables in the model have a significant impact on economic growth, as shown by the F-

statistic of 11.16930 and its very significant probability (0.000003). There are no significant autocorrelation issues, based on the Durbin-Watson value of 1.367100.

Economic growth in the short term is positively and significantly influenced by the variable D(EKS) (export change) individually, with a coefficient of 0.960293 and a significance threshold of 5% (p-value = 0.0247). So in the short term, an increase in exports equal to 1% can increase economic growth by 0.960293%. Meanwhile, the variables of foreign direct investment, inflation, and imports have no significant effect on economic growth up to the alpha level of 10%. In the long term, the variables of foreign direct investment, inflation, and imports have a significant effect on the economic growth rate, while the export variable has no influence on the economic growth rate at the alpha level of up to 10%. With a very high level of significance (p-value = 0.0000) and an ECT coefficient of 0.822912, the error correction model used proved to be usable, and the adjustment process towards long-term equilibrium took place quickly and significantly. Thus, the model as a whole can explain the short-term and long-term patterns of German economic growth.

**Tabel 3:** VIF Test Results

Variabel	VIF	Kriteria	Kesimpulan
FDI	3,144897	< 10	Not Multicollinearity
INF	3,980707	< 10	Not Multicollinearity
EKS	10,96767	> 10	Multicollinearity
IMP	13,04490	> 10	Multicollinearity
KURS	1,361822	< 10	Not Multicollinearity

Source: *WorldBank*, processed.

Based on the use of the Variance Inflation Factor (VIF) value for each independent variable in the model—exports (EKS), imports (IMP), foreign direct investment (FDI), inflation (INF), and exchange rate (KURS)-Table 3 shows the results of the multicollinearity test. A high correlation between independent variables that can interfere with the validity of regression model estimates is what this test seeks to identify. It can be concluded that the foreign direct investment (FDI) variable does not suffer from multicollinearity problems because its VIF value is 3.144897, which is below the general tolerance level (<10). In the same way, the inflation variable (INF) has a VIF value of 3.980707, also indicating that multicollinearity is not detected. However, the import (IMP) and export (EKS) variables have VIF values of 13.04490 and 10.96767, respectively. These figures are above the 10 limit, which indicates an indication of multicollinearity between imports and exports. This multicollinearity indicates a strong linear relationship between the two variables, which can have an impact on how well the model's regression coefficients are. It can be concluded that the exchange rate (SWAP) is free from multicollinearity problems because its VIF value is 1.361822, which is well below the threshold. The majority of variables in the model, with the exception of imports and exports, which require more attention because they can impact the stability of the estimation model, are found to be within the tolerance limits of multicollinearity using this test.

The findings of the data analysis show that Germany's economic growth, foreign direct investment, inflation, exports, imports, and exchange rates have changed considerably

between 1990 and 2022. Between 2009 and 2020, economic growth slowed, most likely as a result of the COVID-19 pandemic and the global financial crisis. Nevertheless, foreign direct investment increased, especially after 2000 which indicated a growing interest in the German economy.

The short-term and long-term relationship between economic growth and independent variables was studied using ECM techniques. Based on the estimated results, the long-term imbalance was corrected at a rate of about 82.29% per period, with ECT having a coefficient of 0.822912 at a significance level of 0.0000. However, more research is needed as these positive results suggest that there may be an ongoing imbalance. Short-term economic growth is positively and significantly influenced by exports as shown by a coefficient of 0.960293 and a p-value of 0.0247. On the other hand, the FDI variable has a negative and significant impact on economic growth in the long term with a coefficient of -0.853917 and a p-value of 0.0033. This means that the increase in FDI in the previous period has a negative impact on current growth. A study indicating that foreign direct investment in the manufacturing sector has a favorable effect on economic growth in developing countries, but foreign direct investment in the tertiary sector, helps explain this. Although it focuses on developing countries, the study's conclusions may apply to Germany if foreign direct investment is not concentrated in productive industries (Emako et al., 2022).

With a p-value of 0.0570 and a coefficient of -0.855565, the INF variable also has a long-term negative impact on economic growth. Study by (Agudze & Ibhagui, 2021) found that in developed countries, inflation that exceeds certain thresholds can reduce direct foreign investment flows, ultimately negatively impacting economic growth. In addition, with a p-value of 0.0628 and a coefficient of -1.026337, the PMI has a long-term negative impact on economic growth. Although not significant in the long term, the KURS exchange rate still needs to be considered because it has an impact on global trade and investment.

Since the VIF value of the independent variable is less than 10, the results of the classical assumption test show that the model does not have a multicollinearity problem. The normality condition was met because the Jarque-Bera test showed that the residual model was normally distributed with a probability value greater than 0.05. With a Chi-Square probability value greater than 0.10, the Breusch-Godfrey test shows that the model has no autocorrelation problems. Since the probability value is higher than 0.10, White's test shows that the model is heteroscedastic. Before conducting the analysis with ECM, a cointegration test was carried out to verify the existence of a long-term relationship between the variables in the model. ECM can be used legitimately if the cointegration test indicates the presence of a long-term relationship. Based on the coefficient of determination (R-Squared = 0.860005), the independent variables in the model explain 86% of the variation in economic development, with other variables not included in the model affecting 14%.

## CONCLUSION

Based on the results of a study on the impact of exchange rates, exports, imports, inflation, and foreign direct investment (FDI) on German economic growth between 1990 and 2022,

these factors generally have a significant effect on the dynamics of economic growth in both the long and short term. In the near future, exports will prove to be an influential and profitable variable for economic growth. Therefore, an increase in exports can directly accelerate the expansion of the German economy over the same period of time. In contrast, imports, inflation, and foreign direct investment do not show a large short-term impact. However, these three factors have a large and detrimental impact on economic growth in the long run. It states that increased foreign direct investment, inflation, and imports can ultimately weigh on the national economy if not effectively controlled. Although the exchange rate does not show a statistically significant impact, its strategic importance in global trade and cross-border investment flows makes it very important. A number of traditional assumption tests, including normality, lack of autocorrelation, lack of heteroscedasticity, and lack of multicollinearity problems, have been met by the econometric model used in this study, with exceptions to the export and import variables that show a strong relationship. The determination coefficient of 86 percent suggests that the independent variables in the model can explain most of the variation in economic growth. In addition, a statistically significant Error Correction Term (ECT) coefficient of 0.822912 attests to the model's ability to quickly correct long-term imbalances towards a new equilibrium. Based on these findings, the German government should concentrate its efforts on increasing exports, while also keeping an eye on FDI flows, maintaining price stability, and controlling imports to prevent long-term economic losses. A number of policy recommendations can be made based on the findings of the ECM analysis. First, one of the main drivers of economic growth must be the promotion of export growth. Second, in order for foreign direct investment (FDI) to have a better long-term influence on economic growth, its effectiveness must be increased. Third, to avoid a detrimental impact on economic growth, inflation stability must be maintained. Fourth, imports must be better controlled because they have a long-term detrimental effect on growth. Fifth, to prevent turmoil in the international trade and investment sector, exchange rate stability must also be considered. The study's findings provide valuable information for policymakers to create more efficient economic plans that will manage the short- and long-term drivers of Germany's economic expansion. Based on the findings of the research conducted, several things can be a reference for future research. In order to better capture quantitative and qualitative features, it would be beneficial for future research to examine the use of mixed methods, as the strategies used in this study are still limited to a single method. It is also recommended to include additional related variables that have not yet been the subject of this study, such as population and government debt, to see how these variables affect the variables studied.

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