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Determinants of Palm Oil Productivity in North Sumatra Province

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Abstract :
The purpose of this study is to identify, review, analyze and describe various macroeconomic factors such as land area, investment, infrastructure, total production and inflation that affect the productivity of oil palm plantations in North Sumatra province. The research method used is the multiple regression method with the error correction model. This model is used to see that the relationship in the short term is with economic theory and in its solution to the variables of time series that are not stationary in the level and the regression of gradual decrease. From this analysis we will obtain a short-term regression equation towards the long-term equilibrium. The type of data used is secondary data. The results of the investigation show that land area, investment, infrastructure, total production and inflation simultaneously have a significant effect, while the area of land, investment, infrastructure, total production partially has a significant and positive effect, and Inflation has a significant and negative effect on the productivity of oil palm plantations in the north sumatra province in the short and long term balance.

Keywords*: land area, investment, infrastructure, total production, inflation, palm oil productivity*

INTRODUCTION

North Sumatra, as one of the central oil palm plantations in Indonesia, produces an average of 1.7 million tons of CPO per year. This amount reaches 8.23% of the total national production of CPO per year. The area of oil palm plantations in North Sumatra increases every year. This widespread increase occurred due to the conversion of agricultural land, especially rice fields, especially in the area of Langkat, Serdang Bedagai and Labuhanbatu. The North Sumatra Province with a total area of 72,981 km² with a population of 13,937.797 million (BPS, 2015) is grouped in agricultural areas because the majority of the population lives in the agricultural sector. The main performance of the agricultural sector consists of annual crops (rubber, oil palm, coffee). The type of annual plant developed in the province of North Sumatra is not the same for each province. The oil palm plantation business was previously a plantation managed by the private sector and the state, but now it is also managed by the community. This is due to the fact that this palm oil product receives great attention from the provincial government. In addition, if this product continues to develop, it will have a positive impact on regional economic development, including the absorption of labor, the opening of opportunities for investment in advanced industries of the oil palm, the impact on regional income, education , comparative advantage and poverty reduction.

The potential to develop oil palm plantations in North Sumatra is supported by available resources, so the idea of making North Sumatra a barometer of national fisheries is not impossible. One of the objectives of plantation revitalization is to increase the productivity of oil palm plantations. Efforts to optimize productivity can not only be based on the

expansion of land due to the limited potential of the land for oil palm plants, so the productivity of the oil palm per hectare of the sown areas should be increased immediately. For this reason, it is important to identify the efforts needed to increase the productivity of oil palm plantations in North Sumatra, given the great potential they have for them to achieve production objectives to support the needs of Sumatra's CPO agroindustry. North and strengthen them to meet the growing demand of the market in the future.

By increasing the productivity of oil palm plantations in North Sumatra, it is also necessary that the participation of investors from both domestic and foreign investors accelerate more plantations, the amount of palm oil production so that the productivity level of the oil palm in North Sumatra is even bigger. For the next five to ten years, it is estimated that North Sumatra still leads the investment. Especially if a series of large-scale projects can be carried out on time. Among other things, the Sei Mangkei Palm Oil Industry Grouping Project in Simalungun Regency, Kualanamu - Tebingtinggi Toll Road Project, which forms part of the toll road that connects the tip of Sumatra Island, that is, Aceh to Lampung. Another mega project that investors expect is the development and expansion of Kualatanjung Port, Batubara Regency. The port managed by Pelindo I Medan is expected to develop much more than the the port of Belawan, and has an international port level.

In the future, it is expected that several factors, such as the addition of the plantation area, the large number of domestic investors and the interests of PMA in the palm oil industry, the massive development of infrastructure that can support the increase in productivity of the oil palm and the growing number of palm oil production each year and supported by inflationary conditions Stable able to provide better productivity of palm oil in the province of North Sumatra. Therefore, it is expected that the productivity of the oil palm can contribute significantly to the increase in the value of the gross regional product (GRDP) of the province of North Sumatra. The benefits of the presence of oil palm plantations in Sumatra North Sumatra are not only enjoyed by those who own or work in oil palm plantations. The oil palm plantations are also one of the economic locomotives that attract the growth of the economic sectors of North Sumatra, both in production, income and added value. Even oil palm plantations also attract and integrate the rural and urban economy of North Sumatra.

LITERATURE REVIEW

Macroeconomic Theory

"What is Macroeconomics?" The answer to this question seems at first trivial. Macroeconomics is by definition a branch of economics which investigates the relationship among macroeconomic variables, such as national product, total employment, the monetary aggregate, the general price and the like. (IWAI, 2011)

Much of the macroeconomic research on fiscal policy and the business cycle can be categorized in one of three areas: (1) analysis of fiscal policy from a normative point of view; (2) descriptive exposition of how fiscal authorities actually behave; and (3) theoretical and empirical analysis of the effects of fiscal policy on the business cycle.(Fatás & Mihov, 2012)

Macroeconomics investigates aggregate behavior by imposing simplifying assumptions (“assume there are many identical firms that produce the same good”) but without abstracting from the essential features. These assumptions are used in order to build macroeconomic

models. Typically, such models have three aspects: the 'story', the mathematical model, and a graphical representation.(Kunst & Franses, 1998)

An economy's macroeconomic health can be defined by a number of goals: growth in the standard of living, low unemployment, and low inflation, to name the most important. How can macroeconomic policy be used to pursue these goals? Monetary policy, which involves policies that affect bank lending, interest rates, and financial capital markets, is conducted by a nation's central bank. (Wiser, 2013)

Productivity

The Cobb–Douglas production function is frequently employed in the economic analysis of production and costs. This production function relates output produced to the inputs of production. If labor hours, L, and capital, K, are the only inputs in production, the Cobb–Douglas production function is:

$$q = AL^{\alpha}K^{\beta}$$

where A is a coefficient that represents the level of technology and are coefficients indicating how output responds to changes in each of these inputs (additional inputs can be added to the function above in a similar fashion). A convenient feature of the Cobb–Douglas production function above is that ECONOMIES OF SCALE in production can be determined by examining the coefficients and .(McAuliffe, 2015)

The performance of the supply side of an economy is often identified with the growth rate of potential output. Potential output is not observed in reality, how-ever, and has to be approximated. The use of the production function method for the measurement of potential output growth takes into account different sources of an economy's productive capacity, namely the contributions of labour, capital and total factor productivity, the latter containing information about technological and allocative efficiency and hence about the supply-side functioning.(Hájková & Hurník, 2007)

One concept that is invariably considered in a course in mathematicalnalysis for business or economics students is the notion of a production function for a single product firm. Such a function describes the maximum amount of output that the firm can produce in a fixed period of time as a function of the inputs (or factors of production) that are available to the firm. These factors of production have traditionally been placed in four categories: land, labor, capital, and entrepreneurship. (Beer, 2010)

The Cobb-Douglas function has had a long and successful life and is still a popular production function. The parameters estimated from this function have provided results which seem to be meaningful from the point of view of economic theory. In a majority of the cases the function fitted has been of the unrestricted type, in the sense that the parameters were allowed to take any value whatsoever, positive or negative, high or low. What seems strange is that despite the known unreliability of input data in general, and capital data in particular, the published results always had parameters of the "right" sign and magnitude, as expected a priori on the basis of economic theory.(Diwan, 2006)

Land Area

Land is a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface including those of the near-surface, climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes, and swamps), the nearsurface sedimentary layers and associated groundwater reserve, the plant and animal populations, the

human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.). (FAO 1995) (Batista e Silva, 2011)

Land use represents a critical intersection of economic and ecological systems. Land-use changes are most often directly linked with economic decisions. This recognition has led LUC to choose an economic framework as the organizing principle, resulting in a broad set of project activities geared towards providing a biophysical and geographical underpinning to the representation of land-based economic sectors in modeling land and water use decisions.(Hubacek & Van Den Bergh, 2006)

Investment

Investment value is defined by Mr. Williams as "the present worth of future dividends, or of future coupons and principal." He holds that "it is of practical importance to every investor because it is the critical value above which he cannot go in buying or holding, without added risk. (Edwards & Williams, 2006)

Investment is defined as the commitment of current financial resources in order to achieve higher gains in the future. It deals with what is called uncertainty domains. From this definition, the importance of time and future arises as they are two important elements in investment. Hence, the information that may help shape up a vision about the levels of certainty in the status of investment in the future is significant. From an economic perspective, investment and saving are different; saving is known as the total earnings that are not spent on consumption, whether invested to achieve higher returns or not.(Meltzer, 2015)

Investment under the definition of ICSID is a long term transfer of financial resources-capital flow-from one country to another (the recipient of the investment) in order to acquire interests in a corporation, a transaction which normally entails certain risks to the potential investor. (Grabowski, 2014)

Infrastructure

Until today we cannot dispose of a well-founded and useful definition of infrastructure ("infra" stems from the Latin language, meaning below, thus "infrastructure" can be taken to express "foundation"). Numerous formulations have been put to the test, leading to a substantial diversity and complexity of suggestions and problems which shall not be described here in detail (cf., for example, Jochimsen/Gustafsson 1970a, 1970b, Frey 1972, 1978, Biehl 1986, Nijkamp 1986, Lakshmanan 1989, Aberle 1995, Rietveld/Bruinsma 1998, Haughwout 2000b, Nijkamp 2000). All of these formulations have in common that infrastructure, essentially material infrastructure, is to be supplied by the state. Also, in the public discussion, the term made a successful terminological career, rising to a formula of political technocracy. Traditionally, "infrastructure" has been applied to permanent installations required for military purposes. Modern general usage of the term concerns the necessary
economic and organizational foundation of a highly developed economy (transport network, labor force etc.) (Drosdowski/Scholze-Stubenrecht/Wermke 1997: 359).(Buhr, 2003)

There is no standard definition of infrastructure across economic studies. Tinbergen (1962) introduces the distinction between infrastructure (for example, roads and education) and

superstructure (manufacturing, agricultural and mining activities) without neither a precise definitions nor any theoretic references of these terms. infrastructure as the sum of material, institutional and personal facilities and data which are available to the economic agents and which contribute to realizing the equalization of the remuneration of comparable inputs in the case of a suitable allocation of resources, that is complete integration and maximum level of economic activities. (Torrisi, 2009)

Finally, Fay et al. ((2011), p. 333) define that "infrastructure services are mostly provided through networks, a fact that implies a nonlinear relation with output". But even though Fay et al. mention two studies which focus on the sectors telecommunication and roads, a more detailed definition of infrastructure is not developed. Equivalently, Egert, Kozluk and Sutherland (2009) and Bühler (2004) name infrastructure as networks. Both do not elaborate on the implications of infrastructure and network theory for economic growth, productivity and competition.(Egert, Kozluk, & Sutherland, 2009)

Inflation

Inflation can be defined as a sustained or continuous rise in the general price level or, alternatively, as a sustained or continuous fall in the value of money. Several things should be noted about this definition. First, inflation refers to the movement in the general level of prices. It does not refer to changes in one price relative to other prices. These changes are common even when the overall level of prices is stable.2 Second, the prices are those of goods and services, not assets. Third, the rise in the price level must be somewhat substantial and continue over a period longer than a day, week, or month. (Labonte, 2011)

Inflation is the rate of increase in prices over a given period of time. Inflation is typically a broad measure, such as the overall increase in prices or the increase in the cost of living in a country. But it can also be more narrowly calculated—for certain goods, such as food, or for services, such as a haircut, for example. Whatever the context, inflation represents how much more expensive the relevant set of goods and/or services has become over a certain period, most commonly a year. (Oner, 2012)

In general, the cause of inflation in developed countries is broadly identified as growth of money supply. In developing countries, in contrast, inflation is not a purely monetary phenomenon. Beside, factors typically related to fiscal imbalances such as higher money growth and exchange rate depreciation arising from a balance of payments crisis dominate the inflation process in developing countries, as discussed by Sergent & Wallace.(Totonchi, 2011)

Philips curve explain about the relationship between unemployment rate and inflation rate in economy. During inflation, the value of money will fall. The low inflation rate results that the price of goods and services will not increase gradually. Besides, unemployment rate refers to groups of labor who willing to work in a particular job, with a particular wage rate, but couldn't obtain it due to some economic problems.(Islam, Abdul Ghani, Mahyudin, & Manickam, 2017)

Hypothesis Development

The study hypothesis is based on literature review and the results of previous studies, so it can be interference to the problem of research in the form of the alternative hypothesis as a temporary answer research. It can be formulated hypothesis of the research is: land area, investment,

infrastructure, total production, inflation simultaneously and partially significant effect on palm oil productivity in the north sumatra province in the short and long term balance.

Theoretically,the effects of land area, investment, infrastructure, total production, inflation are determinant toward palm oil productivity in the north sumatra province.

Research Methodology

This research is quantitative with simultaneous equations model building using secondary data of time series during ten years 2008 – 2017 using quarterly data n = 40. The model consists of one equations that the influence of land area, investment, infrastructure, total production, inflation determinants on palm oil productivity in the north sumatra province in the short and long term balance. The model equations are:

Long-term estimation equations :

Palm oil productivity = $\beta 0 + \beta 1 Ln\_LLt + \beta 2 Ln\_INVt + \beta 3 Ln\_INFRt + \beta 4 Ln\_JPt + \beta 5 Ln\_INFLt$

Short-term estimation equations :

Palm oil productivity = $\alpha\, \beta 0 + \Delta\beta 1 \Delta Ln\_LLt\text{-}1 + \beta 2 \Delta Ln\_INVt\text{-}1 + \beta 3 \Delta Ln\_INFRt\text{-}1 + \Delta Ln\_JPt\text{-}1 - \beta 5 \Delta Ln\_INFLt\text{-}1 - \beta 6 RESt\text{-}1$

The data analysis method used to solve the problem in this research uses the analysis of the error correction model or ECM and Multiple Regression with the OLS (Ordinary Least Square) method because the data are not stationary at the level, but stationary at the level of differentiation and the two variables are cointegrated. The method used to see the short-term relationship is with economic theory and in its solution to the variables of time series that are not stationary in the level and the regression of decrease. Direct regression is a chaotic regression, where the results of the regression are significant from unrelated data. To return to the long-term equilibrium value, the condition is the existence of a cointegration relation between its constituent variables.

From this analysis we will obtain a short-term regression equation towards the long-term equilibrium. Also, if there is a long-term trend in these variables, then the analysis of multiple regression tests is used using the OLS (Ordinary Least Square) method as a long-term equation. Based on the results of the calculations and regression analysis can also be used to respond to the existing hypothesis that can be known about the factors that most influence the problem of productivity.

An error correction model (ECM) was developed to estimate the speed at which the dependent variable returned to equilibrium after a change in the independent variables (Banerjee, Dolado, & Mestre, 1998).

The cointegration procedure developed in Johansen (Johansen, 1991) and Johansen and Juselius (Johansen and Juselius, 1990) was employed to test the long run relationship in Model. Two types of the Johansen test were specified, one with trace and the other with eigenvalue. The null hypothesis for the trace test states that the number of cointegrating vectors is less than or equal to r, while the null hypothesis for the eigenvalue test is the number of cointegrating vector is equal to r. The null hypothesis is rejected when the test statistic is greater than the critical value. Rejecting the null hypothesis means there is a cointegration among the variables in the model, thus verifying that these variables have a long-run relationship. (Sjö, 2008)

RESULTS & DISCUSSION

Normality Test

Based on the test results of the above histogram Jarque Bera 0.0472215 where the probability values greater than 0.05 can thus be concluded that the probability of regression disturbances are normally distributed for Jarque Bera probability value is greater than 0.05.

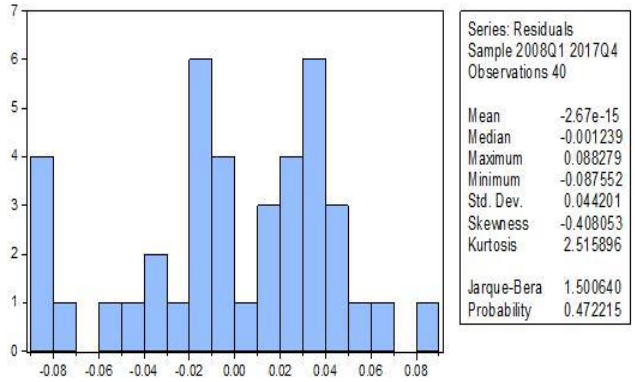

Figure 1 Normality Test

Multicollinearity

Based on test results correlation that no variables have a correlation value above 0.80. It stated that the regression model contains no multicollinearity problems, so these variables are free from multicollinearity problems.

Table 1 Matrix Correlation Test

	land area	Investment	Infrastructure	total production	Inflation
land area	1.000000	0.192028	0.680304	0.593313	-0.180612
Investment	0.192028	1.000000	0.706150	0.465454	-0.122587
Infrastructure	0.680304	0.706150	1.000000	0.721144	-0.040707
total production	0.593313	0.465454	0.721144	1.000000	-0.273748
Inflation	-0.180612	-0.122587	-0.040707	-0.273748	1.000000

Heteroscedasticity

Based on the test results in which the White Probability Chi-squared value of 0.4526 is greater than 0.05. It can be concluded that the regression model is free of symptoms heteroskedasticity

Table 2 Heteroskedasticity White Test

Heteroskedasticity Test: White

F-statistic	1.081500	Prob. F(5,34)	0.4881
Obs*R-squared	4.388804	**Prob. Chi-Square(5)**	**0.4526**
Scaled explained SS	2.661324	Prob. Chi-Square(5)	0.7620

Autocorrelation

Based on test results Lagrange-Multiplier where Probability Chi-squared value of 0.9335 is greater than 0.05. It can be concluded that the regression model is free from the problem of autocorrelation

Table 3 Autocorrelation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.053090	Prob. F(2,30)	0.9484
Obs*R-squared	0.137548	**Prob. Chi-Square(2)**	**0.9335**

Stationarity test

Stationarity test data in this study the first stage in data estimation is stationary test data using the unit root test (unit root test)

Table 4 Unit Root Tes

Variabel	t statistik ADF	Critical Values 5%	Probability	Remarks
Ln_PPKS	-2.664143	-2.941145	0.0896	Not Stationary
Ln_LL	-2.215124	-2.941145	0.2044	Not Stationary
Ln_INV	-2.360002	-2.941145	0.1595	Not Stationary
Ln_INFR	-1.327761	-2.948404	0.6056	Not Stationary
Ln_JP	-0.717837	-2.938987	0.8304	Not Stationary
Ln_INFL	-2.328971	-2.938987	0.1683	Not Stationary

In the previous table you can see the behavior of the data of each variable. Based on the results of the augmented Dickey-Fuller (ADF) test at the level that includes the intersection, it can be seen that all variables at this level have a probability value greater than the value of 0.05. Up to this stage, for all the variables, it can not be said that it is stationary at the same level, that is, at the level. Therefore, it is necessary to perform a degree of integration or stationarity test in the degree of difference until all the variables observed are stationary in the same degree.

Table 5. Degree of integration test (first level of difference)

Variabel	t statistik ADF	Critical Values 5%	Probability	Remarks
D(Ln_PPKS)	-2.995159	-2.941145	0.0444	stationary
D(Ln_LL)	-4.254995	-2.941145	0.0018	stationary
D(Ln_INV)	-11.38112	-2.941145	0.0000	stationary
D(Ln_INFR)	-8.792224	-2.948404	0.0000	stationary
D(Ln_JP)	-3.646443	-2.941145	0.0092	stationary
D(Ln_INFL)	-6.734605	-2.941145	0.0000	stationary

In the previous table, the results of the ADF statistical test are shown in the first difference showing that the null hypothesis is rejected, that is, the data on the palm oil productivity (Ln_PPKS), Land area (Ln_LL), Investment (Ln_INV), Infrastructure (Ln_INFR), Total Production (Ln_JP), and
Inflation (Ln_INFL) after being discarded once the data becomes stationary. With a probability value less than 0.05. This means that all these variables do not contain root-unit problems and have stationary data conditions at the first level of difference or a degree of integration.

Cointegration test

For the cointegration tests between the Land Area (Ln_LL), the Investment (Ln_INV), the Infrastructure (Ln_INFR), the Total Production (Ln_JP) and the Inflation (Ln_INFL) in the
palm oil productivity (Ln_PPKS) method and results were used by Johansen method. These are shown as follows:

Table 6. Johansen cointegration test

Trace Statistic	0.05 Critical Value	Probability	Remarks
204.3252	95.75366	0.0000	Cointegrated
Max Eigen Statistik	**0.05 Critical Value**	**Probability**	**Remarks**
97.46798	40.07757	0.0000	Cointegrated

From the results of the previous test, you can see that the value of Trace Statistic (204.3252)> Critical Value (95.75366) and Probability value 0.0000 <0.05, as well as the value of Max Eigen Statistic (97.46798)> Critical Value (40.07757) and Value of probability 0.0000 <0.05, so it can be concluded that the Land Area (Ln_LL), Investment (Ln_INV), Infrastructure (Ln_INFR), Total Production (Ln_JP) and Inflation (Ln_INFL) in palm oil productivity (Ln_PPKS) in the long term there is cointegration in the equation model.

Error Correction Model (ECM)

Based on the tests of stationarity and Cointegration that have been carried out, the analysis used is the Error Correction Model (ECM) because a long-term balance is produced. Through estimates that show the causal relationship between the independent variables and the dependent variable are the following:

Long Term Estimates :

Table 7 Long Term Estimates Test

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	3.267287	1.297981	2.517208	0.0167
Ln_LL	1.392969	0.113000	12.32718	**0.0000**
Ln_INV	1.297408	0.513018	2.528972	**0.0166**
Ln_INFR	0.220106	0.083960	2.621560	**0.0130**
Ln_JP	0.561444	0.130753	4.293919	**0.0001**
Ln_INFL	-0.039451	0.010611	-3.717965	**0.0007**
R-squared	0.923378			
Adjusted R-squared	**0.912110**			
F-statistic	81.94681			
Prob(F-statistic)	**0.000000**			

The calculation result obtained is the significance probability value ≤ 0.05, 0.0000 which means a significant effect, indicating that the variable land area, investment, infrastructure, total production, inflation simultaneously have a significant influence on the palm oil productivity in north sumatera.

Probability value Land Area is less than α (0.0000 ≤ 0.05), it can be concluded that the variable Land Area significant and positive impact on the palm oil productivity.

Probability value Total Production less than α (0.0001 ≤ 0.05), it can be concluded that the variable Total Production significant and positive impact on the palm oil productivity.

Probability value Inflation less than α(0.0007 ≤ 0.05), it can be concluded that the variable Inflation significant and negative impact on the palm oil productivity.

Short Term Estimates :

Table 8 Short Term Estimates Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.200146	0.005486	2.026535	0.0490
D(Ln_LL)	0.831138	0.150627	5.517839	**0.0000**
D(Ln_INV)	0.408429	0.120466	2.776177	**0.0038**
D(Ln_INFR)	0.296848	0.107988	2.196842	**0.0375**
D(Ln_JP)	0.344856	0.144194	2.698095	**0.0092**
D(Ln_INFL)	-0.023852	0.011682	-2.041808	**0.0495**
RES(-1)	-7.105893	1.644831	-4.320135	**0.0001**
R-squared	0.715179			
Adjusted R-squared	**0.661775**			
F-statistic	13.39186			
Prob(F-statistic)	**0.000000**			

The calculation result obtained is the significance probability value ≤ 0.05, 0.0000 which means a significant effect, indicating that the variable land area, investment, infrastructure, total production, inflation simultaneously have a significant influence on the palm oil productivity in north sumatera.

Probability value Land Area is less than α (0.0000 ≤ 0.05), it can be concluded that the variable Land Area significant and positive impact on the palm oil productivity.

Probability value Total Production less than α (0.0092 ≤ 0.05), it can be concluded that the variable Total Production significant and positive impact on the palm oil productivity.

Probability value Inflation less than α (0.0495 ≤ 0.05), it can be concluded that the variable Inflat

CONCLUSIONS

Land area, investment, infrastructure, total production, and inflation simultaneously have a significant influence on the palm oil productivity in north sumatera in the short and long term balance.

Land area, investment, infrastructure, total production partially have significant and positive, inflation has significant and negative on the palm oil productivity in north sumatera in the short and long term balance.

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