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Relationships between Macroeconomics Indicators and Investments of Enterprises: Evidence from Poland

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Abstract:

Purpose: *The paper aims to analyze the impact of macroeconomics factors, including their delay on investments of enterprises in Poland in the years 2005-2018.*
Design/Methodology/Approach: *The authors use statistical analysis to verify the hypotheses. First, the test of KPSS was done to check the stationarity of the variables. The next step was to calculate coefficients of linear correlation of Pearson between two subgroups of variables. After that, the causality of Granger was done.*
Findings: *There is a relationship between actual investment spending of enterprises and the value of economic growth and its components but only in some cases. Moreover, past investments have a negative impact on investment spending of medium and large-sized companies. However, there is no evidence that inventory investments influence the investment spending of enterprises, and fiscal preferences positively impact on changes in the value of actual investment spending of companies.*
Practical Implications: *The findings could change the rules of preparing predictions for investment spending in Poland. Furthermore, it may affect the changes in fiscal preferences.*
Originality/Value: *The paper contributes to the macroeconomics theory in the area of economic growth. Furthermore, it also makes insights into the theory of incentives, particularly in fiscal preferences.*

Keywords: *Investment spending, fiscal preferences, inventories, economic growth, causality of Granger.*

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1. Introduction

The pandemic of COVID-19 hit the global economy, including investment spending of enterprises. Therefore, we can observe the significant growth of government spending. However, it cannot replace private investments that are one of the most critical factors of long-term economic development. Unfortunately, their value in Poland had been decreasing even before the pandemic. Therefore, it is essential to study the factors that influence the investments of companies as well as their delays. Much research was done in other countries. The results but may differ in the case of Poland. Moreover, most studies in Polish academic literature are based on a simple statistical analysis (Barczyk, 2006; Nowak, 2014).

Furthermore, there is a shortage of research that considers the delay of impact. That makes the research gaps that should be explained. The explanation could be necessary both for academics and politicians. Furthermore, it could help boost Poland's investments and support Gross Domestic Product (GDP) growth, which is particularly important after the depression caused by COVID-19. Therefore, the paper aims to analyze the impact of macroeconomics factors, including their delay on investments of enterprises in Poland in the years 2005-2018. The paper contributes to the macroeconomics theory in the area of economic growth. Furthermore, it also makes insights into the theory of incentives, particularly in fiscal preferences.

The paper is organized as follows. In the second section, the literature review is done. It helps the authors to set four hypotheses. Section 3 shows the data collecting and describes the methodology that enables to confirm or reject the hypotheses. Section 4 presents the results of statistical analysis. Section 5 discusses the hypotheses given these results. It also explains the constraints of the paper and gives directions for future studies.

2. Literature Review

According to the macroeconomic theory, actual investment spending is the sum of planned and unplanned investments. The planned investments depend positively on the current economic situation and the expected growth rate of real GDP in the future (Krugman, 2015; Posłuszny, 2018). Although investments are necessary for economic growth beyond the level lead to excess productive capacity. Then, there is a danger of deflation or financial instability in the future (Garnaut and Huang, 2005). However, GDP consists of consumer spending, investments, government spending, export, and import. The neoclassical growth models emphasize the impact of investments on economic growth (Sultan and Haque, 2011) particularly.

Many studies from abroad confirm relationships between these macroeconomic indicators (Dritsakis *et al.*, 2006; Miarianas, 2007; Herreiras and Ortis, 2010; Tan and Lean, 2010). In the case of Poland, Inessa *et al.* (2019) studied the macroeconomic factors affecting the investment potential of an enterprise. They conducted the

correlation analysis that allowed to identify three indicators that influence the economic growth, the share of gross expenditure on non-current assets in the country's GDP for privately-owned business entities, investment growth rates in non-current and current assets of enterprises, and investment growth rates in non-current assets of companies. On this basis, they developed a model for optimizing the investment potential formation process for an enterprise in the years 2005-2017. They found that real GDP growth is the main factor influencing the availability of companies' investment potential. However, the time series was relatively short, and the authors did not consider the delay. In connection to the above, we set the first hypothesis:

H1: There is a relationship between changes in the value of actual investment spending of enterprises and changes in the value of economic growth and its components in Poland.

Moreover, the planned investments depend negatively on existing production capacity and interest rates (Krugman, 2015; Posłuszny, 2018). As the second factor is connected with monetary policy, we decided to focus only on the first one. Existing production capacity is connected with investments of companies in the past. Therefore, we suggest the following hypothesis:

H2: Changes in the value of past investments negatively impact changes in investment spending of enterprises in Poland.

Inventory investments have to be also taken into consideration. It should be positive when enterprises add to their inventories and negative when companies reduce them. There are empirical pieces of evidence that inventories reflect changes in expectations about the future economic situation. Moreover, they should react in different ways to changes in current conditions and predictions for the future. The good news about the future leads to increased investments and a drop in inventories (Crouzet and Oh, 2015). Nevertheless, changes in inventories often are not deliberate decisions of a firm. Instead, it could result from mistakes in sales in the future (Krugman, 2015). Therefore, we set the third hypothesis:

H3: Changes in the value of inventory investments impact changes in investment spending of enterprises in Poland.

There is no room for policy decisions on long-term economic growth in neoclassical growth models in opposition to endogenous models (Fosu *et al.*, 2012). Fiscal policy should have a multiplier effect on real GDP, including investments except for lump-sum taxes. Discretionary tax preferences are usually implemented from deliberate actions (Krugman, 2015). Woźniak (2018) tested similar issues for Poland, although more broadly. He tested if there is a relationship between the value of public aid and the level of investments in enterprises. The study was done for the years 2004-2016. He used the Pearson correlation as a method of statistical analysis. The results confirm the relationship between microenterprises, both for public and de minimis, and large-

sized companies but only for public aid. However, the study does not consider that the relationship and time series delay was short, too.

However, the study does not consider that the relationship and time series delay was short, too. Lisowski *et al.* (2019) researched the impact of fiscal instruments in the previous year on the investment spending of industrial companies in Poland. The study was conducted for the years 2003-2016. The authors used Granger causality as a method of statistical analysis. The results reveal that only a few tax preferences have a positive impact on the level of investments. It includes the corporate income tax exemptions in the previous year obtained by small, medium, and large-sized enterprises in the special economic zones. There had been implemented, however, some changes in the legal basis of these preferences. The results also suggest that the changes in the value of losses in a previous year deducted by medium-sized enterprises from income in a given year positively impact the increase of investments, but the reasons were inconclusive. However, the study was constrained to a few sectors connected with industrial activity, and time series were relatively short. Therefore, we suggest the last hypothesis:

H4: Changes in the value of fiscal preferences positively impact changes in the value of actual investment spending of enterprises in Poland.

3. Research Methodology

In order to conduct the research analysis, the following data for the years 2005-2018 were collected:

- The level of investments of non-financial enterprises that employ more than ten people and keep accounting books, broken down into small enterprises with up to 49 employees and medium and large enterprises with over 49 employees.
- The macroeconomic variables such as gross national product (GNP), gross domestic product (GDP), gross value added (GVA), domestic demand (DD), total consumption: public (PC) and household (HC), gross accumulation (GA), changes in inventories (CiI), export and import (ExI), GDP per capita, GDP per capita as a percentage of the average GDP per capita for EU countries.
- The value of tax preferences used by taxpayers of corporate income tax and personal income tax such as allowances, exemptions, and deductions.

The number of tax preferences used by taxpayers of corporate income tax and personal income tax such as allowances, exemptions, and deductions. One should consider that gross accumulation consists of two elements, fixed capital expenditures and changes in inventories. Therefore, it is not the same as the level of investment. The accumulation concerns the entire economy - all companies. The investment level includes only non-financial enterprises that employ ten or more people and keep

accounting books. The amounts of this indicator accounted for 35-40% of the accumulation in the analyzed years.

The first stage of the analysis was to check the stationarity of all 26 variables with the test of KPSS. It is designed to test the stationarity of the series. The null and alternative hypotheses follow the reverse system of the Dickey-Fuller test.
The construction of the KPSS test is as follows:

$$y_t = r_t + \xi_t + \varepsilon_t. \qquad (1)$$
$$r_t = r_{t-1} + u_t$$

where ε_t is the stationary random term.

There are two hypotheses:

H0: The time series are stationary, H1: The time series are non-stationary.

If the variance of the random term u_t is equal to zero, then the values of $r_t = r_0$ are constant for every t. Then, the y_t is the sum of the constant r0 or the constant and the deterministic trend $r_0 + \xi_t$ and the stationary purely random factor. If the variance of the random term in the second equation is nonzero, this equation determines the random walk process. Then, the y_t process is the sum of the r_t process and possibly the deterministic trend ξ_t and the purely random stationary factor. Therefore, it is non-stationary. The KPSS test has a complex structure and a highly complex probability distribution. The process is stationary if the following conditions are met:

- the expected value (mean value) is constant and independent of time,
- the variance is constant and independent of time,
- the covariance between different variables depends only on the case numbers and is independent of time.

Typical examples of non-stationary variables are macroeconomic ones. We often observe a trend for these variables, which means that the expected value is changing. The linear model prepared for such variables may seem correct, which could be confirmed by its verification. It can be the apparent regression - this phenomenon was explained by Granger (1992), who is Nobel laureate. One often can convert a series of observations to a stationary series by computing the differences. The KPSS test is based on linear regression. It divides a series into three parts: a deterministic trend, a random walk, and a stationary error. If the data is stationary, it will have a fixed element for an interceptor. The series will be stationary around a fixed level (Charemza and Deadman, 1997). The test uses ordinary least squares to find the equation, which differs slightly depending on whether one wants to test for level stationarity or trend stationarity (Osińska, 2007). A simplified version, without the time trend component, is used to test level stationarity.

The next step was to calculate coefficients of linear correlation of Pearson between two subgroups of variables. The first group consisted of 3 dependent variables representing the level of investments of non-financial enterprises. The second group included the remaining 23 potential explanatory variables. The total correlation coefficient for a detailed - unordered - series of two discrete or continuous variables is calculated as follows:

$$r_{\mathrm{xy}} = \frac{\frac{1}{n}\cdot\sum_{i=1}^{n}(x_i - m_x)\cdot(y_i - m_y)}{s_x \cdot s_y} \tag{2}$$

The numerator is called covariance, s_x, s_y are the standard deviations of the variables X and Y, mx and my are their arithmetic means, and n - number of pairs of information - statistical units.

However, correlation does not necessarily mean the actual relationship between the variables, so we analyzed Granger's causality. The correlations can be completely random and, therefore, should be verified. Granger causality says that the variable *Y* is the cause of the variable X if the current values of the variable *Y* can be predicted with greater accuracy using the past X values than without their use (Charemza and Deadman, 1997). The Granger causality analysis is based on the estimation of the following models (Osińska, 2007):

$$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \ldots + \alpha_k y_{t-k} + \varepsilon_t$$
$$y_t = \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \ldots + \alpha_k y_{t-k} + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \ldots + \beta_k x_{t-k} + \eta_t \tag{3}$$

Where y_t is the implementation of the Y process, x_t is the implementation of the X process, α_1, β_1 are parameters of a model, k means the delay of a model, ε_t is a random component of the Y_t model explained only by its own delayed values and η_t is a random component of the Y_t model explained only by its own delayed X_t values. Granger causality tests the null hypothesis that there are no significant differences between the residual variances of the model that means no causality:

$$H_0: \ \sigma^2(\varepsilon_t) = \sigma^2(\eta_t) \tag{4}$$

In the view of the alternative hypothesis:

$$H_1: \ \sigma^2(\varepsilon_t) \neq \sigma^2(\eta_t) \tag{5}$$

where $\sigma^2(\varepsilon_t)$, $\sigma^2(\eta_t)$ are the variance s of the random component of the models.

The calculations were made with the Gretl program based on vector autoregression models (VAR). The maximum possible lag of the delay of the variables was set to 3 because of the relatively short time series. Moreover, the selection of the delay order for a specific model was based on the criteria of AIC (Akaike criterion), BIC (Schwartz-Bayesian criterion), and HQC (Hannan-Quinn criterion). Akaike's (1974)

information criterion (AIC) is a fined technique based on in-sample fit to estimate the likelihood of a model to predict/estimate the future values. A good model is the one that has minimum AIC among all the other models. Bayesian information criterion (BIC) (Stone, 1979) is another criterion for model selection that measures the trade-off between model fit and complexity. A lower BIC value indicates a better fit. The following equations are used to estimate the AIC and BIC (Stone, 1979; Akaike, 1974) of a model:

$$AIC = -2 \times lnL + 2 \times k$$
$$BIC = -2 \times lnL + 2 \times lnN \times k \quad (6)$$

where L is the value of the likelihood, N is the number of recorded measurements, and k is the number of estimated parameters.

The Hannan-Quinn information criterion (HQC) measures the goodness of fit of a statistical model and is often used as a criterion for model selection among a finite set of models. It is not based on the log-likelihood function (LLF) and but is related to the information criterion of Akaike. Like AIC, the HQC introduces a penalty term for the number of parameters in the model, but the penalty is larger than one in the AIC. In general, the BIC is defined as:

$$HQC = n \times ln\frac{RSS}{n} + 2 \times k \times ln\,(ln\,n) \quad (7)$$

where:

- n is the number of observations.
- k is the number of model parameters.
- RSS is the residual sum of squares that result from the statistical model.

Given any two estimated models, the model with the lower value of HQC is preferred; a lower HQC implies either fewer explanatory variables, better fit, or both.

The last part was a test of the autocorrelation function (ACF) and partial autocorrelation function (PACF) for independent variables. In the first function, at lag k, there is a correlation between the series values that are k intervals apart. In the latter case, at lag k, the correlation between the series values separated by k intervals from each other, with simultaneous recording of values in the intervals between them.

5. Statistical Analysis

Depending on the selection of the significance level and taking into account or not considering the occurrence of the trend, the KPSS test gave different results. However, the time series usually appeared to be non-stationary. Therefore, we calculated the first differences of variables and denoted by the prefix "d," which were stationary. On that basis, further calculations were conducted. The following nine correlations were significant:

- changes in the level of investments in all enterprises and changes in gross national product, domestic demand and gross accumulation;
- changes in the level of investments in small non-financial enterprises and changes in gross national product, domestic demand, public consumption and gross accumulation;
- changes in the level of investment in medium and large-sized enterprises and the changes in domestic demand and gross accumulation.

We found no relationship between the level of investments in non-financial companies and the amounts of used tax preferences. The correlation coefficients considered significant at the level of p = 0.1 are presented in Table 1.

Table 1. *Significant correlation coefficients between the variables.*

Variable	d_GNP	d_DD	d_PC	d_GA
d_Investments of all enterprises	0.483832	0.541303	-	0.731059
d_Investments of small enterprises	0.488977	0.528880	0.480038	0.566221
d_Investments of medium and large-sized enterprises	-	0.526653	-	0.731379

Note: *Level of significance: p = 0.1*
Source: *Own creation.*

There were seven out of nine correlations that proved to be the causal correlations of Granger when p was 0.1, and the lag of delay in each case was 3. In some cases, a causal relationship was bilateral or had a reverse direction. That means the dependent variable appeared to be the independent one, although we initially assumed the opposite. The results of the calculations are presented in Table 2.

Table 2. *P-value for causal correlations*

Explained variable	Explanatory variables		
	d_DD	d_GA	
d_Investments of small enterprises	0.0427	0.0358	
Explained variable	Explanatory variables		
	d_Investments of all enterprises	d_Investments of small enterprises	d_Investments of medium and large-sized enterprises
d_GNP	-	0.0572	-
d_ND	0.0092	0.0530	0.0149
d_GA	0.0194	-	0.0137

Source: *Own creation.*

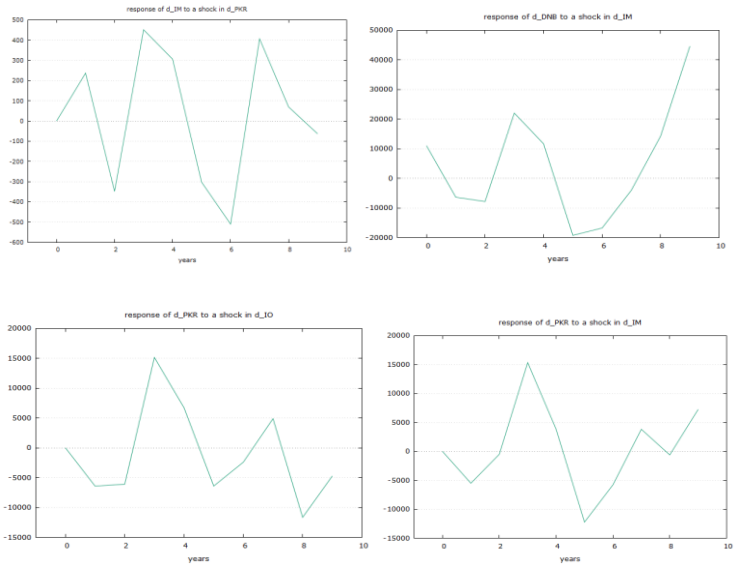
Based on the results, we made the following conclusions:

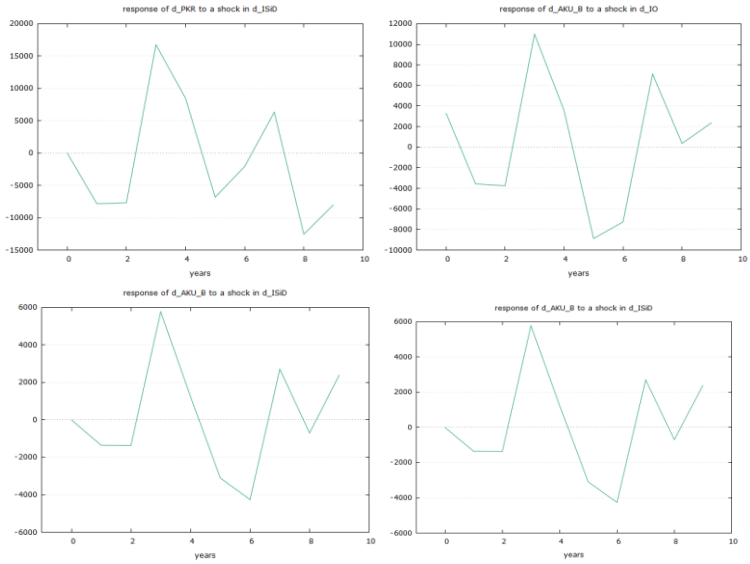
- changes in the level of investments in small enterprises are caused by changes in domestic demand and gross accumulation;

- changes in the level of gross national product are caused by changes in investments in small enterprises;
- changes in the level of domestic demand are caused by changes in investments in small enterprises and medium and large-sized enterprises as well as in all enterprises, probably due to the alignment of the variables: changes of investments in medium and large-sized enterprises as well as all enterprises as the correlation of Pearson is 0.9967;
- changes in the level of gross accumulation are caused by changes in investments in medium and large-sized enterprises as well as all enterprises, probably due to the alignment of the variables in changes of investments in medium and large-sized enterprises as well as in all enterprises as the correlation of Pearson is 0.9967;
- the signs of correlation coefficients presented in Table 1 indicate that all of the above relationships are simply proportional (positive);
- the lags of the delay of the explanatory variables equal to 3 mean that the dependent variable is influenced by the values of the explanatory variables from one year, two years, and three years ago,
- as there are significant correlations between the explanatory variables: changes of investments of medium and large-sized enterprises, small enterprises, and all enterprises and between domestic demand and gross accumulation, there are no grounds to attempt to construct single-equation econometric models.

The estimated models made it possible to conduct the forecast by examining the impulse response function (IRF). Figure 1 shows the expected changes in the following explanatory variables due to changes in the explanatory variables' values.

Figure 1. *Impulse response function*





Source: *Own creation.*

Additionally, the autocorrelation (ACF) and partial autocorrelation (PACF) functions for the dependent variables were examined. It appeared that for the changes of investments in medium and large-sized enterprises and all enterprises, there is a significant and negative autocorrelation (at the level of $p = 0.01$) for the delay equal to 2. This means that the current changes in the level of investments in medium and large enterprises and enterprises, in general, are inversely proportional to changes in the level of investments from two years ago.

6. Discussion and Conclusion

The paper aims to analyze the impact of macroeconomics factors, including their delay on investments of enterprises in Poland in the years 2005-2018. Therefore, the authors set four hypotheses:

H1: There is a relationship between changes in the value of actual investment spending of enterprises and changes in the value of economic growth and its components in Poland.

The hypothesis is supported in the case of domestic demand and gross accumulation. Pearson correlations were significant for each group of enterprises but Granger causality only for small-sized companies. Furthermore, statistical analysis results support the hypothesis in the case of GNP - Pearson correlations for all entities and small-sized companies - and public consumption - Pearson correlations for small-sized companies. The best lag of delay is three years. However, there is also influence in the opposite direction in the following cases: domestic demand, gross accumulation,

and GNP. It derives from the multiplier principle and the fact that investment spending is also a macroeconomic indicator.

H2: Changes in the value of past investments negatively impact changes in investment spending of enterprises in Poland.

The hypothesis is supported in the case of medium and large-sized companies as well as all enterprises. The delay for these autocorrelations is two years. However, the hypothesis was rejected for small companies. This is not consistent with the theory of macroeconomics. The reason could be connected with the results mentioned before while the first hypotheses were discussed - investments in small-sized enterprises in Poland are caused by domestic demand, gross accumulation, public consumption, and GNP.

H3: Changes in the value of inventory investments impact changes in investment spending of enterprises in Poland.

The hypothesis should be rejected. There are no significant correlations that could support it. It seems to be surprising, but there are possible explanations. The value of inventories of companies in Poland could change not because of deliberate decisions of enterprises but be connected with false predictions of future sales. Therefore, it could be consistent, however, with the theory.

H4: Changes in the value of fiscal preferences positively impact changes in the value of actual investment spending of enterprises in Poland.

The hypothesis should also be rejected. There is no evidence of any impact of fiscal preferences on the investment spending of enterprises. As mentioned in section 2, Lisowski *et al.* found the opposite result but in the case of industrial companies. The possible explanation could be that such enterprises need more investments than entities from other sectors, such as sales or vehicle repairs.

The study also has some constraints. First of all, it does not include microenterprises that significantly contribute to Poland's economic growth. The available data for these companies are not completed. Most of microenterprises do not keep accounting books. Therefore, the data are often based only on the results of questionnaires that could be biased. The second constraint is connected with quite a short period of analysis - only thirteen years. In connection to this, the study should be continued in the future. It is also advisable to find a way how to test the hypotheses on microenterprises. The autocorrelation of investment spending in small companies should also be the subject of future studies.

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