Information Technologies in Modeling the Impact of the Economic Environment on the Performance of Companies*

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Abstract

The article investigates the use of information technologies to model the impact of the economic environment on the financial performance of companies (on the example of Adidas AG). The study is based on building an econometric model using EViews, which allows quantifying the impact of macroeconomic factors such as gross domestic product, inflation and unemployment on the income of Adidas AG. In the process of modeling, the least squares method was used, the significance of variables was assessed, and tests for autocorrelation, heteroscedasticity, normality of residuals distribution, and multicollinearity were performed. The results confirmed the high level of dependence of the company's financial results on the dynamics of the external economic environment. The practical value of the study is to substantiate the feasibility of introducing digital information systems to support financial forecasting and strategic management in the context of economic instability.

Keywords

information technology, econometric modeling, forecasting, macroeconomic factors, financial results, regression analysis, economic environment

1. Introduction

The current level of economic globalization is characterized by dynamism, instability and uncertainty. In such circumstances, the study of the impact of the economic environment on the performance of companies is of particular relevance. After all, a combination of macroeconomic factors determines business development opportunities, creates new risks, and creates certain limitations for strategic and tactical management.

In the context of digital business transformation, information technology (IT) plays a key role in ensuring the efficiency of management processes, analytics and strategic planning. The digital transformation of the economy requires companies to implement new data processing and financial analytics tools. This leads to the need to integrate information technology into the process of strategic analysis, planning and forecasting of performance. There is a significant number of studies confirming the importance of IT as a factor that directly affects the performance of enterprises and their adaptability to changes in the external environment.

In particular, the work of A. Keramati et al. [1] emphasizes that the level of maturity of IT solutions in a company is one of the determining factors of its ability to function effectively in a complex external environment. The authors emphasize that IT infrastructure in conjunction with

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the quality of business relations forms the prerequisites for increasing productivity and financial stability.

In turn, M. T. Bolívar-Ramos et al. [2] prove that IT contributes to the formation of the company's internal ability to absorb new knowledge and innovations. This, in turn, improves the financial performance of enterprises. Thus, information systems serve not only as an analysis tool but also as a means of organizational learning.

E. Clemons, R. Kauffman, T. Weber [3] consider information systems as a strategic asset that provides competitive advantages in the face of economic turbulence.

The study by Yang Zhou et al. [4] traces the relationship between the introduction of digital technologies and the innovation activity of companies. This demonstrates that enterprises that integrate IT into analytics and forecasting processes are more adaptable to changes in the economic environment, which is a key factor in ensuring stable financial results in the digital economy.

The paper "The Effect of Information Technology on Business and Marketing Intelligence Systems" [5] emphasizes the role of IT in providing business intelligence. By automating the collection, processing and interpretation of data, companies are able to respond to market changes in a timely manner, which increases the flexibility and sustainability of the business.

Particular attention should also be paid to the work of Nigel P. Melville et al. [6], which presents an integrative model of the value of IT for business. The authors offer a systematic vision of how information technology affects organizational efficiency through interaction with internal company resources and external factors.

Melinda Cline and Carl Stephen Guynes [7] analyzed the relationship between IT investments and financial results of companies. The authors conclude that the effectiveness of such investments largely depends on the ability of the enterprise to strategically integrate IT into its business processes.

Despite the existence of a significant number of scientific papers in this area, the issues of quantifying the impact of the economic environment on the financial results of companies remain insufficiently studied. That is why it is important to combine econometric analysis methods with modern digital modeling tools that allow for a more accurate assessment of the dependence of business indicators on external factors.

The aim of the study is to build a model using information technology to determine the degree of influence of key macroeconomic factors on the financial performance of companies (on the example of Adidas AG as a representative of international business operating in a highly integrated global economic environment).

The study applies a comprehensive methodological approach that includes the provisions of economic theory, system analysis, strategic management, and the use of information technology for modeling and forecasting. The practical value of the work lies in the possibility of using the built model as a tool for assessing business risks and developing strategies for adapting to changes in the global economic environment.

2. Research Results

In today's business environment and changing economic environment, it is necessary to understand how the dynamics of external economic factors affect the activities and financial results of an enterprise. For this purpose, a variety of methods and econometric tools are used.

It is a common practice to use regression analysis, which is carried out using the least squares method. Therefore, the study is based on the creation of a regression model of the impact of the external environment in the form of basic indicators of the state of the economy on the success and profitability of the company in the form of its income (on the example of Adidas AG). For modeling, the program EViews 8 was used.

The first step in building an econometric model is to put forward hypotheses that can be tested by modeling. Thus, the main assumptions that explain the logic of the regression are defined:

1. The impact of the external environment on the company can be characterized as the influence of basic macroeconomic indicators that outline the state of the world economy, such as gross domestic product (GDP), inflation and unemployment [8, 9], on one of the main indicators of the company's performance—total income in the form of net sales.

2. Global GDP is a reflection of the general state of the economy, its growth or decline, economic and business activity, and a source of development for business entities. If GDP in countries grows, it means that businesses have more opportunities to grow, increase efficiency, conduct business relations, and produce more and different products to meet the growing needs of consumers due to their better financial capacity [10]. Thus, the hypothesis is that with the growth of GDP in the world, the company has more favorable conditions for its operation, so it has a positive impact on the results of its activities and their growth.

3. The global consumer inflation rate reflects the growth of prices for goods and services, which limits the ability of the population to spend actively. If prices are rising rapidly, especially for basic foodstuffs with low elasticity of demand, consumers are less likely to spend money on branded sportswear and will prefer products of greatest need and utility. That is why another hypothesis was that inflation could negatively affect the company's sales.

4. An increase in the global unemployment rate can also affect the consumer capacity of business customers, because the lower the employment rate, the lower the financial security, stability and confidence of the population, which reduces their demand for products. In addition, companies may lose high-quality and productive labor, which will affect the efficiency and volume of production of goods and services. Thus, the final hypothesis is that rising unemployment has a negative impact on firm revenues.

The quantitative values of the indicators used in this model were collected from various sources. Information on Adidas AG's revenues was collected from one of the largest statistical databases, Statista [11]. Net sales figures cover the annual period from 2000 to 2022. The year 2023 was not taken into account because the company went through a major structural change, the result does not reflect the usual business trends, and therefore could worsen the quality of the model.

Macroeconomic indicators of global GDP, inflation and unemployment are taken from the World Bank's World Bank Open Data website, which in turn were collected from the national accounts of the World Bank and the Organization for Economic Cooperation and Development [12]. The time period is comparable to the object of the study and covers 2000-2022.

The model consists of a dependent variable—the company's total income—and three independent variables—factors that influence the dependent variable:

1. LOG(REV) is an indicator of income in the form of net sales of Adidas AG, in millions of euros, to which logarithmization was applied.

2. LOG(GDP) is a measure of total world GDP, in millions of dollars, to which logarithmization was applied.

3. INF is the global inflation rate measured by the consumer price index, the annual percentage change in the cost of purchasing a consumer basket of goods by an average consumer, %.

4. UNEMP is the global unemployment rate, the share of the labor force that is unemployed but ready and looking for work, % of the total labor force.

Taking into account these variables, the model is described by the following equation:

$$LOG(REV) = \beta_0 + \beta_1 LOG(GDP) + \beta_2 INF + \beta_3 UNEMP + u, \quad (1)$$

The modeling results are shown in Fig. 1. A number of coefficients were obtained and are presented in the Coefficient column. They reflect the change in the dependent indicator when the corresponding independent variables increase by one percent. Thus, it is possible to interpret how much the company's income changes when the three macroeconomic environment factors selected for the study increase by a basic unit in percentage terms.

Dependent Variable: LOG(REV)
Method: Least Squares
Sample: 1 23
Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-9.334519	1.863283	-5.009717	0.0001
LOG(GDP)	1.172691	0.081107	14.45851	0.0000
INF	-0.052271	0.014012	-3.730507	0.0014
UNEMP	-0.348260	0.092930	-3.747529	0.0014

R-squared	0.958226	Mean dependent var	9.409728
Adjusted R-squared	0.951630	S.D. dependent var	0.485810
S.E. of regression	0.106845	Akaike info criterion	-1.478098
Sum squared resid	0.216902	Schwarz criterion	-1.280621
Log likelihood	20.99813	Hannan-Quinn criter.	-1.428434
F-statistic	145.2750	Durbin-Watson stat	1.443891
Prob(F-statistic)	0.000000		

Figure 1: Results of the regression model

As can be seen from the results, with a 1% increase in GDP, the company's revenue positively changes by 1.17%. The hypothesis that global GDP growth has a positive impact on the company's financial results was confirmed. A 1% increase in the global inflation rate causes a 0.05% downward change in the group's revenue. Thus, the hypothesis that inflation has a negative impact on financial results was also confirmed. A 1% increase in global unemployment has a 0.34% downward effect on the company's total revenues. Thus, unemployment does have a negative impact on the company's performance. The results also show that the largest change in revenue occurs when GDP changes, and the smallest change is characterized by the impact of inflation.

The next step in modeling is to check the model for correctness using various tests available in EViews software.

In order to test the significance of the independent variables for the model, it is worth considering the p-values obtained. Fig. 1 shows that all the p-values in the Prob. column are close to zero and, accordingly, less than 5%. Therefore, we can conclude that the hypothesis that the coefficients are zero and therefore insignificant is rejected with a five percent confidence interval. In addition, we can observe a high value of the F-statistic, as well as a low p-value for this statistic. This indicates that the model is significant in general, all the coefficients are not equal to zero, and therefore the considered independent variables are significant factors influencing business performance.

If we consider the aspect of the level of explanation of the model, it is worth evaluating the determination indicators. This group includes the R-squared and Adjusted R-squared coefficients, which are more appropriate for use. In the resulting model, these indicators are 95.8% and 95.1%, respectively. These measurements mean that the object of study is more than ninety-five percent explained by changes in the regression factors, namely its independent variables. Thus, macroeconomic factors largely explain changes in the main indicator of the company's income.

To check the correctness of the model, it is also necessary to conduct tests for the presence/absence of autocorrelation, homoscedasticity, normality of distribution, and multicollinearity.

In order to determine whether there is autocorrelation in the model, we used the EViews functionality in the form of the Breusch-Godfrey Serial Correlation LM Test. It allows to detect the presence of autocorrelation of different orders. The null hypothesis is that there is no autocorrelation. Fig. 2 shows the test results; for reliability, we chose more than the automatically suggested number of orders (2), namely 4. Considering the Prob. Chi-Square, as well as individual p-values from the first to the fourth orders, we can see that the probabilities both in general and individually for each order are at a high level, more than 5%. This means that the null hypothesis of no autocorrelation of these orders cannot be rejected and should be accepted, so the regression is adequate.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.732939	Prob. F(4,15)	0.5836
Obs*R-squared	3.760389	Prob. Chi-Square(4)	0.4394

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Sample: 1 23
Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.245260	1.949772	-0.125789	0.9016
LOG(GDP)	0.006383	0.084187	0.075821	0.9406
INF	0.004943	0.015590	0.317091	0.7555
UNEMP	0.018199	0.100295	0.181455	0.8584
RESID(-1)	0.324216	0.271363	1.194768	0.2507
RESID(-2)	-0.239396	0.292916	-0.817287	0.4266
RESID(-3)	-0.133684	0.313379	-0.426590	0.6757
RESID(-4)	-0.028053	0.272472	-0.102957	0.9194

R-squared	0.163495	Mean dependent var	-6.20E-15
Adjusted R-squared	-0.226874	S.D. dependent var	0.099294
S.E. of regression	0.109982	Akaike info criterion	-1.308795
Sum squared resid	0.181440	Schwarz criterion	-0.913841
Log likelihood	23.05115	Hannan-Quinn criter.	-1.209465
F-statistic	0.418822	Durbin-Watson stat	1.935169
Prob(F-statistic)	0.875766		

Figure 2: Autocorrelation testing

In addition, we analyzed the absence of heteroscedasticity of the model's random variables. For this purpose, the Heteroskedasticity Test: White was applied (Fig. 3). The results showed positive

values, as all p-values are greater than 5%. This indicates that there are no grounds to reject the null hypothesis of homoscedasticity of random variables, so the test was correct.

Heteroskedasticity Test: White

F-statistic	0.707986	Prob. F(9,13)	0.6935
Obs*R-squared	7.565250	Prob. Chi-Square(9)	0.5785
Scaled explained SS	4.544429	Prob. Chi-Square(9)	0.8721

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Sample: 1 23
Included observations: 23

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-27.67369	17.53330	-1.578351	0.1385
LOG(GDP)^2	-0.015465	0.038047	-0.406474	0.6910
LOG(GDP)*INF	-0.047267	0.024412	-1.936256	0.0749
LOG(GDP)*UNEMP	-0.148092	0.079572	-1.861112	0.0855
LOG(GDP)	1.634886	1.503727	1.087223	0.2967
INF^2	-0.001333	0.001063	-1.254337	0.2318
INF*UNEMP	-0.028547	0.015409	-1.852654	0.0868
INF	1.036505	0.526052	1.970349	0.0705
UNEMP^2	-0.067899	0.052759	-1.286978	0.2205
UNEMP	3.610881	1.998310	1.806967	0.0940

R-squared	0.328924	Mean dependent var	0.009431
Adjusted R-squared	-0.135667	S.D. dependent var	0.012794
S.E. of regression	0.013634	Akaike info criterion	-5.453440
Sum squared resid	0.002417	Schwarz criterion	-4.959746
Log likelihood	72.71455	Hannan-Quinn criter.	-5.329277
F-statistic	0.707986	Durbin-Watson stat	2.677650
Prob(F-statistic)	0.693508		

Figure 3: Heteroscedasticity testing

We assessed the normality of the distribution of residuals in the model. For this purpose, we used the Normality Test, or the Jarque-Bera test for the normality of the residuals distribution. The results are shown in Fig. 4. The null hypothesis is the presence of a normal distribution. Probability shows a high value (43%), which means there is no reason to reject the hypothesis. This means that the distribution of the residuals is normal. This can also be seen by the similarity to the graph shape characteristic of a normal distribution.

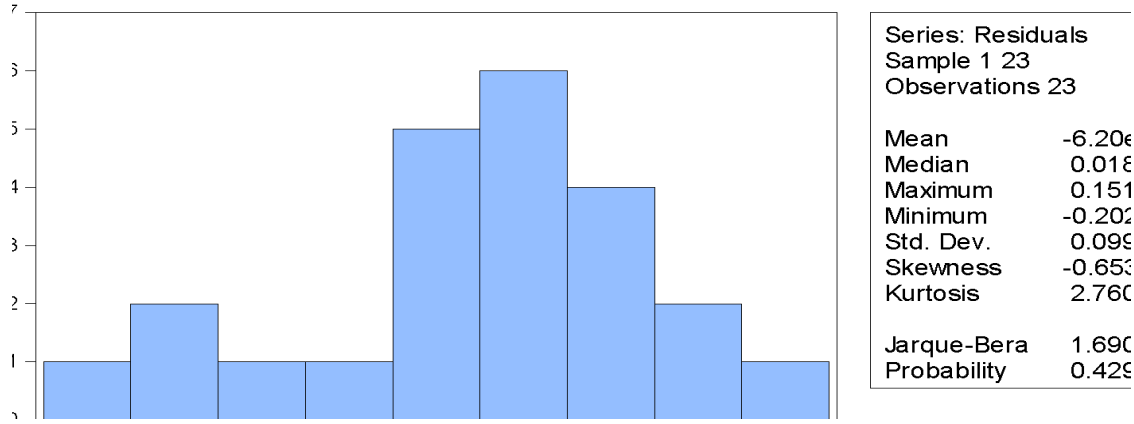

Figure 4: Testing the normality of the distribution

To test the phenomenon of multicollinearity, we used the correlation matrix between the variables in the model (Table 1). Its values are acceptable and do not indicate too high a level of strong correlations. It can be concluded that multicollinearity does not pose a risk to the model.

Table 1
Multicollinearity testing

	REV	GDP	INF	UNEMP
REV	1.000000	0.943100	-0.148334	-0.644156
GDP	0.943100	1.000000	-0.016943	-0.573362
INF	-0.148334	-0.016943	1.000000	-0.357286
UNEMP	-0.644156	-0.573362	-0.357286	1.000000

Thus, a regression model of the impact of factors of the external dynamic environment on the results of its activities in the form of income is built. The independent variables of GDP, inflation, and unemployment are chosen as macroeconomic factors. The resulting model has significant coefficients, a high level of explanation and positive adequacy tests.

The above factors do have a significant impact on the object of study. This indicates that the company is quite dependent on changes in the external economic environment. This result potentially poses significant threats, because the stronger such dependence is, the more the company will experience negative trends in the external environment, crises, economic downturns, etc. High interconnectedness means less independence from external factors, which is dangerous for the company's ability to function effectively in difficult periods. This problem will affect the company's financial position, profitability, liquidity, solvency, and, accordingly, the confidence and willingness of investors to invest in the company.

3. Discussion

The results of modeling the impact of the external economic environment on the financial performance of Adidas AG confirmed the hypotheses regarding the importance of macroeconomic factors such as GDP, inflation and unemployment. The high correlation between the change in global GDP and the company's revenues indicates the sensitivity of the business to the phases of the economic cycle, which is especially important for globalized enterprises focused on consumer markets.

The negative impact of inflation and unemployment on the company's financial results indicates that consumer demand is highly dependent on overall economic stability. Rising inflation reduces

the purchasing power of the population, while rising unemployment affects both demand and the efficiency of the company itself due to the loss of productive staff.

The use of information technology, in particular the EViews software, allowed us to implement a qualitative approach to building an econometric model. This ensured the accuracy of the results and the possibility of conducting additional tests for correctness, which confirmed the reliability of the model. The use of information systems to analyze the relationships between macroeconomic variables and financial results of a business demonstrates the effectiveness of digital tools in financial analytics.

Based on the results obtained, recommendations can be offered to increase the adaptability of companies to changes in the external environment. Such measures include the introduction of a system for monitoring macroeconomic indicators in real time, adaptation of pricing policy in accordance with changes in purchasing power, and diversification of sales markets to reduce the risks associated with regional economic fluctuations.

Thus, the results of the study confirm the feasibility of using information and analytical systems to support decision-making in the strategic management of enterprises operating in an unstable economic environment.

Conclusion

In the course of the study, the author modeled the impact of certain macroeconomic factors of the external environment on the financial performance of the company on the example of Adidas AG. The built regression model with the use of information technology allowed to quantify the dependence of the company's income on changes in gross domestic product, inflation and unemployment.

The modeling results confirmed the hypotheses: GDP growth has a positive effect on company revenues, while rising inflation and unemployment have a negative effect. This indicates a high sensitivity of business to the dynamics of the external economic environment, which is important for international companies integrated into global markets.

The use of information technology, in particular EViews software, has proven to be effective in financial analysis and forecasting. In today's environment, information systems play a key role in building analytical models. Software such as EViews allows not only to perform regression analysis, but also to integrate the results into business intelligence, providing a quick response to changes in the macroeconomic environment.

The practical significance of the work is to create an analytical framework for making strategic management decisions using digital tools. The proposed model can be used as a tool for risk assessment, business adaptation to changes in the external environment, and increasing the financial stability of enterprises.

In the future, it is advisable to use artificial intelligence technologies, in particular machine learning models, which can improve the accuracy of forecasts by identifying hidden patterns in large amounts of data. Such approaches can complement classical econometric models in a highly volatile environment.

Declaration on Generative AI

While preparing this work, the authors used the AI programs Grammarly Pro to correct text grammar and Strike Plagiarism to search for possible plagiarism. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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