GOSPODARKA NARODOWA

4(320)2024, 74–92
DOI: 10.33119/GN/190908
gnpje.sgh.waw.pl
SGH

The Polish Journal of Economics

Istnieje od / Published since 1931

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Macroeconomic Determinants of Investment Decisions for Medium and Large Enterprises in Poland's Manufacturing Sector

Makroekonomiczne determinanty decyzji inwestycyjnych średnich i dużych przedsiębiorstw sektora przetwórstwa przemysłowego w Polsce

Abstract

This article examines how fluctuations in macroeconomic indicators influence companies' propensity to invest, gauged by the investment intensity index – defined as the ratio of investment expenditures to total revenue. The analysis focuses on the five most revenue-generating sectors within Poland's manufacturing industry, as defined in the Polish Classification of Activities (PKD). Using unpublished Statistics Poland (GUS) quarterly panel data from 2008 to 2022, sourced from the F-01 and F-02 reports, the research targets medium and large companies. Cointegration analysis and the Vector Error Correction Model (VECM) are employed to identify macroeconomic indicators that consistently impact the propensity to invest in specific sectors, while also assessing the presence of investment seasonality. The findings reveal a strong long-term correlation between corporate investments and macroeconomic indicators, capturing both enduring equilibria and transient fluctuations. Significantly, the research uncovers varied macroeconomic impacts on investment decisions, with GDP and SP emerging as pivotal in the chemical sector (PKD-20), and temporal and inter-sectoral dynamics notably influencing the computer and electronics sector (PKD-26). These insights highlight the complexity of macroeconomic effects on investment strategies within Poland's industrial landscape.

Keywords:
Poland, cointegration, medium and large company, manufacturing sector, Vector Error Correction Model

JEL classification codes:
C32, E20, E60, G30, L60

Article history:
submitted: November 22, 2023
revised: May 24, 2024
accepted: July 8, 2024

Streszczenie

Artykuł ma na celu ustalenie wpływu fluktuacji wskaźników makroekonomicznych na skłonności inwestycyjne przedsiębiorstw, mierzone wskaźnikiem intensywności inwestycji – zdefiniowanym jako stosunek wydatków inwestycyjnych do całkowitych przychodów. Analiza obejmuje pięć sektorów przemysłu przetwórczego w Polsce (według Klasyfikacji Działalności PKD) generujących największe przychody. Wykorzystując niepublikowane panelowe dane kwartalne GUS z lat 2008–2022 pochodzące z badań F-01 i F-02, w badaniu skoncentrowano się na średnich i dużych przedsiębiorstwach. Zastosowanie analizy kointegracji oraz modelu wektorowej korekty błędu (VECM) pozwala na określenie wskaźników makroekonomicznych,

Słowa kluczowe:
Polska, kointegracja, średnie i duże przedsiębiorstwo, sektor przemysłu przetwórczego, model wektorowej korekty błędu

Kody klasyfikacji JEL:
C32, E20, E60, G30, L60

Historia artykułu:
nadesłany: 22 listopada 2023 r.
poprawiony: 24 maja 2024 r.
zaakceptowany: 8 lipca 2024 r.

które trwale wpływają na skłonności inwestycyjne w poszczególnych sektorach. Badanie pozwoliło również stwierdzić sezonowość inwestycji w tych sektorach, ujawnić głęboką długoterminową korelację między inwestycjami korporacyjnymi a wskaźnikami makroekonomicznymi oraz uchwycić zarówno trwałe równowagi, jak i przejściowe fluktuacje. Co istotne dowiedziono w nim zróżnicowany wpływ makroekonomii na decyzje inwestycyjne z PKB i SP jako kluczowymi elementami w sektorze chemicznym (PKD-20) oraz to, że dynamika czasowa i międzysektorowa wyraźnie wpływa na sektor komputerów i elektroniki (PKD-26). Te spostrzeżenia dowodzą złożoności efektów makroekonomicznych w kontekście strategii inwestycyjnych funkcjonujących w ramach przemysłowej struktury Polski.

Introduction

Enterprises play a key role in the economic landscape, acting as catalysts for job creation, fostering innovation, and significantly contributing to economic growth, development, and standard of living at both the local and regional levels [**Alperovych et al., 2019**; **Audretsch, 2018**; **Bloch and Bhattacharya, 2016**; **Zając et al., 2021**]. Their influence on economic growth is evident across various countries, regardless of differences in economic, social or cultural development [**Ordeñana et al., 2019**]. However, managers and entrepreneurs now face unprecedented levels of transformation, scale and complexity in the global environment [**Korzyński, 2014**]. Industry professionals argue that conventional management theories yield effective outcomes during periods of stability, yet they often fall short in uncertain environments [**Korzyński et al., 2023**]. The pandemic crisis demonstrated that enterprises can quickly adapt to changing conditions, even integrating outsiders into the ideation and development process while allowing consumers to play a central role from start to finish [**Karaś, 2020**]. The economic security of enterprises is vital for their sustainable development and overall economic health [**Ianioglo, Põlajeva, 2016**]. Large enterprises, in particular, play a crucial role in the economic landscape, acting as engines of growth, innovation, and stability. **Smyth** [**2000**] argues that large-scale enterprises have been pivotal for sustained growth in China, suggesting a similar potential for Poland's industrial sector. **Varum and Rocha** [**2013**] note that while larger firms are more vulnerable during economic downturns, they provide a stabilizing force in the European Union's economy. **Harvey and Jones** [**1992**] posit that the success of large enterprises is central to the competitiveness of corporate economies. **Ahrend and Martins** [**2003**] highlight the contribution of SMEs to employment and export growth, but assert that large enterprises remain dominant in the economy. **Barrow and Hall** [**1995**] find that large multinationals have a generally positive impact on local economies, underscoring their significant role in economic development. The sustainable development of enterprises is crucial, particularly in times of economic fluctuation [**Guo et al., 2020**].

The importance of investment can be considered at both the micro and macroeconomic levels. From the perspective of an individual enterprise, which aims to maximise the benefits for its owners [**Dresler, Czekaj, 2016**], investment is essential. Undertaking investments is necessary for surviving in a changing environment, ensuring company development, increasing value, generating profit, and capturing market shares [**Sierpińska, Jachna, 2007**]. Investing is an obligation for every enterprise operating in the modern market economy, regardless of the type of production or services provided [**Michalak, 2007**]. For investments to bring benefits to a company, they must be an integral part of its operations. There is a series of correlations between investment and strategic planning in enterprises [**Walica, 1999**]. Through investments, companies can improve their competitiveness, economic, and financial position. In a market economy, competitiveness is a condition for the functioning and development of enterprises [**Janik, Gałązka, 2014**]. Maintaining and strengthening a competitive position requires regular investment outlays. Moreover, investments that enhance a company's competitiveness contribute to improving macroeconomic indicators in the long term [**Szymczak, 2017**]. In a macroeconomic perspective, investments also play a vital role, with investment fluctuations influencing aggregate demand and

national income. Moreover, in the long term, they increase the production capacity of the economy and lead to growth in potential production [**Milewski, Kwiatkowski, 2005**]. Investment decisions taken by companies are of paramount importance, shaping the trajectory and future prospects of the organisation, directly influencing its growth and sustainability. **King** [**1974**] argues that investment significantly influences the direction and structure of a company, with decisions related to organisational change, product-market stance, and research and development often stemming from or resulting in capital investment.

Macroeconomic variables have a multifaceted influence on investment decisions, significantly determining companies' investment decisions. **Tokuoka** [**2012**] provided evidence that macroeconomic factors can largely explain corporate investment, emphasising the role of the business environment. **Mlambo and Oshikoya** [**2001**] highlighted the significance of fiscal, financial, and monetary policy, as well as macroeconomic uncertainty and trade variables, in determining private investment. **Rashid and Saeed** [**2017**] point out that understanding how firm-specific and macroeconomic uncertainties influence investment decisions can inform policies to encourage investment during economic downturns. **Białowolski and Węziak-Białowolska** [**2014**] note that the importance of macroeconomic and law-related factors in investment decisions is heightened among companies facing significant investment reductions. **Grundy and Johnson** [**1993**] emphasise that major investment decisions shape strategic change in complex organisations. **Männasoo and Maripuu** [**2015**] observe that macroeconomic fluctuations impact a company's performance and, by extension, its investment decisions. **Fernández-Gámez et al.** [**2020**] argue that while financial variables are important, macroeconomic and regulatory factors in the countries where companies operate play a significant role. **Aytürk** [**2017**] notes that government borrowing, firm-specific factors and other macroeconomic variables are significant for corporate financing decisions. **Farla** [**2014**] provides a counterpoint, suggesting that firms' investment behaviour shows little dependence on a country's macroeconomic setting. **Issah and Antwi** [**2017**] recommend incorporating macroeconomic conditions when predicting firms' performance.

Empirical studies on Polish enterprises, particularly in the manufacturing sector, have provided valuable insights into the macroeconomic determinants of investment decisions. **Cieślik** [**2019**] highlights the vertical motive for foreign direct investment in Poland by OECD-based firms, while a subsequent study by the same author [**Cieślik, 2020**] identifies market access and efficiency seeking as primary reasons for investment from new EU member states. **Sytnik et al.** [**2019**] developed a model to assess macroeconomic factors influencing investment potential in Polish enterprises. **Walkenhorst** [**2004**] found diversity across manufacturing industries in Poland regarding factors influencing foreign investment activities. **Sachpazidu-Wójcicka** [**2017**] reported a gap in patenting and implementing highly novel innovations among Polish industrial firms. **Lisowski et al.** [**2021**] observed that only certain macroeconomic parameters correlate with investment in Poland's energy sector. These studies collectively underscore the complexity of investment decision-making in Poland's manufacturing sector, influenced by both internal firm dynamics and the broader macroeconomic environment.

Our study seeks to fill a gap in the literature by examining the macroeconomic determinants of investment decisions in medium and large enterprises within the manufacturing sector, focusing on five specific subsectors. While general research on investment behaviours influenced by macroeconomic factors is available, there is a distinct lack of studies centred on medium and large enterprises, including within the Polish economy. Most existing studies tend to focus on micro and small companies. To offer a long-term perspective, our research uses a dataset spanning from 2007 to 2022. By applying the VECM model, which incorporates a broader range of macroeconomic variables, we provide a comprehensive analysis of how the economic environment influences investment decisions in these larger enterprises. The findings from this study are expected to contribute valuable insights for other researchers and practitioners in the field.

The structure of the paper is as follows: The next section presents a literature review. Then, the methodology section outlines the study's aim, describes the data, and explains the research methods used. The subsequent section reports the empirical findings and provides a detailed discussion. Finally, we offer our conclusions.

Literature review

Macroeconomic conditions play an important role in the investment decisions of enterprises. The perceived stability and predictability of the incentive structure and the macroeconomic policy environment are important factors in investment decision making. Economic literature has explored various approaches to understanding which factors influence investment decisions and to what extent [**Białowolski, Węziak-Białowolska, 2014**]. Our analysis focuses on the following macroeconomic determinants of enterprise investment decisions: GDP growth, domestic demand, final consumption expenditure, public consumption, household consumption expenditure, gross capital formation, exports, imports, exchange rates, wage dynamics, interest rates, energy price changes, and the unemployment rate. Below, we provide a critical literature review on how these macroeconomic factors affect corporate investment decisions.

The nexus between GDP and enterprise investment is a critical area of study in macroeconomic research. GDP growth is a key determinant of investment decisions, and a growing GDP typically signals a healthy economy, encouraging firms to invest in new projects and expand existing ones in anticipation of increased demand for goods and services. Economic expansion fosters a positive business environment, boosting confidence among enterprises in future stability [**Barro, 1990**; **Mankiw, 2010**]. Research has demonstrated that factors such as labour, fixed capital formation, and foreign direct investment have a positive impact on GDP growth, as evidenced by panel regression models. GDP growth, in turn, encourages corporate investment [**Sepehrdoust, Shabkhaneh, 2018**]. A study employing multivariate growth regressions to investigate the factors behind Africa's recent economic recovery identified investment as a primary driver of economic growth, with private sector access to credit and government effectiveness also playing crucial roles [**Mijiyawa, 2013**]. These findings suggest that a secure environment for private sector investment, supported by sound macroeconomic policies, can lead to faster growth at a given investment rate [**Bleaney, 1996**]. Additionally, strong GDP growth is often associated with low interest rates, making borrowing cheaper for businesses, facilitating larger investments and leading to potentially higher returns [**Mishkin, 2016**]. However, the relationship between GDP growth and investment can be shaped by a variety of factors, including government policies, market conditions, and global economic scenarios [**Romer, 2012**].

The influence of domestic demand on enterprise investment decisions is well documented in economic literature. **Blanchard et al.** [**2017**] observe that an uptick in domestic demand often prompts enterprises to ramp up investment to meet growing consumer expectations and preferences. **Mankiw** [**2015**] similarly reports that a surge in domestic demand fosters an environment conducive to new projects and ventures, as enterprises anticipate sustained higher sales. Moreover, firms are more likely to invest during periods of increased domestic demand, given that favourable economic conditions often reduce investment risks, as noted by **Aghion et al.** [**2010**]. According to a recent study by the International Monetary Fund [**Kopp et al., 2019**], the standard accelerator model of investment predicts increased corporate investment when opportunities arise for higher sales. The study found that rising domestic demand has been the principal driver of corporate investment since 2017, with business growth largely fuelled by private sector expectations of future product demand.

Final consumption expenditure refers to the total spending by resident institutional units on goods or services that directly meet individual or community needs or desires. This expenditure is broadly classified into two segments: private and public consumption. Private consumption includes household sector spending and expenses by non-profit institutions serving households, while public consumption covers expenditures by the general government sector. Final consumption expenditure is a pivotal macroeconomic variable that influences enterprise investment decisions.

Research shows that an increase in public consumption within a simple endogenous growth model can spur economic activity, creating fertile ground for private investment [**Barro, 1990**]. Additionally, **Aschauer** [**1989**] argues that government expenditure on infrastructure can enhance private sector productivity, thereby encouraging enterprises to invest. Governments can thus strategically use public consumption to foster an environment conducive to business investment [**Afonso, Sousa, 2012**]. **Pérez-Montiel and Manera Erbina**

[2019] advocate for incentivising final public expenditure, as it supports the long-term relationship between private decisions to consume and invest.

Household consumption expenditure accounts for a substantial portion of aggregate demand, and its fluctuations are closely monitored by businesses as a signal of economic health and consumer confidence. When household consumption rises, firms anticipate higher demand for their products, which can lead to increased investment in capital to expand production capacity. Conversely, a decline can signal a contraction in demand, prompting firms to reduce investment. **Bhatia and Mitchell** [2016] suggest that household consumption expenditures rise with increased capital gains on housing, indicating that household wealth and spending power can drive investment. **Fiebiger** [2018] points out that household investment and consumption expenditures are critical in shaping post-WWII US business cycles, highlighting their independent role in economic fluctuations. **Zhang and Guo** [2020] note that household investment can have a crowding-out effect, but this is mitigated by household income, which suggests that consumption can still promote investment under certain conditions.

Gross capital formation is a fundamental macroeconomic determinant influencing enterprise investment decisions, acting as both a measure and driver of economic growth. **Boamah et al.** [2018], using panel data from 1990 to 2017, found that gross fixed capital formation [GFCF] positively affects economic growth, which in turn can create a conducive environment for enterprise investment. **Amighini et al.** [2017] highlighted the positive impact of foreign direct investment on total investment, particularly in manufacturing, which is closely linked to GFCF. **Zaidi et al.** [2019] noted that economic growth and GFCF positively impact financial development, further facilitating enterprise investment. **Ruggles and Ruggles** [1992] pointed out that enterprise saving and capital formation in the United States have been significant, indicating a strong relationship between internal capital accumulation and investment activities. **Kitao** [2008] suggested that reducing the tax burden on capital formation stimulates investment, emphasising the role of fiscal policy in shaping investment decisions. **Bayer** [2008], using panel data containing 694 companies and covering the 1960–1997 period, found that while finance has a limited long-term impact on the capital stock, it significantly influences investment decisions, particularly in German firms.

Investment decisions are also influenced by a country's trade policies and international agreements. Firms strategically invest in avenues that allow them to leverage the benefits of favourable trade terms and agreements [**Helpman et al., 2004**]. Moreover, the uncertainty in international markets, induced by fluctuations in the trade balance, can affect investment decisions as firms often rely on stable and predictable trade environments to plan their investment [**Handley, Limão, 2017**]. Exports can stimulate investment as firms might opt to expand their production capabilities to meet the demands of foreign markets, which can potentially offer higher revenue streams. This expansion might involve substantial investment in technology, human resources, and infrastructure to improve the competitiveness of their goods or services in international markets [**Melitz, 2003**]. **He and Huang** [2021] demonstrate that exports can stimulate firms to invest more in innovation, improving energy efficiency and environmental performance. **Montobbio and Rampa** [2005] highlight that in both high-tech and low-tech sectors, export performance is influenced by the growth of technical capabilities and foreign direct investment. **Liu and Lu** [2015] show that firm investment significantly increases the likelihood of exporting due to the positive effect on productivity. **Ottaviano and Volpe Martincus** [2009] find that investment in product improvement is associated with a higher probability of exporting. **Esaku** [2020] notes that exporting experience influences a firm's decision to invest, likely as a means to upgrade production technology.

On the other hand, an increase in imports may prompt domestic firms to invest more in R&D to maintain a competitive edge, or it might lead to reduced investment if enterprises find it more feasible to import goods rather than produce them domestically [**Grossman, Helpman, 1991**]. **Gonchar and Kuznetsov** [2018] found that importing has a more significant impact on product innovation than process innovation, with firms' decisions to invest in innovation and imports being influenced by their location, technology position,

import competition, and R&D efforts. **Yang et al. [2004]** highlighted the importance of technology imports and training investment for small firms, suggesting that external technological sources are crucial for developing technological capabilities. **Siedschlag and Yan [2021]** observed that larger firms and importers are more likely to invest in pollution control and cleaner technologies. **Li et al. [2018]** examined the joint effect of imports and inward foreign direct investment on domestic firms' capital investment decisions.

Firms engaged in international business must carefully monitor and manage the potential risks and opportunities presented by fluctuations in exchange rates. A depreciation of the domestic currency can make a country's exports cheaper and potentially boost the competitiveness of domestic firms in foreign markets, encouraging investment in production and expansion capacities. Conversely, a stronger domestic currency can increase the cost of exported goods but reduce the cost of imported inputs, which can, in turn, influence the firm's decision on where to allocate investments. **Swift [2006]** found that the effects of exchange rates on investment vary with the firm's engagement in international trade, where a higher export share amplifies the positive impact, while a higher import share dampens it. **Mohamed and Youssef [2004]** observed that exchange rates and firms' capacity levels significantly affect their production, distribution, and investment decisions. **Nucci and Pozzolo [2001]** reported that the impact of exchange rate fluctuations on investment is more pronounced for firms with low monopoly power and those facing high import penetration. **Sercu and Vanhulle [1992]** suggested that increased exchange rate volatility could positively affect the value of exporting firms and make exporting more attractive than direct investment. Meanwhile, **Lee [2017]** found that the impact of exchange rates on firm investment through the export channel is insignificant, while the import channel is significant, indicating that currency appreciation may not necessarily reduce a firm's investment level. **Lotfalipour et al. [2013]** identified a negative impact of real exchange rate movements on manufacturing investment. **Atella et al. [2003]** argued that a stable exchange rate incentivises investment by allowing a more reliable estimation of its marginal productivity. Moreover, exchange rate volatility can create uncertainty and deter investment due to an increased risk of cross-border transactions [**Aghion et al., 2009**]. Furthermore, exchange rate changes can affect the financial performance of firms, altering their capacity to invest. For instance, firms may face issues with debt servicing during periods of adverse exchange rate movements [**Allayannis, Ofek, 2001**].

Wages constitute a significant portion of the operational costs in many enterprises and consequently play a crucial role in determining investment decisions. An increase in wage levels may deter investment as it raises the cost of labour, potentially reducing the profitability of investment projects [**Nickell, Nicolitsas, 1999**]. On the other hand, higher wages can sometimes stimulate investment, as they increase the purchasing power of consumers, thereby potentially leading to an increase in the demand for the company's products or services [**Draca et al., 2011**]. Furthermore, offering higher wages can also be a strategy to attract skilled labour, which can enhance productivity and innovation, potentially yielding higher returns on investment in the long term [**Edmans, 2012**]. Therefore, the impact of wages on enterprise investment decisions is multifaceted and influenced by a myriad of factors, including the industry in which the enterprise operates, the skill level of its workforce, and the broader economic context. It is essential for enterprises to carefully consider the potential implications of wage changes on their investment decisions to strategically navigate their operational dynamics in a competitive marketplace.

Interest rates critically affect the investment decisions of enterprises. A fundamental economic principle posits that when interest rates are low, borrowing costs are also low, encouraging firms to take out loans for investment in various projects that can potentially enhance their production and operational capabilities [**Chirinko, 1993**]. Higher interest rates, conversely, tend to dampen investment as the cost of borrowing rises, potentially stifling business expansion and innovation [**Fazzari et al., 1988**]. Beyond affecting the cost of borrowing, interest rates also have implications for the discount rates used in investment appraisal, influencing the perceived profitability of potential investment [**Modigliani, Miller, 1958**]. Empirical studies have demonstrated that there is a negative relationship between interest rates and investment: when interest rates rise, investment falls and vice versa [**Bernanke, Gertler, 1995**]. **Suyuan and Khurshid [2015]** reported a complex

relationship where interest rates negatively affected investment in the long term but positively in the short term. **Ang [2009]** found that interest rate controls had a positive impact on private investment.

The literature underscores the significant impact of energy prices on the investment decisions of enterprises. **Ratti et al. [2011]** found that a 1% increase in real energy prices could lead to a 1.9% decrease in manufacturing investment. **Yoon and Ratti [2011]** observed that energy price uncertainty makes firms more cautious, dampening the responsiveness of investment to sales growth, especially for high-growth firms. **Ai et al. [2020]** suggest that while higher industrial electricity prices increase energy costs, they may also incentivise enterprises to innovate and improve efficiency. **Lin and Moubarak [2014]**, as well **Sadath and Acharya [2015]**, indicate that rising energy prices weaken the sales-growth-investment relationship due to firms' cautious investment approaches. **Uri [1980; 1981]** asserts that energy prices are increasingly important in explaining investment decisions.

The relationship between unemployment rates and enterprise investment decisions is multifaceted. **Husson [2013]** suggests that higher unemployment can be counterbalanced by financialisation, which affects investment rates. **Oesch [2010]** indicates that investment in labour market policies can reduce unemployment, potentially affecting investment decisions. **Jackman et al. [1990]** and **Bernoth and Colavecchio [2014]** highlight the impact of labour market policies and the economic environment on investment activities.

The literature offers various models that explain changes in corporate investment. The Sraffian supermultiplier model combines a neo-Kaleckian growth and distribution model with the Sraffian supermultiplier mechanism, demonstrating that a decrease in the propensity to save and a change in income distribution favouring labour lead to higher average rates of production growth and capital accumulation in the long term [**Nah, Lavoie, 2017**]. It is a stock-flow consistent model that represents a closed economy without the government sector, with workers and capitalist households, where only the latter are not credit-constrained [**Teixeira, Petrini, 2023**; **Deleidi, Mazzucato, 2019**]. The economic framework emphasises the role of demand in driving investment and economic growth [**Haluska et al., 2021**; **Freitas, Christianes, 2020**]. The model includes two non-capacity-creating autonomous expenditures: residential investment and capitalist consumption, with the residential investment growth rate responding to changes in house price inflation. The model adheres to the main results of the standard Sraffian supermultiplier growth model, with numerical simulations reproducing stylised facts, such as residential investment leading the business cycle and capital accumulation [**Teixeira, Petrini, 2023**; **Deleidi, Mazzucato, 2019**]. The Sraffian supermultiplier model accounts for both the multiplier and accelerator effects, and different types of fiscal policies, including "mission-oriented" ones, have the potential to generate positive effects on investments and output growth. The model highlights that growth is led by autonomous demand components, with private productive investment being an induced expenditure, and income distribution being exogenous [**Freitas, Serrano, 2015**]. The Kaldor-Verdoorn law describes a positive but less than one-for-one causal relationship between the growth of output and labour productivity [**Basu, Budhiraja, 2021**]. It is introduced within a neo-Kaleckian model of growth and distribution, incorporating the Sraffian supermultiplier mechanism [**Nah, Lavoie, 2019**]. Studies have found that the Kaldor-Verdoorn coefficient lies between 0 and 1, indicating a positive relationship between output growth and labour productivity growth, but not a one-to-one relationship [**Basu, Budhiraja, 2021**; **Gabrisch, 2021**]. The Kaldor-Verdoorn coefficient is influenced by factors such as the elasticity of factor substitution, labour supply elasticity, profit share, and increasing returns to scale [**Basu, Budhiraja, 2021**]. The law suggests that demand dynamics, rather than adverse technological progress, drives productivity dynamics [**Gabrisch, 2021**]. The law has been tested in various contexts, including the impact of robotisation on labour productivity growth and its relevance to economic growth and development in specific regions [**Borsato, Lorentz, 2023**]. The Bhaduri-Marglin model explores the relationship between income distribution and growth within post-Keynesian macroeconomic theory [**Pariboni, 2016**]. The model suggests that income distribution affects aggregate demand, leading to wage- or profit-led growth regimes [**Molero-Simarro, 2015**; **2017**]. Long-run capital accumulation is influenced by the interrelations between external demand, profits, and capacity uti-

lisation in firms [**Araujo, Moreira, 2021**; **Hartwig, 2014**]. The model's treatment of investment has been critiqued, with doubts raised about the independent long-run influence of the profit rate on investment [**Pariboni, 2016**]. Models discussed in the literature cited above provide an alternative closure for the heterodox analysis of economic growth [**Serrano, Freitas, 2017**].

The comprehensive review of literature examining the influence of macroeconomic determinants on enterprise investment decisions underscores the criticality of these factors for medium and large enterprises within Poland's industrial processing sector. These studies collectively illuminate the complex interplay between the wider economic climate and individual firm investment choices, emphasising the necessity for businesses to integrate macroeconomic insights into their strategic planning and decision-making processes.

In selecting the macroeconomic variables for the study, we aim to cover a comprehensive range of factors influencing investment decisions, particularly from the perspective of medium and large enterprises within Poland's manufacturing sector. GDP growth, domestic demand, and final consumption expenditure, including public and household consumption, are considered key indicators of economic strength and consumer confidence, which directly affect corporate investment levels. Gross capital formation reflects the aggregate amount of resources invested in adding to the economy's capital stock, providing a clear picture of investment trends. Exports and imports are included in the analysis to assess the impact of foreign trade dynamics on investment. At the same time, exchange rates were considered due to their influence on the cost of foreign investment and earnings. Wage dynamics and changes in energy prices were chosen to evaluate the effects of labour market conditions and energy cost fluctuations on investment decisions. Interest rates are taken as a cost factor for corporate financing, and the unemployment rate indicates overall economic health and labour market tightness. These variables help provide a comprehensive view of the macroeconomic landscape that medium and large enterprises must navigate when making investment decisions.

Methodology

This study aims to examine how fluctuations in macroeconomic indicators influence the investment propensity of companies in Poland's manufacturing sector. The analysis traces the impact of selected macroeconomic factors, including GDP growth, domestic demand, final consumption expenditure, public consumption, household consumption expenditure, gross capital formation, exports, imports, exchange rates, wage dynamics, interest rates, changes in energy prices, and the unemployment rate. The research is based on an analysis of investment levels in selected groups of companies from 2008 to 2022, considering variables such as the value of investment outlays and total revenues. Based on this data, an investment intensity index was calculated to evaluate the investment activity of the examined companies. This economic indicator is defined as the ratio of investment outlays to the total revenue generated by the analysed entities.

Financial efficiency indicators for the analysed companies from five subsectors were calculated using unpublished data from the state-run Statistics Poland (GUS) agency. These data were sourced from companies legally required (under a law passed by Poland's parliament in 1995) to submit their financial statements via the standardised F-01/I-01 form, which details revenues, costs, financial results, and fixed assets investments for the study period. Additionally, selected macroeconomic data for Poland, including aggregated demand, investments, foreign trade, wage income, unemployment, and inflation, were sourced from Statistics Poland's Macroeconomic Data Bank. Data from various financial market segments, such as Treasury bond yields, key exchange rates and interest rates critical to the Polish economy, were obtained from the National Bank of Poland. Moreover, crude oil prices were sourced from Investing.com, using the London Intercontinental Exchange as a benchmark for other markets where this key energy commodity, which impacts transportation costs, is traded.

The analysis of the relationship between companies' investment propensities and macroeconomic indicators allows for the formulation of long-term investment strategies. Empirical studies indicate the presence of equilibrium in the long term and disequilibrium in the short term, with the influence of technological changes

often becoming evident only over an extended period [**Granger, 1993**]. However, existing research is primarily focused on the nature of businesses, especially micro-enterprises and SMEs [**Janik, Gałązka, 2014**], without providing a sectoral breakdown of the economy.

This study aimed to determine whether there is a long-term dependence between enterprises' investment inclination and shifts in macroeconomic indicators, categorised according to the PKD classification. The analysis of this long-term dependency was conducted using cointegration analysis, which assumes that economic processes can achieve long-term equilibrium, regardless of time. If such a relationship exists and deviations from the long-term path are stationary, the variables are considered cointegrated [**Charemza, Deadman, 1997**]. Ignoring potential cointegration can result in a loss of vital information, stripping the model of its long-term attributes [**Favero, 2001**; **Malczyk, 2011**].

Many sectoral economic studies employ Granger causality analysis to identify long-term dependencies between macroeconomic variables. Given their characteristics [**Granger, 1981**], the Vector Autoregression Model [VAR] and its modifications [**Hendry, 1995**; **Johansen, 1991**; **Sims, 1972**] are commonly used to describe cointegrated macroeconomic time series and decompose their variability into long-term relationships, short-term fluctuations, and random disturbances. Of special note is the Vector Error Correction Model [VECM], which accommodates both long-term relationships and short-term disequilibria [**Engle, Granger, 1987**; **Johansen, 1988**; **Maddala, 2006**; **Welfe, 1995**]. According to Granger's representation theorem [**Engle, Granger, 1987**], cointegration between variables implies the existence of a long-term adjustment mechanism, i.e., an error correction mechanism [**Majsterek, 2014**]. Individual economic sectors included in the analysis should not be viewed as separate entities. Entrepreneurs' actions often overlap across different sectors, justifying the application of a multivariate approach.

The basic endogenous variable in our study is the ratio of investment expenditures to revenues, which is a measure of companies' investment propensities. Five sectors of the economy, as defined in the PKD classification, were examined:

- 10: food product manufacturing,
- 20: chemical and chemical product manufacturing,
- 22: rubber and plastic product manufacturing,
- 26: computer, electronic, and optical product manufacturing,
- 29: motor vehicle, trailer and semi-trailer manufacturing, excluding motorcycles.

Quarterly time series were used, spanning from the first quarter of 2007 to the third quarter of 2022, sourced from unpublished Statistics Poland data. In the models, real values of exogenous factors were applied. The GDP deflator, which measures the general price level as the ratio of nominal to real GDP, was employed to obtain real values of indicators, calculated using prices from a specific base year [index 2006.04 = 100], allowing for the identification of dynamic relationships [**Coleman, 2012**; **Krugman, Wells, 2022**]. A standard unit was retained for variables such as the euro/zloty exchange rate, the WIBOR 3M rate, and the unemployment rate. A detailed description of the data, along with descriptive statistics for the analysed variables, is provided in Table 1. The descriptive statistics show distributions that diverge asymptotically from normal, potentially indicating the non-stationarity of the variables [**Engle, Granger, 1991**; **Majsterek, 2014**]. Theoretically, most economic categories are characterised by non-stationarity [**Majsterek, 2014**].

Results

Table 1 offers a comprehensive summary of the descriptive statistics for the time series data used in this study. It encompasses key statistical measures including the mean, which represents the average value across the dataset; the median, indicating the middle value when the data points are arranged in order; the standard deviation, which quantifies the amount of variation or dispersion within the data; and the coefficient of variation, which provides a standardised measure of dispersion relative to the mean. Additionally, Table 1

details the skewness, reflecting the asymmetry of the data distribution around the mean, and the kurtosis, which measures the "tailedness" of the distribution. Together, these statistics provide a foundational understanding of the data's central tendency, variability, and distribution shape, which are crucial for the subsequent econometric analysis.

Table 1. Description and summary of descriptive statistics for the time series used

Time series [label]	Mean	Median	Standard deviation	Coefficient of Variation	Skewness	Kurtosis
Investment to revenue ratio PKD 10 [Y10]	0.0371	0.0362	0.0097	0.2625	0.5951	0.0769
Investment to revenue ratio PKD 20 [Y20]	0.0526	0.0519	0.0183	0.3479	0.8196	0.9163
Investment to revenue ratio PKD 22 [Y22]	0.0575	0.0561	0.0173	0.3005	1.0489	1.6780
Investment to revenue ratio PKD 26 [Y26]	0.0275	0.0205	0.0229	0.8332	2.4675	7.1580
Investment to revenue ratio PKD 29 [Y29]	0.0437	0.0389	0.0161	0.3689	0.6347	−0.4849
Gross Domestic Product [PKB]	103.79	104.00	2.7915	0.0269	−0.8256	4.3359
Domestic demand [PK]	103.63	103.70	3.9139	0.0378	−0.1494	0.7996
Final consumption expenditure [SP]	103.16	103.40	2.5041	0.0243	−0.6937	4.4206
Consumption expenditure in households sector [K]	103.29	103.50	3.2402	0.0314	−1.0771	5.6263
Public consumption [SPB]	103.10	103.00	3.0474	0.0296	−0.1165	0.3525
Gross capital formation [AKU]	106.06	106.50	13.1290	0.1238	0.2939	0.5348
Exports [EXP]	106.35	106.90	6.4709	0.0608	−0.1315	5.1083
Imports [IMP]	106.19	106.90	8.6256	0.0812	−0.3569	2.5214
Exchange rate EUR/PLN [EURPLN]	4.2012	4.2277	0.2817	0.0671	−0.9295	1.3419
Wage dynamics in the economy (y/y) [WAGE]	105.93	104.99	2.6726	0.0252	0.9456	0.3897
Interest rates WIBOR3M [WIBOR3M]	3.0978	2.6800	1.8707	0.6039	0.3682	−0.7967
CPI Energy (y/y) [CPI_ENERGY]	104.83	103.50	7.4279	0.0709	2.6419	9.0073
Unemployment rate [BEZR]	9.5916	10.1000	3.0045	0.3133	−0.1294	−1.4631

Source: Authors' own calculations.

In the initial phase of the empirical analysis, the stationarity of the time series used in the study was verified. Unit root tests examine whether a time series variable is non-stationary and indicate the presence of a unit root [or trend variable] under the null hypothesis. Table 2 presents the results of unit root tests using the augmented Dickey-Fuller test, wherein the time series is transformed using a generalised least squares regression prior to conducting the test [ADF-GLS]. Employing the traditional ADF test in the presence of structural breaks in the time series can yield results that suggest the presence of a unit root when in reality the time series is trend-stationary [**Socha, Wdowiński, 2018**]. The ADF-GLS test is an efficient modification of the Dickey-Fuller test, offering superior overall performance in terms of size and power for small data samples, markedly prevailing over the regular and augmented versions of the DF test [**Elliott et al., 1996**]. Specifically, this modification significantly enhances the test's power when "an unknown trend is present" [**Elliott et al., 1996**] and is more likely to reject a false null hypothesis when the data stems from a nearly integrated time series [**Stock, Watson, 2007**]. Various empirical studies encompassing financial variables such as exchange rates or inflation demonstrate that the statistic values in the Dickey-Fuller test hover on the edge of rejecting the null hypothesis [**Malczyk, 2011**]. The optimal lag order in the test was determined based on the Schwarz Bayesian Information Criterion, as conclusions drawn using the commonly employed Akaike criterion may lead to overestimating the lag order [**Socha, Wdowiński, 2018**].

Unit root testing was carried out under the assumption that the variables in question might be generated by stochastic processes with a shift [ADF-GLS test with a constant term], and that alongside the stochastic trend, a deterministic trend might also be present [ADF-GLS test with a constant term and a linear trend].

Table 2. ADF-GLS test results for the tested time series

Time series [label]	ADF-GLS test with intercept and linear trend		
	HO: I(1), H1: I(0)	HO: I(2), H1: I(1)	HO: I(3), H1: I(2)
Investment to revenue ratio PKD 10 [Y10]	−2.0768	−13.7218***	
Investment to revenue ratio PKD 20 [Y20]	−1.4409	−12.0710***	
Investment to revenue ratio PKD 22 [Y22]	−2.5345	−15.4685***	
Investment to revenue ratio PKD 26 [Y26]	−1.7074	−11.6483***	
Investment to revenue ratio PKD 29 [Y29]	−2.0512	−10.5482***	
GDP growth [PKB]	−2.8645*	−3.3554**	
[PK]	−2.8258*	−2.8589*	−15.2765***
[SP]	−2.8059*	−3.4350**	
[K]	−2.9043*	−3.5096**	
[SPB]	−4.4053***		
[AKU]	−2.7564*	− 3.1997**	
[EXP]	−4.4495***		
[IMP]	−3.3412**		
[EURPLN]	−3.2753**		
[WAGE]	−1.1366	−2.6123	−15.0857***
[WIBOR3M]	−0.0734	−3.8281***	
[CPI_ENERGY]	−1.1039	−2.2924	−3.0953**
[BEZR]	−1.4228	−0.6756	−9.9009***

Note: In the notation of hypotheses, the following designations were used: I (0) – stationary series, I (1) – series integrated of order 1, I (2) – series integrated of order 2, I (3) – series integrated of order 3. Symbols ***, **, and * indicate the rejection of the null hypothesis in favour of the alternative hypothesis at the significance levels of $\alpha = 0.01$, $\alpha = 0.05$, and $\alpha = 0.1$, respectively.

Source: Authors' own calculations.

In the ADF-GLS test for all considered investment measures of enterprises, there was no basis to reject the null hypothesis [at a significance level of $\alpha = 0.05$] assuming the presence of a unit root, and hence the non-stationarity of the time series. However, the results of this test for the first differences of these variables allow the rejection of the null hypothesis in favour of the alternative concerning the stationarity of the considered variables, indicating that the original series are integrated of the first order. In the subsequent analysis, macroeconomic indicators also found to be integrated of the first order were taken into account.

In the second step of the empirical analysis, the Johansen cointegration method [**Johansen, 1988**] was employed for time series that were integrated to the same order. Unlike the Engle-Granger procedure, which only allows the determination of a single random cointegrating vector, the Johansen method can identify all linearly independent cointegrating relationships [**Majsterek, 2014**]. The order of cointegration was determined using the trace test [**Johansen, Juselius, 1990**]. Testing the order of cointegration with the trace test, which constitutes what is known as the recursive approach, enables the assessment of the stability of the cointegration results of processes [**Hansen, Johansen, 1999**]. Cointegration implies Granger causality, but not vice versa [**Syczewska, 2014**].

Table 3. Cointegration analysis using the Johansen method – results of the trace test

Order	Eigenvalue	Trace test [p value]
0	0.53824	122.77 [0.0001]
1	0.45792	77.181 [0.0009]
2	0.33524	41.053 [0.0157]
3	0.18782	16.961 [0.0840]

Source: Authors' own calculations.

At a significance level set at $\alpha = 0.05$, the cointegration test results indicate the presence of three cointegrating vectors. Subsequently, a Granger causality analysis based on the VECM model was conducted. Beyond the identified macroeconomic indicators, a deterministic linear trend and seasonal effects were incorporated into the model. The BIC information criterion achieves its smallest value at a lag of order two. Table 4 presents the model parameter estimates, together with the assessment of the EC1 error correction component representing the mechanism for short-term adjustments to converge to the long-term equilibrium of the modelled variable [**Salamaga, 2015**].

Table 4. Results of VECM model estimation

Explanatory variables	Modelled variable DY_t in the VECM model				
	DPKD10	DPKD20	DPKD22	DPKD26	DPKD29
DPKD10_1	−0.39826***	−0.05775	−0.16744	1.01255*	−0.46336
DPKD20_1	0.03904	−0.27119*	0.20681	−0.44552	0.30040*
DPKD22_1	−0.10739	0.22233	−0.41757***	0.30943	0.13622
DPKD26_1	0.08209**	−0.15191**	0.00311	0.04882	−0.08234
DPKD29_1	0.03401	0.39014**	0.05665	−0.59885*	0.00387
PKB	0.00008	−0.00536***	0.00213	0.00533*	−0.00193
SP	0.00073	0.00371**	−0.00103	−0.00338	−0.00022
K	−0.00085	−0.00033	−0.00091	0.00022	0.00089
AKU	0.00014*	0.00027	−0.00015	0.00010	0.00027
WIBOR3M	−0.00006	−0.00004	−0.00045	0.00139	−0.00149
S1	−0.03041***	−0.05242***	−0.04989***	−0.05119***	−0.04238***
S2	−0.00922	−0.00616	−0.01580	0.01128	−0.00976
S3	−0.00301	−0.01667***	−0.01646***	0.00471	−0.00962*
time	−0.00009	0.00028**	−0.00004	−0.00099***	0.00012
const	−0.01211	0.18329**	−0.01798	−0.25841*	0.11557
EC1	−0.20378*	0.76616***	−0.07285	−2.89952***	0.69997**
R squared	92.92%	90.46%	91.70%	66.75%	83.89%

Note: The symbols ***, **, * mean the rejection of the null hypothesis of no significance in favour of the alternative hypothesis at the significance level: $\alpha = 0.01$, $\alpha = 0.05$, $\alpha = 0.1$, respectively.

Source: Authors' own calculations.

The analysis demonstrated which macroeconomic indicators are the Granger cause of long-term investment propensity across various economic sectors. It reveals that in the PKD-20 sector (chemical and chemical product production) alone, GDP and SP are the primary long-term determinants of changes in enterprise investment behaviour. The passage of time positively impacts the investment propensity in the PKD-20 sector, while exerting a negative effect in the PKD-26 sector (computer, electronic, and optical product manufacturing). A significant seasonal component emerges across all sectors, with a lower propensity to invest observed in the first quarter compared to the annual average. This pattern is also evident in the third quarter for the PKD-20 (chemical and chemical product production) and PKD-22 (rubber and plastic product manufacturing) sectors.

In terms of inter-sectoral relations, an increase in investment propensity from the previous period in the PKD-26 sector (computer, electronic, and optical product manufacturing) is associated with a significant rise in investment in the PKD-10 sector and a decline in the PKD-20 sector. Additionally, the investment growth in the PKD-26 sector is significantly influenced by prior investment trends in the PKD-29 sector (manufacturing of motor vehicles, trailers, and semitrailers, excluding motorcycles). The parameter evaluations of the EC1 error correction component are significant in three equations of the VECM model [ΔPKD20, ΔPKD26, ΔPKD29], indicating a short-term adjustment process that helps the variables converge towards long-term equilibrium. The most pronounced correction towards equilibrium is observed in the PKD-26 sector.

Conclusions

The research focused on identifying the long-term dependence between companies' investment propensities and macroeconomic indicators in the Polish economy, categorised according to the PKD classification. The main analytical tool was cointegration analysis, a method used to detect long-term equilibrium relationships between economic processes. The study highlighted the need to account for cointegration to ensure models retain their long-term properties. Vector Autoregression [VAR] and its modified forms, such as Vector Error Correction Models [VECM], were instrumental in describing cointegrated macroeconomic time series, ensuring that both long-term relationships and short-term fluctuations were accurately captured. The study aimed to determine which sectors demonstrated stability in the short and long term, and which sectors, after experiencing short-term volatility, returned to balance in the long term. This insight is crucial not only for business managers but also for economic policy makers [**Becchetti, 2007**].

The primary endogenous variable studied was the relationship between investment expenditures and revenue, focusing on five economic sectors from Q1 2007 to Q3 2022. Initial unit root tests, specifically the augmented Dickey-Fuller test, confirmed the non-stationarity of the time series for enterprise investment measures. Following this, cointegration tests, particularly the Johansen method, identified three cointegrating vectors, highlighting macroeconomic indicators that significantly influenced investment propensities across the analysed sectors. The analysis showed that in the PKD-20 sector (chemical and chemical product production), GDP and SP emerged as key long-term determinants of investment behaviour. Temporal factors also played a role, with time exerting a positive effect in the PKD-20 sector but a negative effect in the PKD-26 sector (computer, electronic, and optical product manufacturing). Inter-sectoral dynamics were also in evidence. A notable finding was the influence of the prior period's investment propensity in the PKD-26 sector (computer, electronic, and optical product manufacturing) on subsequent investment in the PKD-10 and PKD-20 sectors. Meanwhile, investments in the PKD-26 sector was markedly impacted by past investment trajectories in the PKD-29 sector (manufacturing of motor vehicles, trailers, and semitrailers, excluding motorcycles). The VECM model offered a nuanced picture, particularly highlighting the PKD-26 sector (computer, electronic, and optical product manufacturing) as undergoing the most robust correction, enabling it to realign to long-term equilibrium after short-term fluctuations.

One limitation of our study is that it relies primarily on cointegration analysis, which, while comprehensive, may not capture all potential externalities influencing companies' investment propensities. Additionally, the focus on certain sectors may leave broader economic contexts unexplored.

Future research should delve deeper into sector-specific nuances, investigate external geopolitical factors, and employ alternative econometric methods to further validate these findings.

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