

SHIFT-SHARE STUDY OF INVENTORY CHANGES IN ENTERPRISES DURING COVID-19

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Purpose: The COVID-19 pandemic significantly impacted business operations worldwide, including in Poland. Inventory management became a key area that underwent dynamic changes due to sudden supply chain disruptions, demand variability, and logistical constraints. As a result, enterprises had to adapt their warehousing strategies to minimize risks and maintain business continuity. This study analyzes changes in inventory levels in Polish enterprises from a sectoral and regional perspective (by voivodships) between 2019 and 2023, with particular attention to the impact of the pandemic on inventory levels and structures across different economic sectors.

Design/methodology/approach: The study employs the Shift-Share method to evaluate the influence of macroeconomic, industry-specific, and local factors on variations in enterprise inventories. This method allows inventory volume changes to be decomposed into components reflecting general economic trends, specific industry effects, and individual enterprise characteristics. The study analyzed inventories for three sectors: industry, trade, and construction. Each type of inventory was considered in four categories: raw materials, semi-finished products, finished products, and goods. The data were collected according to the classification of the Central Statistical Office of Poland. All data have been adjusted for inflation to ensure consistency, using 2019 as the base year. Since inflation in Poland exceeded 34% during the analyzed period, these adjustments provided accurate rates of change.

Findings: Despite significant disruptions in global supply chains, the overall inventory volume in Polish enterprises increased by 19.8% between 2019 and 2023. However, the dynamics of changes varied significantly between the periods 2019–2021 and 2021–2023. The volume of most inventories increased significantly in the first period and slightly in the second. The most significant fluctuations occurred in the industrial production of raw materials and supplies.

Originality/value: This study applies the Shift-Share method to analyze inventory changes across firms during the COVID-19 pandemic. It offers a sectoral and regional perspective, providing insight into the key factors influencing inventory fluctuations. The results are relevant for researchers interested in supply chain resilience and inventory management strategies during periods of economic uncertainty.

Keywords: Shift-share analysis, pandemic impact, inventory.

Category of the paper: Research paper, Viewpoint.

1. Introduction

The COVID-19 pandemic has had a significant impact on the functioning of businesses around the world, including Poland. Inventory management is one of the key areas that has undergone dynamic changes. As a result of sudden disruptions in supply chains, demand variability and logistical constraints, companies have had to adapt their warehouse strategies to minimize risk and maintain business continuity. The post-pandemic period (2021-2023) has brought further challenges related to rebuilding economic stability, structural changes in various sectors and regional differences in the pace of returning to pre-pandemic levels of production and distribution. The topic concerning the study of the specific logistical aspects of inventory management, taking into account the difficulties faced by enterprises during the pandemic, can be found, among others, in the works of (Pasimeni, 2021; Kott, Sukiennik, 2022; Comporek, 2024; Sobczak, Chomac-Pierzecka, 2024; Gasowska, 2024).

Regardless of the industry, Polish enterprises have faced challenges related to excessive inventory accumulation due to falling sales and shortages caused by logistics disruptions. This study focuses on analyzing the dynamics of changes in inventories of enterprises in Poland from a sectoral and regional (by province) perspective in the years 2019-2023. Particular attention is paid to the impact of the pandemic on the levels and structure of inventories in various sectors of the economy and on regional differences in inventory management. The Shift-Share method used in the study allows for identifying factors responsible for changes in inventories resulting from nationwide economic trends and those specific to individual provinces and sectors. It was introduced to the economic analysis of regions by E.S. Dunn (1960) and used in later works (Kundsen, 2000; Malik, 2011; Suchecki, 2010; Mach, 2017). Research on inventory dynamics in globalization and business environment changes using the shift-share approach is covered in the following works (Gradzewicz, Mućk, 2019; Ferrari, 2022).

This article aims to analyze the impact of the COVID-19 pandemic on changes in the structure and level of inventories in Polish enterprises. In particular, key trends in inventory changes in various sectors will be discussed, focusing on the geographical aspect in the pandemic period (2019-2021) and the post-pandemic period (2021-2023). The study's results can provide valuable guidance on the future shaping of warehouse policy in the face of potential economic crises at both the sectoral and regional levels.

2. Methods

The Shift-Share method is an analytical tool used to assess the impact of various factors on changes in inventories of industrial, commercial, and construction enterprises by decomposing these changes into components resulting from macroeconomic, industry-specific, and local influences. It allows for identifying the factors affecting inventory level changes (materials, finished goods, semi-finished products, and merchandise) by breaking down their increase or decrease into components that result from general market trends, specific industry effects, and individual characteristics of a given type of enterprise.

The analysis examined the formation of quantitative variables denoted as TX_{jir} , where j represents the industries of enterprises, i – types of inventories, r – regions (voivodship), that indicate absolute increases or the rate of change in X_{ji} . The diagnostic variables describing the categories include variable X_{1ir} – inventories of industrial enterprises by types; variable X_{2ir} – inventories of trade enterprises by types; and variable X_{3ir} – inventories of enterprises in the construction sector by types. Each variable representing the value of inventories has four dimensions: inventories of materials, semi-finished products and work-in-progress, finished goods, and merchandise. Average growth rate of variable X in the country and in a given industry:

$$TX_{j..} = \frac{\sum_r \sum_i (X_{jri}^* - X_{jri})}{\sum_r \sum_i X_{jri}}, \quad (1)$$

X_{jri}^* is the observation of the analyzed variable in the r -th region and i -th cross-sectional group, to the industry; in SSA analyses we use aggregate measures (Sucheckı, 2010, p. 164).

Statistical data were collected across multiple dimensions for each variable, developing a contingency table with matrix elements. The values in this table represent the total variable X for the r -th voivodeship and the j -th sector. The time range of the analyzed data covers the years 2019-2023. The shifts were analyzed over three-time intervals: 2019-2021, 2021-2023, and 2019-2023. The data were collected using the local GUS database.

The selection of the three industries for analysis, quantitatively defined as variables X_1 , X_2 , and X_3 , was dictated not only by the availability of data but also by the fact that these three sectors account for approximately 90% of the inventories of all enterprises in the country, allowing for an aggregated assessment of dynamics at the macro level.

To minimize the impact of regional size, weighted variables were applied in the calculations and analysis. During this process, we calculated the individual rate of change for each variable examined and three aggregate indicators: the average rate of change for the r -th region, the j -th sector, and the country as a whole. Furthermore, the values obtained from the statistical data bank were adjusted for inflation using the inflation index, with all calculations based on prices modified to reflect the 2019 level. Since inflation in Poland exceeded 34% from 2019 to 2023, this approach allowed us to achieve more accurate rates of change. Although the inflation index

has certain limitations and may not reflect specific price changes for raw materials, supplies or products in specific industries, the value of an enterprise's inventories may change under other factors. For accurate adjustment, it is necessary to have access to detailed macroeconomic data and consider the inflation dynamics at the industry and regional levels.

The outcome of the Shift-Share analysis is the calculation of structural-geographical equality. This relationship describes the geographical differentiation of the excess of the average regional inventory growth rate over the national average and is represented as a component of two effects: structural and geographical. Suchecki (2010) describes the detailed calculation method in section 6.1 on the Classical Variable Distribution Method (SSA). Determining and analyzing the dynamics of inventory changes will allow us to present the studied area of working capital management in a structural-spatial dimension while highlighting the strengths and weaknesses of the analyzed regions.

In assessing the dynamics of inventory changes in enterprises, the average values of financial variables were examined across three categories: industrial enterprise inventories, wholesale and retail trade enterprise inventories, and construction industry enterprise inventories. The specificity of economic activity for each group of enterprises with inventories is reflected in the results of the analysis. The data used for calculations are accurate and were collected over five years, with two-year intervals, and presented for each of 16 voivodeships. The conducted study will enable the assessment of changes in the inventory structure of enterprises in individual voivodeships, which will also allow for evaluating the regional structure and dynamics of enterprise inventories during the studied period.

Conducting the study by the outlined assumptions will allow for answering the following research hypotheses:

- on a national scale, during the COVID-19 pandemic (2019-2023), enterprises experienced disruptions in global supply chains and reduced inventory value,
- by examining the structural effect of changes, it is possible to identify industries and types of inventories whose dynamics have a decisive impact on the level of enterprise stock,
- changes in the structure (structural effect) and competitiveness zone (geographical effect) influence the increase or decrease in inventories in individual voivodeships (total effect).

3. Results

In studying the dynamics and structure of enterprise inventories, data on enterprise inventories for three industries available in the Financial Results of Enterprises category, according to the PKD 2007 sections, were collected and analyzed. Additionally, data on

inventories across all business sectors were reviewed collectively. The analysis of manufacturing enterprise inventories, where balance sheet categories present inventories, is provided in subsection 3.1. Similarly, the analysis results for wholesale and retail trade enterprises are presented in 3.2, and for the construction industry in 3.3. Each of the three data categories underwent a general and detailed analysis, including a structural (sectoral) breakdown and a share change analysis.

The starting point for the conducted analysis was the determination of inventory value (in millions of zlotys) for the years 2019-2023. The data were adjusted for inflation. We calculated the dynamics and structure of inventories based on the balance sheet classification, which includes materials, finished goods, semi-finished products, and merchandise, across three primary industries. Table 1 presents the industry's average growth/decline rates of enterprise inventory value.

Table 1.

Average growth rate in the country by industries

Rate of change by industries	2019-2021	2021-2023	2019-2023
Total	20,2%	-0,4%	19,8%
Industrial enterprises	28,6%	-2,3%	25,7%
Wholesale and retail trade	12,8%	4,1%	17,4%
Construction industry enterprises	4,9%	2,1%	7,7%

Source: own study based on data from the Central Statistical Office.

It is worth noting that despite significant changes in international supply chains during and immediately after the pandemic, the overall inventory volume did not decrease; instead, an increase of 19.8% was observed. However, there is a notable difference between 2019-2021 and 2021-2023 dynamics. Among the industries, the most significant fluctuations occurred in industrial production, where a 2.3% decline was followed by growth of 28.6% in the first period in the second. This sector accounts for more than half of the total inventory volume, so such fluctuations indicate a precarious supply chain situation.

Table 2 presents the analysis of the situation by structural components of inventories. The overall trend is similar and confirms the previous conclusions. The most significant materials category for industrial production experienced the most extraordinary fluctuations. A 7.8% decline followed a growth of 37.9% in the first and second sub-periods.

Table 2.

Average growth rate in the country by type of inventories

Rate of change by inventories	2019-2021	2021-2023	2019-2023
Materials	37,9%	-7,4%	27,7%
Semi-finished products	20,2%	-1,0%	19,0%
Finished products	12,7%	4,6%	18,0%
Goods	10,1%	4,8%	15,4%

Source: own study based on data from the Central Statistical Office.

3.1. Industrial enterprises

In the study of changes occurring in the inventories of industrial enterprises, a general analysis of the examined category was conducted (by calculating the dynamics of changes), and its structural components were analyzed (using shift-share analysis) in the form of materials, finished goods, semi-finished products, and merchandise.

The interpretation of the obtained results examines how the analyzed variable influences inventory situations across various industries. First, we determined the inventory change rates at the national level. These calculated rates of change were weighted based on the inventory components, as shown in Table 1. We analyzed three distinct periods: the first two comprise data ranges in two-year intervals (2019-2021 and 2021-2023), while the third period encompasses the entire analysis timeframe from 2019 to 2023.

Throughout the study period, the volume of inventories in manufacturing enterprises increased by 25.7%. In the first sub-period (2019-2021), inventories grew by 28.5%, while in the second sub-period (2021-2023), there was a decrease of 2.3%.

Table 3 illustrates the dynamics of structural factors and provides a detailed analysis of the changes. The structural change coefficient was calculated for the three components mentioned earlier.

Table 3.

Sectoral (structural) factor of changes in industrial enterprises

Rate of change by inventories	2019-2021	2021-2023	2019-2023
Materials	37,2%	-9,5%	24,2%
Semi-finished products	26,0%	2,3%	28,9%
Finished products	20,3%	7,1%	28,4%
Goods	16,1%	7,3%	24,5%

Source: own study based on data from the Central Statistical Office.

When analyzing the structural changes in the inventories of manufacturing enterprises, the most significant fluctuations—both in growth and decline—were observed in the materials category, which is a fundamental component of manufacturing. During the pandemic, the volume of materials in these enterprises increased dramatically by 37.2%. However, in the post-pandemic period, it experienced a decrease of 9.5%.

For other inventory categories, growth was noted across all analyzed periods. Nonetheless, the growth rates during the second post-pandemic period were relatively moderate, averaging around 5%, compared to the pandemic period, when growth rates reached up to 20% on average.

In the third stage of the study, the structural-geographical equality was calculated to represent the total effects of changes that occurred during the analyzed periods. This equality was calculated based on equation (1) presented in Section 2 using the methodology described in Suchecki (2010) – see Table 4.

Table 4.*Structural-geographic equality (total effect) in industrial enterprises*

Rate of change by voivodship	2019-2021	2021-2023	2019-2023
Dolnośląskie	13,8%	1,5%	15,5%
Kujawsko-pomorskie	-22,8%	-5,8%	-28,5%
Lubelskie	30,8%	0,6%	33,9%
Lubuskie	30,7%	-10,4%	13,7%
Łódzkie	0,6%	26,4%	41,0%
Małopolskie	13,6%	-10,1%	-1,9%
Mazowieckie	-1,5%	10,8%	12,3%
Opolskie	23,8%	-13,7%	3,9%
Podkarpackie	-2,0%	16,0%	18,0%
Podlaskie	8,6%	8,0%	21,8%
Pomorskie	-20,4%	7,4%	-16,3%
Śląskie	-7,3%	-5,6%	-14,2%
Świętokrzyskie	-11,5%	-6,8%	-18,6%
Warmińsko-mazurskie	17,3%	-16,9%	-7,9%
Wielkopolskie	-3,1%	-11,2%	-17,1%
Zachodniopomorskie	26,5%	-18,1%	-0,8%

Source: own study based on data from the Central Statistical Office.

The columns in Table 4 present the percentage changes in the total effects achieved for the analyzed regions. Over the entire study period, the highest inventory growth rate among industrial enterprises was observed in Łódź Voivodeship, which exceeded the national average by 41%.

Conversely, the lowest inventory growth rate, specifically a decline of 28.5%, was recorded in Kujawsko-Pomorskie Voivodeship and in the Świętokrzyskie, Śląskie and Wielkopolskie Voivodeships. Moreover, the growth/decline trends in the sub-periods within these voivodeships were opposite to the national trends.

Additional calculations were made to analyze the structural and geographical effects of the changes, as detailed in Table 5. The total effect for Łódź Voivodeship increased by 41%. This increase was only slightly influenced by changes in the structure of inventory components, with the structural effect rising by just 0.6%. Instead, it was predominantly driven by internal changes unique to the region, as the geographical (local) effect accounted for 40.4% of the total change.

Table 5.*Shift-Share Analysis results 2019-2023 in industrial enterprises*

Rate of change by voivodship	Total	Structural	Geographic
Dolnośląskie	15,5%	0,4%	15,1%
Kujawsko-pomorskie	-28,5%	0,8%	-29,3%
Lubelskie	33,9%	0,8%	33,1%
Lubuskie	13,7%	0,6%	13,2%
Łódzkie	41,0%	0,6%	40,4%
Małopolskie	-1,9%	0,7%	-2,6%
Mazowieckie	12,3%	0,5%	11,8%
Opolskie	3,9%	0,3%	3,6%
Podkarpackie	18,0%	0,9%	17,0%
Podlaskie	21,8%	0,9%	20,9%
Pomorskie	-16,3%	0,3%	-16,7%

Śląskie	-14,2%	0,4%	-14,6%
Świętokrzyskie	-18,6%	1,1%	-19,7%
Warmińsko-mazurskie	-7,9%	0,7%	-8,6%
Wielkopolskie	-17,1%	0,5%	-17,6%
Zachodniopomorskie	-0,8%	0,6%	-1,4%

Source: own study based on data from the Central Statistical Office.

3.2. Retail trade

The analysis for the wholesale and retail trade enterprises was conducted based on the same principles as for industrial enterprises. Sector-weighted growth rates were calculated for three periods. Over the entire analysis period (2019-2023), the inventories of trade enterprises increased by 17.4%. The growth trend in 2019-2021 was three times higher, reaching 12.8%, whereas in 2021-2023, it amounted to 4.1% (Table 1).

The structural change coefficient was calculated for the four inventory components of trade enterprises as part of the detailed analysis of structural (sectoral) changes (see Table 6).

Table 6.
Sectoral (structural) factor of changes in retail trade

Rate of change by inventories	2019-2021	2021-2023	2019-2023
Materials	84,5%	-40,4%	10,0%
Semi-finished products	27,6%	-6,5%	19,3%
Finished products	9,0%	10,2%	17,9%
Goods	10,7%	6,4%	17,8%

Source: own study based on data from the Central Statistical Office.

During the analysis of changes in inventory volumes at trade enterprises, it was observed that from 2019 to 2021, there was a significant increase in the materials category. However, this increase was later followed by a substantial decline in the subsequent period. As a result, the overall growth for the entire analyzed period remained moderate. This indicates that such fluctuations during the pandemic were very significant for retail enterprises.

In the next stage of the study, the total impact of inventory changes across the examined periods was calculated using structural-geographical equality, as presented in Table 7.

Table 7.
Structural-geographic equality (total effect) in retail trade

Rate of change by voivodship	2019-2021	2021-2023	2019-2023
Dolnośląskie	8,8%	-16,8%	-11,2%
Kujawsko-pomorskie	7,4%	-21,2%	-18,1%
Lubelskie	18,2%	-8,4%	8,0%
Lubuskie	35,8%	-4,2%	31,1%
Łódzkie	-14,0%	-7,5%	-21,9%
Małopolskie	-4,2%	2,5%	-1,7%
Mazowieckie	-5,4%	4,1%	-1,2%
Opolskie	-15,5%	12,1%	-4,4%
Podkarpackie	-1,2%	-8,1%	-10,2%
Podlaskie	-4,4%	-2,1%	-6,8%
Pomorskie	9,2%	-28,2%	-24,8%
Śląskie	11,4%	14,1%	29,2%

Cont. table 7.

Świętokrzyskie	-2,2%	-10,9%	-14,3%
Warmińsko-mazurskie	-7,0%	11,6%	5,0%
Wielkopolskie	1,1%	12,4%	15,3%
Zachodniopomorskie	-0,9%	10,3%	10,6%

Source: own study based on data from the Central Statistical Office.

The most considerable inventory growth among trade enterprises occurred throughout the study period in Lubuskie Voivodeship, reaching 35.8% in the first sub-period. Conversely, the most significant decline was recorded in Pomorskie Voivodeship, with a 28.2% decrease in the second analyzed sub-period.

Notably, the general trend of significant inventory increases during the pandemic, followed by a slight rise in the subsequent period, was not confirmed in any single voivodeship. Instead, each region exhibited different trends, resulting in the observed overall effect.

In an attempt to conduct a more detailed analysis of the changes recorded in trade enterprises within the achieved total effect, structural and geographical effects were additionally calculated – see Table 8.

The increase in the total effect for Lubuskie Voivodeship was primarily driven by the local factor (+30.8%) and, to a lesser extent, by the structural factor (+0.3%).

Table 8.

Shift-Share Analysis results 2019-2023 in retail trade

Rate of change by voivodship	Total	Structural	Geographic
Dolnośląskie	-11,2%	0,3%	-11,5%
Kujawsko-pomorskie	-18,1%	0,2%	-18,3%
Lubelskie	8,0%	0,3%	7,7%
Lubuskie	31,1%	0,3%	30,8%
Łódzkie	-21,9%	0,2%	-22,1%
Małopolskie	-1,7%	0,1%	-1,8%
Mazowieckie	-1,2%	0,3%	-1,4%
Opolskie	-4,4%	0,2%	-4,6%
Podkarpackie	-10,2%	0,0%	-10,3%
Podlaskie	-6,8%	0,3%	-7,1%
Pomorskie	-24,8%	0,2%	-25,0%
Śląskie	29,2%	0,0%	29,3%
Świętokrzyskie	-14,3%	0,2%	-14,5%
Warmińsko-mazurskie	5,0%	0,2%	4,8%
Wielkopolskie	15,3%	0,3%	15,0%
Zachodniopomorskie	10,6%	-0,1%	10,7%

Source: own study based on data from the Central Statistical Office.

3.3. Construction industry enterprises

The analysis of inventory changes for construction industry enterprises showed a similar trend – an overall increase throughout the entire study period, with more significant growth in the first sub-period (2019-2021) and half the growth in the second sub-period (2021-2023). Compared to other industries, the construction sector did not exhibit significant fluctuations in inventory accumulation overall.

Table 9 presents a detailed analysis of structural changes, including the coefficient of changes in inventory components for construction industry enterprises.

Table 9.

Sectoral (structural) factor of changes in construction industry enterprises

Rate of change by inventories	2019-2021	2021-2023	2019-2023
Materials	15,7%	-4,4%	10,6%
Semi-finished products	-2,8%	1,4%	-1,4%
Finished products	30,1%	10,7%	47,3%
Goods	19,6%	12,5%	34,6%

Source: own study based on data from the Central Statistical Office.

Overall, the situation across the inventory components aligns with the general trend. However, in the semi-finished products and work-in-progress category, a notable increase was observed in the second sub-period, while a decrease occurred in the first sub-period.

In the finished goods category, inventory accumulation in the first sub-period was three times higher than in the second, reaching 30.1% and 10.7%, respectively. As for merchandise, the trend was 19.6% in the first sub-period compared to 12.5% in the second. These observed trends can be attributed to the nature of the production process in this industry.

Table 10 presents the calculation of structural-geographical equality for voivodeships, where the total effect of inventory changes over the analyzed periods was computed.

Table 10.

Structural-geographic equality (total effect) in construction industry enterprises

Rate of change by voivodship	2019-2021	2021-2023	2019-2023
Dolnośląskie	-10,3%	253%	228,6%
Kujawsko-pomorskie	1,6%	-12%	-12,9%
Lubelskie	31,8%	31%	72,9%
Lubuskie	-14,8%	-34%	-53,4%
Łódzkie	76,4%	17%	121,1%
Małopolskie	10,4%	5%	21,8%
Mazowieckie	1,5%	-5%	-4,1%
Opolskie	57,4%	-47%	-15,1%
Podkarpackie	9,4%	-5%	1,4%
Podlaskie	30,0%	9%	42,9%
Pomorskie	-6,8%	-20%	-28,0%
Śląskie	-10,1%	-6%	-16,7%
Świętokrzyskie	37,1%	-17%	11,1%
Warmińsko-mazurskie	-9,2%	-10%	-19,9%
Wielkopolskie	5,2%	-3%	1,3%
Zachodniopomorskie	-59,2%	32%	-46,0%

Source: own study based on data from the Central Statistical Office.

The increase in the total effect for Dolnośląskie Voivodeship was primarily driven by the local factor (+223.2%) and, to a lesser extent, by the structural factor (+5.3%).

Throughout the study period, the most extensive inventory growth in the construction sector occurred in Dolnośląskie Voivodeship, reaching 253% in the second sub-period for the semi-finished products and work-in-progress category.

This anomalous increase may result from specific production processes in this industry compared to other categories and voivodeships. It significantly contributed to the atypical fluctuations in inventories' structural dynamics.

Overall, the construction sector exhibited substantial variability in inventory dynamics across regions, with a standard deviation of approximately 70%.

Furthermore, the calculations for structural and geographical effects have been conducted and are presented in Table 11. The increase in the total effect for Dolnośląskie Voivodeship was primarily driven by the local factor, which accounted for a rise of 223.2%, and to a lesser extent by the structural factor, contributing an increase of 5.3%.

Table 11.

Shift-Share Analysis results 2019-2023 in construction industry enterprises

Rate of change by voivodship	Total	Structural	Geographic
Dolnośląskie	228,6%	5,3%	223,2%
Kujawsko-pomorskie	-12,9%	7,3%	-20,2%
Lubelskie	72,9%	12,4%	60,5%
Lubuskie	-53,4%	5,7%	-59,0%
Łódzkie	121,1%	4,8%	116,3%
Małopolskie	21,8%	3,3%	18,5%
Mazowieckie	-4,1%	-1,5%	-2,5%
Opolskie	-15,1%	-1,0%	-14,1%
Podkarpackie	1,4%	4,6%	-3,3%
Podlaskie	42,9%	3,3%	39,6%
Pomorskie	-28,0%	3,8%	-31,8%
Śląskie	-16,7%	-5,8%	-10,9%
Świętokrzyskie	11,1%	4,6%	6,5%
Warmińsko-mazurskie	-19,9%	4,1%	-23,9%
Wielkopolskie	1,3%	2,6%	-1,3%
Zachodniopomorskie	-46,0%	1,5%	-47,5%

Source: own study based on data from the Central Statistical Office.

4. Discussion

The study demonstrated the dynamics of changes and structural-geographical shifts in enterprises' current material assets during the COVID-19 pandemic and immediately after its conclusion. Calculations were performed for enterprises in three industry types according to the balance sheet classification of inventories. The data used for calculations were indexed to the 2019 level to ensure comparability, considering changes in the Consumer Price Index (CPI).

Across all analyzed industries, enterprises generally exhibited a stimulating effect on inventory changes throughout the study period. The growth rate in the first sub-period (2019-2021) was strictly positive and averaged around 20%. However, in the second sub-period (2021-2023), the growth rate was nearly absent, yet no negative trend was observed either.

A key aspect of analyzing the results was associating them with the regional characteristics of enterprises. As a summary of the study, Figure 1 presents the inventory dynamics by voivodeships, comparing 2023 to 2019, accumulated to 100%.

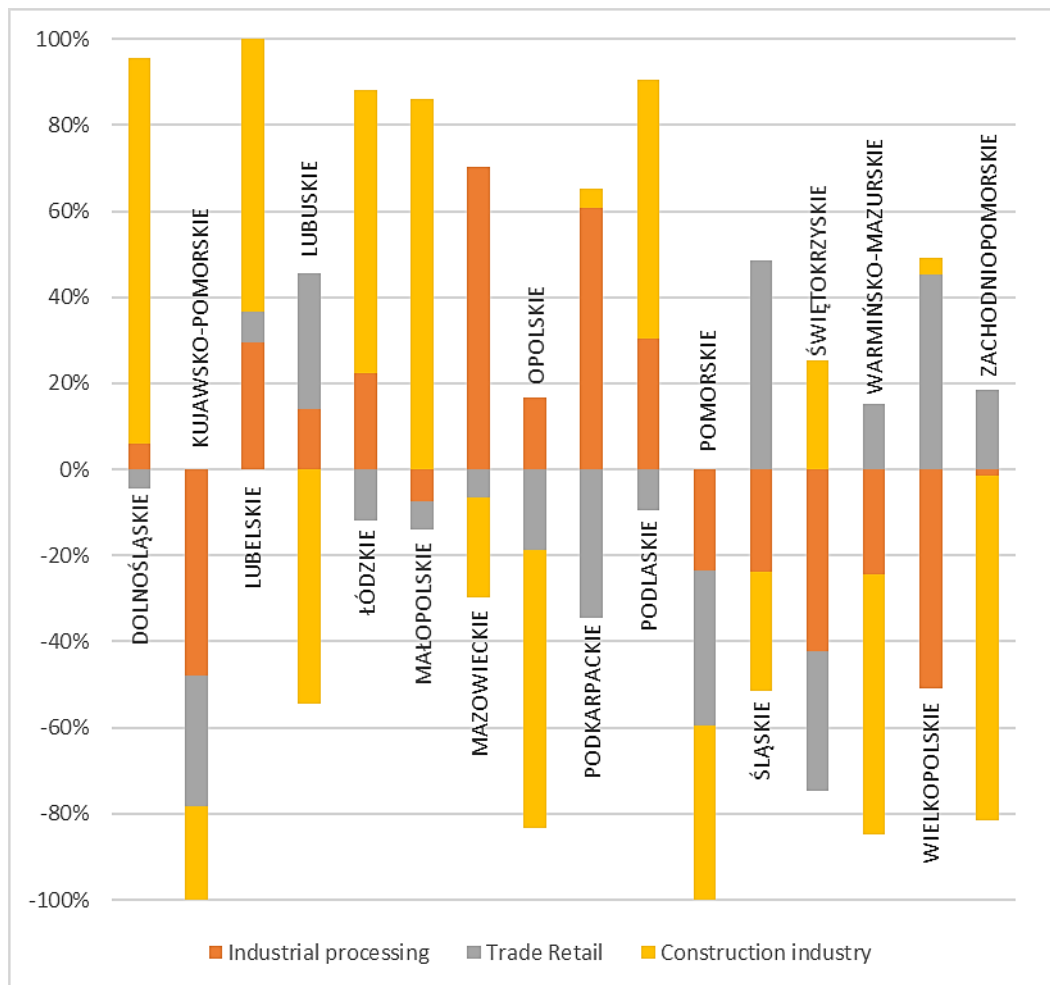


Figure 1. Inventory dynamics by voivodeships (2019-2023), accumulated to 100%.

Source: own study based on data from the Central Statistical Office.

Figure 1 shows that only in Lubelskie Voivodeship were the dynamics strictly positive across all three analyzed industries. In contrast, in Kujawsko-Pomorskie and Pomorskie Voivodeships, the trend was strictly negative. In all other voivodeships, positive and negative trends were observed, leading to an average gradual overall accumulation of inventories.

Another interesting aspect is the variability of inventory dynamics by industry across voivodeships, which can also be observed in Figure 1. For industrial enterprises, the standard deviation was 19%; for trade enterprises, it was 16%, whereas for construction enterprises, it reached 68%. These results indicate the specific nature of the production process in the construction sector and significant regional differences. Overall, the geographical effect had the greatest impact on inventory dynamics, in contrast to the structural effect, across all voivodeships.

The study conducted allowed for specific quantitative estimates of inventory dynamics at the industry and voivodeship levels. These estimates allow for further research not only to analyze but also to forecast the situation with the accumulation of inventories, which in turn allows for the prediction of the dynamics of transportation and storage prices.

The study confirmed the hypothesis that, on a national scale, enterprises experienced disruptions in global supply chains and a decrease in inventory costs during the COVID-19 pandemic (2019-2023). This is evident from the differing dynamics observed in the two sub-periods of the study: the first (2019-2021) and the second (2021-2023).

Regarding the second hypothesis about the structural effects of these changes, the production sector and raw material inventories were identified as significantly influencing inventory levels within enterprises. Additionally, local geographical factors also play a crucial role in the dynamics of inventories.

Further research is needed into the extent of inflation's impact on inventories' value. The indexation carried out has certain limitations and risks associated with the methodological component—methods of inventory valuation in accounting and adjustments based on industry price indices, which can complement inflation indexation for a more accurate analysis.

5. Summary

On a national scale, during the COVID-19 pandemic (2019-2023), enterprises experienced disruptions in global supply chains and a shift in inventory value. However, it cannot be conclusively stated that in the post-pandemic period, enterprises fully transitioned from the Just-in-Time (JIT) strategy to the Just-in-Case (JIC) strategy.

With the end of the pandemic, enterprises have begun abandoning risk-reduction strategies focused on avoiding supply shortages and ensuring supply chain stability, as these are more costly. Instead, businesses are gradually returning to strategies that minimize inventory levels and optimize supply chains, ensuring that goods and raw materials arrive just in time for their use, thereby reducing storage costs.

By analyzing the structural effect of changes, the industrial sector and raw materials and material inventories were identified as key factors influencing inventory levels in enterprises. During the study period, inventory fluctuations in the industrial sector reached 30%, while for raw materials and supplies, they reached 45%. In contrast, other analyzed categories did not exceed a 20% change.

The Shift-Share Analysis (SSA) revealed changes in the total effects across different industrial sectors and further divided these changes into structural and geographical impacts. The increase or decrease in inventories in specific voivodeships (total effect) was influenced by both structural changes (structural effect) and changes in the competitiveness zone

(geographical effect). In most cases, the geographical (local) effect was more significant and had a noticeable impact across all enterprise sectors.

The study covers the years 2019–2023, which allows us to assess the short-term effect of the pandemic, which is its weakness. There is no long-term analysis that would take into account enterprises' resilience after the pandemic. Also, the inflation adjustment is based on the average level of inflation, but individual industries may have experienced different inflation levels.

The study showed that enterprises tried to adapt to disruptions in supply chains, but due to uncertainty, not all were able to avoid overstocking. In the short term, an increase in inventories was characteristic of all sectors, but in the post-pandemic period, there was a return to optimising warehouse inventories.

The study also showed different industry scenarios:

- industry experienced the most significant fluctuations due to changes in demand for raw materials,
- the trade sector had more stable growth but with significant changes in 2021-2023,
- the construction sector showed the minor changes, indicating longer adaptation cycles.

The data obtained can help optimise procurement policies and identify practical approaches to inventory management in times of crisis. The study's results can also be useful for shaping economic policy, and data on regional differences can help better target state support and subsidies. The study provides a valuable analysis of the impact of COVID-19 on inventory management in Polish enterprises. However, it has certain limitations due to the methodology and time range.

Businesses, government agencies, and academics can use the lessons learned to develop inventory management strategies during times of instability.

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