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An Evaluation of the Development Trajectory of the Construction Sector in the Context of Global Crises Using Hellwig's Synthetic Development Measure - The Case of Poland*

Joanna CYMERMAN

Koszalin University of Technology, Koszalin, Poland

Correspondence should be addressed to: Joanna CYMERMAN, joanna.cymerman@tu.koszalin.pl

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Abstract

The principal aim of the study was to assess the development of the construction sector within the broader context of global crises, using Hellwig's synthetic development measure, with Poland serving as the case study. The temporal scope of the analysis covered the past 18 years (2007–2024), a period marked by a high incidence of global shocks, including the global financial crisis of 2008, the Eurozone sovereign debt crisis of 2011, the COVID-19 pandemic, and the onset of Russia's full-scale war against Ukraine in 2022. For the construction of Hellwig's synthetic development measure, nine diagnostic variables were selected. The values obtained from Hellwig's synthetic development measure for the construction sector clearly indicated a dynamic expansion of this sector in Poland over the period under analysis. Additionally, cyclical fluctuations in the value of the measure were observed, confirming the presence of cyclical variability within the construction sector.

Keywords: construction sector, global crisis, Hellwig's synthetic development measure.

Introduction

Construction, which encompasses real estate, infrastructure, and industrial structures, is the largest industry in the global economy, accounting for 13 percent of the world's GDP. In the past couple of decades, it has been plagued by dismal performance, characterized by lagging productivity growth, limited digitalization, frequent insolvencies. The industry's global annual labor productivity growth over the past 20 years was less than 1 percent, which is significantly less than the productivity growth of the global economy, approximately 2,8 percent a year. The industry feel the economic impact of COVID-19 strongly (disrupted supply chains, energy crisis, etc.), as will the wider construction ecosystem - which includes construction companies' suppliers, distributors, customers, and competitors, as well as government regulators (Ribeirinho et al., 2020, p. 16). The construction sector is of strategic importance for the European Union, being a pillar for both the economy and society. It generates almost 10% of gross domestic product (GDP) in the European Union and provides 25 million direct jobs, having a direct impact on the safety of persons and on the quality of life (European Commission, 2022).

In Poland, the construction sector also plays a significant role by contributing to GDP growth, creating jobs, generating tax revenues, and supplying new real estate space (residential, commercial, industrial, or specialized). This sector accounts for 6.3% of Poland's GDP (Fig. 1), generating one of the highest shares in Europe in terms of gross value added (amounting to PLN 228 652 million in 2024).

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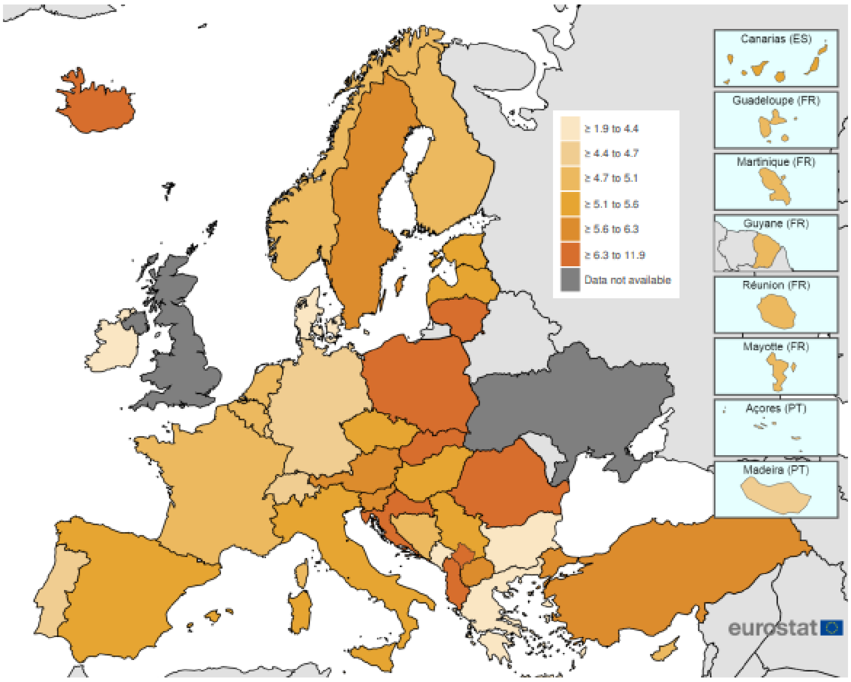


Fig. 1. Gross value added of the construction sector as % of the gross domestic product (GDP) in 2024

Source: (Eurostat, 2025a).

According to Eurostat, the Polish construction sector is among the largest in Europe, placing the country at the forefront of the industry, second only to major economies such as Germany, France, Italy, and Spain. With 431,946 enterprises in the construction sector, Poland ranks third in Europe. In terms of employment, with 1,153,354 workers in the sector, Poland holds the fifth position, and with net revenues of €138,909.89 million, it ranks sixth in Europe (Eurostat, 2025b).

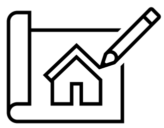
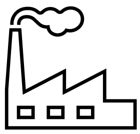
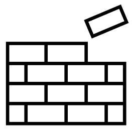
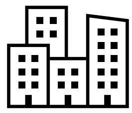
Like other sectors and the overall economy, the construction industry is subject to fluctuations, including seasonal, random, and cyclical variations (business cycles) (Grzegorzewski and Łazarowicz, 2024, p. 52). Demand for construction sector "products" is derived from other sectors that require new buildings and infrastructure. During periods of economic expansion, when the economy is growing, demand in the construction sector increases, whereas during economic downturns, it declines. Building cycles tend to be more prolonged and volatile than any other type of economic cycle because of the unique characteristics of building investment. These include the length of the construction lags and the lumpiness of the investments (which create a tendency to over-building), the stickiness of rent adjustment due to demand-side rigidities (which delays the transmission of market signals), the durability of building stock (which reduces the stabilizing effect of replacement investment on unstable induced demand), the existence of a buffer stock of vacant space (which slows the supply response on the upswing and prolongs over-building on the downswing) and the traditionally fragmented nature of the development industry (which means that many firms are liquidated in a slump, creating a delay while capacity is restored during an upswing) (Barras, 2009, p. 78).

The principal objective of the study is to evaluation of the development of Poland's construction sector within the overarching framework of global crises. For the purpose of assessing the development of the construction sector Hellwig's synthetic development measure - also known as the taxonomic development measure - was employed. In the subsequent part of the study, both the broad and narrow approaches to defining the construction sector are outlined. This is followed by an analysis of the fluctuations experienced by the construction sector (in the narrow approach) in Poland over the adopted research period (2007–2024), a timespan marked by major global shocks, including the global financial crisis of 2008, the Eurozone sovereign debt crisis of 2011, the COVID-19 pandemic, and the onset of Russia's full-scale war against Ukraine in 2022. The next stage of the research presents the methodological framework, namely Hellwig's synthetic development measure (the Hellwig's method). Finally, the results of applying this measure to assess the development of the Polish construction sector in the years 2007–2024 are presented.

Broad and narrow approaches to defining the construction sector

In international economic statistics, both "narrow" and "broad" approaches to defining the construction sector can be found. The narrow definition refers to Section F – Construction, as classified in the *Statistical Classification of Economic Activities in the European Community (NACE Rev. 2)*, and encompasses three groups: F.41 *Construction of buildings*, F.42 *Civil engineering*, and F.43 *Specialised construction activities*. NACE is an acronym derived from the French *"Nomenclature Statistique des Activités économiques dans la Communauté européenne"* - constitutes a fundamental component of the international, integrated system of economic classifications. It is based on the classifications developed by the United Nations Statistical Commission (UNSTAT), Eurostat, as well as national statistical classifications. These systems are closely interconnected, enabling the comparability of economic statistics produced worldwide by various institutions. The NACE Rev. 2 version has been in force since 2008 and remains applicable through 2024. For a detailed discussion, see: *NACE Rev. 2. Statistical Classification of Economic Activities in the European Community*, Eurostat, Office for Official Publications of the European Communities, Luxembourg 2008. The broad definition of the construction sector, applied for example by the *European Construction Sector Observatory (ECSO)*, presents a holistic perspective by treating the sector as a complete process: from the architectural and construction design phase, through the production of building materials, to the execution of construction works, and finally the introduction of new space to the market through the sale or rental of real estate, i.e., commercialization (Tab. 1).

Tab. 1. Construction sector – broad definition

Sector M Professional, scientific and technical activities	**Sector C Manufacturing**	**Sector F Construction**	**Sector L Real estate activities**
			
M.71.1. Architectural and engineering activities and related technical consultancy.	C.16.2 Manufacture of products of wood, cork, straw and plaiting materials. C.23.3. Manufacture of clay building materials. C.23.5. Manufacture of cement, lime and plaster. C.23.6. Manufacture of articles of concrete, cement and plaster. C.23.7. Cutting, shaping and finishing of stone, C.25.1. Manufacture of structural metal products.	F.41 Construction of buildings. F.42 Civil engineering. F. 43 Specialised construction activities.	L.68.1. Buying and selling of own real estate. L.68.2. Renting and operating of own or leased real estate. L.68.3. Real estate activities on a fee or contract basis.

Source: own study based on European Commission European Construction Sector Observatory (2016), pp. 56-57.

In this approach, the construction sector comprises four sectors according to the NACE Rev. 2 classification, referred to as subsectors of the construction sector in the broad sense. It is worth noting that the broad definition is used in EU analyses and reports concerning the implementation of the circular economy within the construction industry ecosystem. The following section presents the fluctuations in the Polish construction sector (in the narrow approach) between 2007 and 2024.

Fluctuations in the construction sector in Poland

According to World Bank data, in the first year of the COVID-19 pandemic (2020), economic activity contracted in approximately 90% of countries, surpassing the number of countries that experienced a decline during the two World Wars, the Great Depression of the 1930s, the emerging market debt crises of the 1980s, and the global financial crisis of 2007–2009 (Fig. 2).

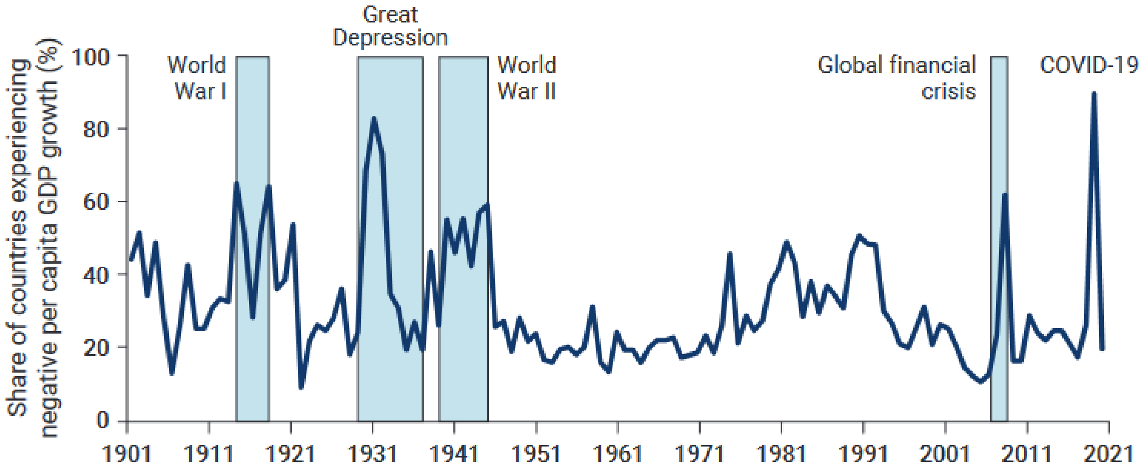


Fig. 2. Economic impact of COVID-19 in historical perspective

Source: (Holston et al., 2021).

Global real GDP growth in 2020 is estimated at – 3.1 percent in the International Monetary Fund's (2021) World Economic Outlook and – 3.5 percent in the World Bank's (2021) Global Economic Prospects. In the era of widespread globalization, which now encompasses virtually all spheres of human activity—social, economic, cultural, and scientific—along with the associated free flow of information, capital, goods, and people, the interconnections and interdependencies among national, regional, and continental economies have intensified. As a result, the impact and transmission of significant global phenomena, including so-called "black swan" events, have expanded, also affecting the construction sector.

Like other sectors and entire economies, the construction industry experiences fluctuations — seasonal, random, and cyclical. In economies at different stages of development, endogenous propagation processes combine with irregular exogenous shocks, creating a cyclical tendency for alternating phases of construction booms and downturns. As the most volatile component of investment cycles, construction cycles play a crucial role in shaping economic growth trajectories, driven by capital accumulation and technological advancement. During boom periods, construction investments are perceived as growth drivers, whereas in times of crisis, construction cycles act as propagators of economic instability.

The distinctive characteristics of the construction sector and the real estate market — where newly developed spaces are commercialized — contribute to its inherent instability. Key factors such as the long duration of investment processes, the global nature of the market and its strong links to capital markets, the longevity of real estate assets, and the absence of substitutes result in low supply and demand elasticity. Consequently, construction cycles tend to be the most volatile and prolonged among all economic cycles. During the analyzed period (2007–2024), the Polish construction sector underwent fluctuations but maintained an overall upward trend. Between 2007 and 2024, key sectoral indicators increased significantly: the sector's value-added rose by 167.92% (from PLN 85,344 million in 2007 to PLN 228,652 million in 2024) (Fig. 3), while the value of construction and assembly production grew by 185.3% (from PLN 135,714 million in 2007 to PLN 387,138 million in 2024) (Fig. 4).

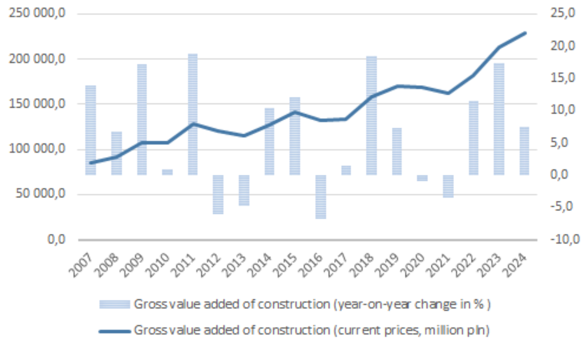


Fig. 3. Gross value added of construction sector in Poland

Source: own study based on (Eurostat, 2025c).

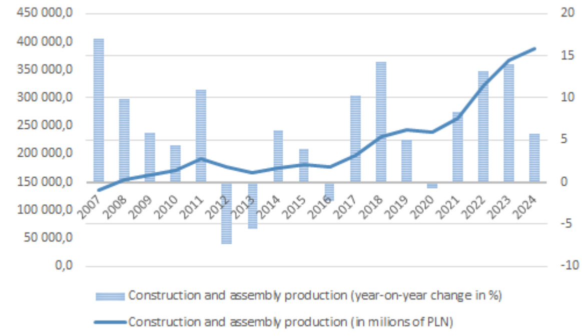


Fig. 4. Construction and assembly production in Poland

Source: own study based on (Statistics Poland, 2025a)

An increase in the number of companies in the sector by 109.4% was also recorded (from 206,323 in 2007 to 431,946 in 2024), accompanied by a 27.9% rise in employment (from 901.5 thousand people in 2007 to 1,153.3 thousand people in 2024) (Fig. 5–6).

Fig. 5. Number of enterprises in the construction sector in Poland

Source: own study based on (Eurostat, 2025c).

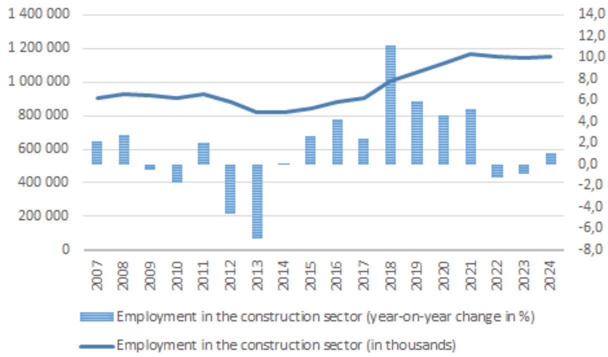


Fig. 6. Employment in the construction sector in Poland

Source: own study based on (Eurostat, 2025c).

The impact of global crises is evident in 2009, as well as in 2012–2013 and 2020, when negative trends were observed in the analyzed indicators. The most significant declines occurred following the Eurozone debt crisis (2012–2013). A more in-depth analysis of the real estate development sector further highlights the cyclical nature of fluctuations in the construction industry.

Examining developer activity in the residential market reveals that 2007–2008 was a period of economic prosperity, reflected in the growth of key indicators: the number of building permits issued for residential units, the number of housing projects initiated, and the number of completed dwellings (Fig. 7). In 2009, the market experienced a downturn, which deepened in 2012–2013. From 2014 onward, a gradual recovery in the housing market was observed, though it was disrupted by the COVID-19 pandemic in 2020, marking the crisis's lowest point. This was followed by a market rebound, which was subsequently corrected in 2022 due to the outbreak of the war in Ukraine. In 2024, a noticeable improvement in market conditions and developer sentiment has been observed. This is reflected in a substantial increase, exceeding 20%, in both the number of residential units granted building permits and the number of units for which construction has commenced.

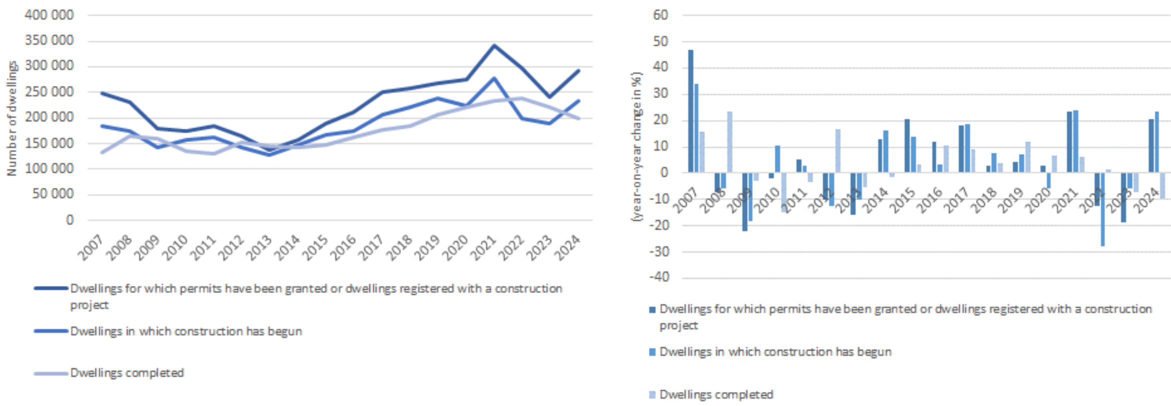


Fig. 7. Developer activity on the Polish housing market (number of dwellings – left, year-on-year change in % - right)

Source: own study based on (Statistics Poland, 2025b).

Over the analyzed period, the number of completed dwellings per 1,000 inhabitants increased by 69%, rising from 3.5 in 2007 to 5.3 in 2024. At the same time, the average usable floor area of newly completed dwellings decreased by 15.5%, from 105.6 m² in 2007 to 89.2 m² in 2024 (Fig. 8).

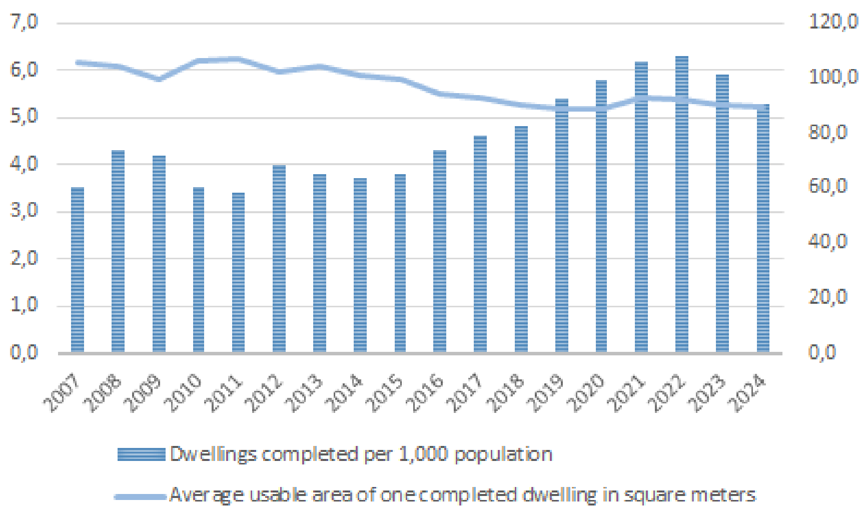


Fig. 8. Dwellings completed per 1,000 population (left axis) and average usable area of one completed dwelling in square meters (right axis) in Poland

Source: own study based on (Statistics Poland, 2025b, 2025c).

An analysis of the average transaction price per square meter of usable residential space in the primary market in Warsaw and the six largest cities in Poland indicates a sustained upward trend. However, the impact of global crises can be observed in periods of price declines occurring in 2009–2010 (global financial crisis), 2012–2013 (Eurozone sovereign debt crisis), 2020 (COVID-19 pandemic), and 2021 (outbreak of the war in Ukraine) (Fig. 9).

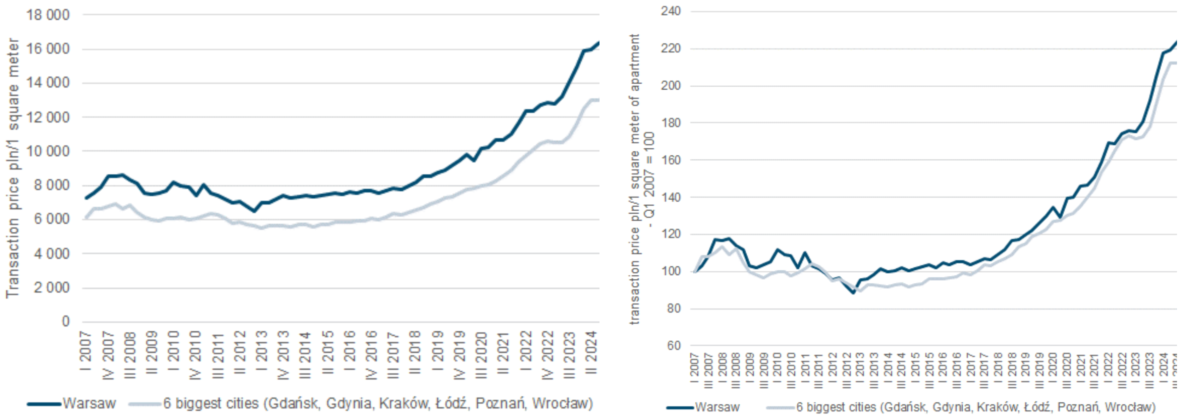


Fig. 9. Transaction price 1 square meter of usable area of the dwelling on the primary market in Warsaw and 6 biggest cities in Poland (in PLN – left, Q1 2007 = 100 - right)

Source: own study based on (National Bank of Poland, 2025).

In the commercial real estate market, developer activity has been subject to greater fluctuations. Following a period of strong economic conditions in 2007–2008, a sharp downturn occurred in 2009: the usable floor area of non-residential buildings for which construction permits were issued declined by 17%, while the usable floor area of completed non-residential buildings fell by 10% (Fig. 10).

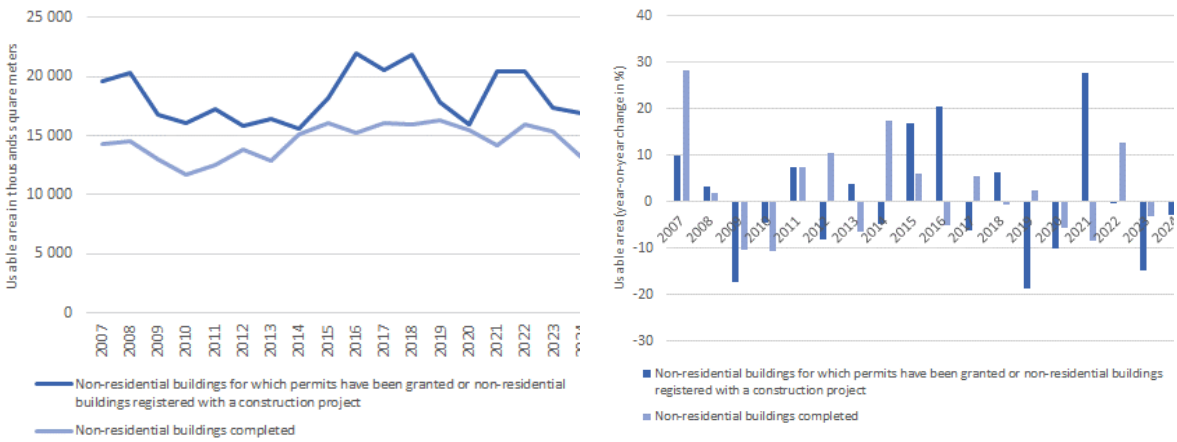


Fig. 10. Developer activity on the Polish commercial real estate market – non-residential buildings (usable area in thousands square meters – left, year-on-year change in % - right)

Source: own study based on (Statistics Poland, 2025b, 2025c).

After a slight recovery in 2011, another downturn in market conditions and a deterioration in developer sentiment were observed in 2012, reflected in an 8.2% year-on-year decrease in the usable floor area of non-residential buildings for which construction permits were issued. Another recovery in 2015 was followed by a significant collapse in 2019, with an 18.8% year-on-year drop in permitted non-residential construction area, largely attributable to the COVID-19 pandemic. A strong rebound occurred in 2021, with a record year-on-year increase of 27.8% in the usable floor area of non-residential buildings for which construction permits were issued. However, a renewed downturn in developer activity was observed in 2022–2023, continuing into 2024. In the subsequent part of the study, an attempt was made to assess the development of the construction sector using Hellwig's synthetic development measure**.**

Methodology

Hellwig's synthetic development measure (the Hellwig's method) was developed by Hellwig in 1968 (Hellwig, 1968). The method enables the ranking of objects from the least to the most developed based on the level of advancement of the phenomenon under evaluation. For each aspect of the analysed phenomenon, a set of diagnostic variables is selected on the basis of substantive and statistical criteria, and the corresponding data are collected. Subsequently, the Euclidean distance of each object from the reference object - the so-called development pattern - is calculated, and on this basis the synthetic development measure (synthetic variable) is derived. The measure takes values within the interval from 0 to 1, with values closer to 1 indicating a higher level of development.

The classical algorithm of the Hellwig method is similar to the widely used TOPSIS procedure (Hwang and Yoon, 1981). The TOPSIS method employs the concepts of distance to ideal and anti-ideal solutions. Its fundamental premise is that the selected object should exhibit the smallest distance from the ideal solution and the greatest distance from the anti-ideal one. In contrast, the Hellwig method relies solely on the concept of the ideal solution (Dulewicz and Filipowicz-Chomko, 2024, p. 467). References to and applications of the Hellwig method can be found, among others, in the works of Di Domizio (2008), Sokołowska and Filipowicz-Chomko (2015), Bąk (2016), Pawlas (2016), Reiff et al. (2016) and Roszkowska et al. (2022).

For the construction of Hellwig's synthetic development measure in this study, nine diagnostic variables were selected (Tab. 2).

Tab. 2. Diagnostic variables used to construct Hellwig's synthetic measure of development for the construction sector

Lp.	Diagnostic variables	Type of variable
x_1	Gross value added of construction (million PLN)	stimulant
x_2	Construction and assembly production (million PLN)	stimulant
x_3	Employment in the construction sector (thousands of employees)	stimulant
x_4	Number of enterprises in the construction sector	stimulant
x_5	Dwellings for which permits have been granted or dwellings registered with a construction project (number of dwellings)	stimulant
x_6	Dwellings in which construction has begun (number of dwellings)	stimulant
x_7	Dwellings completed (number of dwellings)	stimulant
x_8	Non-residential buildings for which permits have been granted or non-residential buildings registered with a construction project (usable area in thousands square meters)	stimulant
x_9	Non-residential buildings completed (usable area in thousands square meters)	stimulant

The standardisation of variables was performed using the following formula:

$$z_{ij} = \frac{x_{ij} - x_j}{s_j},$$

where:

z_{ij} – the standardised value of the diagnostic variable,,
x_{ij} – the diagnostic variable,
x_j – the arithmetic mean of the diagnostic variable,
s_j – the standard deviation of the diagnostic variable.

The taxonomic (Euclidean) distance in each year was calculated using the following formula:

$$d = \sqrt{\sum_{j=1}^{m}(Z_{ij} - Z_{0j})^2},$$

where:

d – the taxonomic distance,
z_{ij} – the standardised value of the diagnostic variable,

z_{0j} – the standardised value of the pattern (ideal solution - A theoretical object that attains the highest values for all diagnostic variables.

The synthetic Hellwig development measure was calculated using the following formula:

$$H_i = 1 - \frac{d_i}{d_{max}},$$

where:

H_i – the synthetic development measure of the construction sector in year i,
d_i – the taxonomic distance in year,
d_{max} – the maximum distance.

Empirical results

The values obtained from Hellwig's synthetic development measure for the construction sector in Poland clearly indicate a dynamic expansion of the sector over the analysed period. Between 2007 and 2024, the measure increased fourfold - from 0.1439 in 2007 to 0.580 in 2024 (Fig. 11). In addition to the upward trend, cyclical fluctuations of the measure can also be observed. Following an increase in 2008, a decline occurred in 2009–2010, reflecting the lagged impact of the 2008 global financial crisis. Subsequently, after a slight recovery in 2011, the indicator fell again over the next two years, with the sharpest drop recorded in 2013 (a value of 0), resulting from the combined effects of the 2008 global financial crisis and the 2011 Eurozone sovereign debt crisis. Beginning in 2014, the construction sector exhibited relatively stable development, reflected in a year-on-year increase in the indicator, which was interrupted in 2020 due to the global crisis triggered by the COVID-19 pandemic.

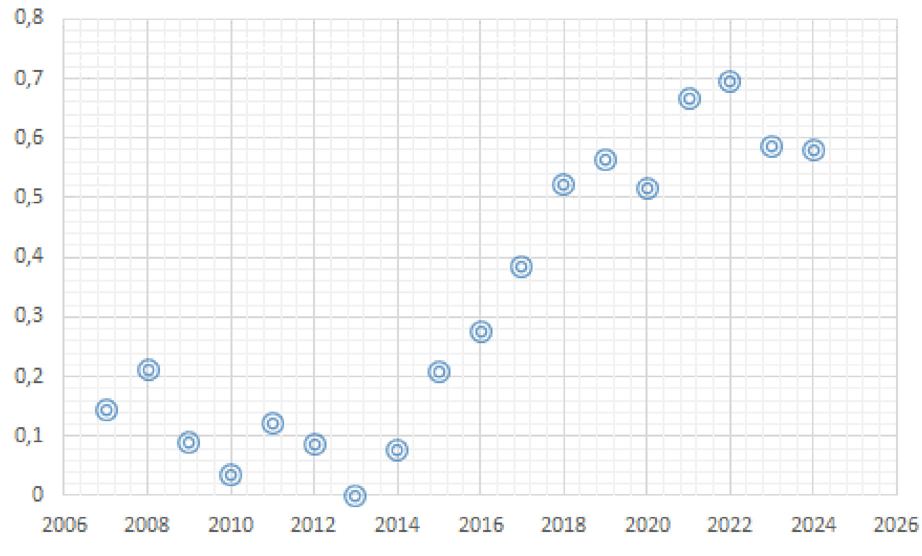


Fig. 11. Hellwig's synthetic development indicator for the construction sector in Poland
Source: own study.

The recovery and renewed expansion that began in 2021 reached their peak in 2022 (Hellwig's synthetic development measure of 0.685). In 2023 and 2024, however, a slowdown in development was recorded, attributable to the lagged effects of the outbreak of the war in Ukraine

Conclusions and Recommendations

The obtained research results allow for the formulation of the following conclusions:

1. Over the analysed period (2007–2024), the construction sector in Poland exhibited dynamic development. Hellwig's synthetic development measure increased markedly, rising from 0.1439 in 2007 to 0.580 in 2024.
2. The development trajectory of the construction sector was characterised by cyclical fluctuations. Global shocks and crises generated downturns and growth slowdowns, which were reflected in declines in Hellwig's synthetic development measure in:

- ✓ 2010 - the lagged impact of the 2008 global financial crisis,
- ✓ 2013 - the cumulative effects of the 2008 global financial crisis and the 2011 Eurozone sovereign debt crisis,
- ✓ 2020 - the global crisis triggered by the COVID-19 pandemic,
- ✓ 2023 - the lagged impact of the outbreak of the war in Ukraine.

3. In the years 2007–2013, forces inhibiting the development of the construction sector in Poland predominated, as reflected in the downward trend of Hellwig's synthetic development measure. In contrast, during the period 2014–2022, forces stimulating development clearly prevailed, which was evidenced by a steep upward trend in the value of Hellwig's synthetic development measure.

This study has limitations: the analyses conducted in this study refer to global crises of a shock-type nature (sudden events). An important issue not covered in the present research is the impact of global systemic crises (e.g., the climate crisis), which are associated with the long-term transformation of the sector and entire economies. The progressing climate crisis currently represents one of the most significant global challenges. It is estimated that the construction sector is responsible for 38% of global greenhouse gas emissions, of which 28% results directly from the operational use of buildings (Polish Green Building Council, 2021). These phenomena will undoubtedly influence the development of the construction sector in individual countries and in the global economy.

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