

REGIONAL OFFICE SPACE SUPPLY AND ECONOMIC GROWTH IN POLAND

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ARTICLE INFO	ABSTRACT
Keywords: office space supply, estimation of office stock, regional growth	The office space supply is an important factor for highly skilled jobs, which generate a large added value and boost regional economic growth. Earlier studies for Poland have shown that office construction is concentrated around the capital city, while there is much less of new supply in the remaining regions. To understand office supply we need to compare it to regional GDP growth. However, at a regional level, new office supply comes in bulks, and this makes an econometric analysis infeasible. Therefore, the growth of the office stock should be studied, which is a smoother variable and can be linked to GDP growth. However, no official estimate exists. This article proposes a method to calculate the regional office stock in Poland with the help of various data from Statistics Poland. In the second step, the growth of this calculated office stock is put into a relationship with GDP growth. We find a nonlinear relationship between these variables, which differs across the regions. This finding calls for further investigations.
JEL Classification: R11, R12, R33	
Citation:	
	Olszewski, K. (2026). Regional office space supply and economic growth in Poland. <i>Real Estate Management and Valuation</i> , 34(3), 22-32. https://doi.org/10.2478/remav-2026-0022

1. Introduction

Modern analyses of economic development emphasize the role of human capital and physical capital. However, while human capital is thoroughly examined and quantified in these analyses, commercial real estate, which makes an essential contribution to the production function, is generally not even mentioned and is instead treated as a form of physical capital. For example, Mutreja (2014) distinguishes physical capital into equipment and structures, but due to data limitations does not look into office, residential, and other property types, separately. Office employment is important for workers, but it also generates demand for other property types, as workers ask for housing and amenities. Gillette (2023) provides an extensive literature review on this topic considering the rise of remote work, which temporarily disrupted those positive externalities. Under such a scenario, one could ask whether investigating the office space stock in Poland is still of interest. However, while writing this article (September 2025), there are publications by large advisory companies about the fact that firms plan to return to the office and strategies how to do so in a proper way are proposed. Recently some firms state

that they would like to expand their office space, but there is not enough supply. New offices that are currently delivered are largely adjusted to serve as a backup place for remote work. This means that true office space is scarce, while a significant share of the area is used as conference rooms in which the workers meet from time to time when such a need arises. However, such meeting rooms are not well suited for desk work, and some renovations and construction work are needed to adjust the office space for standard office work. Thus, the topic is once again gaining prominence and should be supported by academic research.

Commercial real estate, in general, is important for regional development, as shown by Babalievsky, Herkenhoff, Ohanian, and Prescott (2023) for US regions. In the case of Poland, studies by Brzychcy (2014) for Szczecin and Maleszyk and Sagan (2016) for Lublin show that the development of office space attracts investors and contributes to the development of the local economy. However, in Poland, there is a very uneven distribution of new office space construction per capita across the voivodeships (Mazovia has a very large share), while this indicator is

more evenly distributed for residential and retail space (Łaszek & Olszewski, 2018). The concentration of office space in Warsaw and the further development of new office space there in the recent years is explained by Olszewski, Trojanowski, and Łaszek (2024), who call this process uncreative destruction, which we explain in some detail: under low interest rates, and despite growing construction costs, investors mainly choose Warsaw for new office construction. The Warsaw market is the biggest office market in Poland and has the highest office rents. Investors choose it because, despite the growing competition, they are able to find demand for their office supply there, temporarily lowering rents, using the following mechanism: they lower the rent of the new building by the amount of money they should put aside for future capital expenditures, and still obtain the expected free cash flow. This way, new offices attract tenants, who move out of older buildings that are, moreover, in unfavorable locations. However, such a strategy can be followed only for several years, until capital expenditures need to be made.

The phenomenon of office construction being concentrated in mainly one or a few large cities is also known in other countries, such as Great Britain. Henneberry and Roberts (2008) argue that the concentration of office buildings in London and a "handful" of other cities contradicts the theory of rational capital allocation, which postulates a much more even distribution of office space among different cities.

To analyze the evolution of the office stock in relation to regional GDP growth and vice-versa, data about the office stock is needed. But there are no official statistics in Poland about the office space stock in each city or the country as a whole. While there are very good and granular statistics about the housing stock and also very good data about the retail space stock in Poland from Statistics Poland, there is a limited amount of data from international advisory firms. This data has some flaws. Firstly, the big advisory firms focus on a few large cities. Secondly, they focus only on prime property, which is the core of their business. But, as international evidence and the book by DiPasquale and Wheaton (1994) show, each kind of modern office space is important for the modern economy. Sure, the biggest firms are usually located in the top office buildings, but there is a vast amount of private and governmental firms that contribute to the economy which are in smaller office buildings, which are located in the outskirts of the city and also in the

agglomeration.

2. Material and methods

The main contribution of this paper is the estimation of the office space stock in the 16 agglomerations of Poland and linking this variable with economic growth. So far, there is no official estimate of the office stock, and we therefore need to estimate it based on the available, public data. The steps involved in doing so have to be explained in detail. The data about new construction is collected from various publications from Statistics Poland. We decided to focus not on the 16 voivodeship capital cities alone, but rather on their agglomerations. The focus on agglomerations is based on economic theory (see for example DiPasquale and Wheaton, 1994). From the theoretical point of view, office space is a type of property which generates services for inhabitants, similarly to the way residential buildings, retail buildings etc. do, but each kind of property generates a unique service. Due to the land rent and its gradient, the more productive properties are in the city center, and the less productive ones are in the outskirts. This division means that one finds skyscrapers in the city center and smaller buildings, mainly detached houses, in the outskirts. People who work in office buildings live in different parts of the agglomeration, so they also use other services located in buildings in various locations. The functioning of the real estate sector as a significant part of the metropolitan economy is presented in detail, both in theoretical and empirical terms for the Boston Metropolitan Area, by DiPasquale and Wheaton (1994). Whilst the literature on real estate investment usually focuses on large scale investments in high-rise buildings, the macroeconomic view of the market should treat all office buildings equally. This is the same logic which applies to all other forms of capital. We are aware of differences between small shops and large factories, cabs and large machines, but in a classical or modern growth model, they all enter the equation as the cumulated capital stock.

We need to explain how the composition of the agglomerations was chosen. The initial point is to start with the capital cities of the 16 voivodeships of Poland and their agglomerations. We apply the agglomerations (sometimes also called metropolitan area) that were defined by Eurostat (2025) and Statistics Poland (2025). A detailed discussion about how the concept and definitions evolved for Poland can be found in Gorzelak, Jałowiecki, and Smętkowski (2009) and also in Puc and Pazder (2023). Churski et al., (2023)

present a detailed analysis of the concept of Functional Urban Areas, and related areas and their definitions.

In this article we decided to rely on the NUTS3 regions and their socio-economic data, which are widely used for the analysis of the growth and convergence of regions in the European Union. We decided to apply the NUTS3 regions also due to the fact that we need to base our estimates and calculations on precise and publicly available data, which are available at the NUTS3 level for Poland. In some cases, we needed to add adjacent NUTS3 regions to obtain the agglomeration. For example, in the case of Warsaw, we added the Warsaw NUTS3, the Western Warsaw Region and the Eastern Warsaw Region, to obtain the Warsaw agglomeration. For Łódź, we added the surrounding Łódzki NUTS3 region, and for Katowice we included also the Bytomski, Gliwicki, Sosnowiecki and Tyski NUTS3 region. A table of the 16 agglomerations and how they are composed is presented as Table A.1 in the appendix.

The data about new office construction have been available at the municipality level only since 2005, before having been published at the voivodeship level. The problem with this is that Poland underwent an administrative reform. The 49 voivodeships, which functioned until 1999, were transformed into 16 larger ones in 2000. However, the former, small voivodeships were not only merged into larger ones; their administrative borders were significantly shifted as well. Moreover, in the initial years only the volume of new office space, and not the floor area, was published. We explain our calculations in the following 5 steps.

The first step involves the years 1995-1999, where data from Statistics Poland on the volume of newly delivered office space in the old voivodeships is used. To obtain the floor area, the volume is divided by the average height for each old voivodeship. This ratio was calculated from data for the years 2005-2010, for which both the floor area and the volume are available (such data is available also for the most recent years, but is necessary only for calculations about the past). We find that due to the technical improvements of the more recent buildings, the floor height increased by a few percent.

The second step deals with the years 2000-2004: For that period, we obtained data about the newly delivered floor space, but only for the 16 new voivodeships. The problem is that the only data available is for the voivodeships, thus only at NUTS2

level, while we need NUTS3 level data. To obtain the appropriate data we used the average share of the space at the NUTS3 level to space at the voivodeship level for the years 2005 – 2010 and applied this share backwards to the data for the voivodeships for 2000 – 2004.

The third step covers the years 2005-2024: Since 2005, Statistics Poland has been publishing annual data about delivered office space for each "gmina", i.e. municipality. We decided to use the NUTS3 regions, which are rather close in size to the old voivodeships.

In the fourth and final step, we add the delivered space for each year. From 2016, quarterly data is also available, so one could go into the calculation of the quarterly office stock. We skipped this step here, because we want to use the data for a macroeconomic perspective, where most other variables are on an annual basis.

The fifth step is adding monetary value to the meters. To apply monetary value to the estimated stock, we need to use the price of the newly constructed office space. Since we do not have such data, we estimate it with the help of the total cost of construction, including land, which is published by the Narodowy Bank Polski (2025, tables 4 to 12). This idea follows the DiPasquale and Wheaton (1994) model, in which developers build new office or other real estate buildings, when the market price covers at least the construction costs or exceeds them. So when there is new construction under way, which we observe for all the analysed agglomerations, the construction costs can be considered as a proxy for the value of real estate. However, the Narodowy Bank Polski (2025) construction costs data covers only 9 of the biggest cities and the years 2015-2025. We need to make extrapolations, which are based on the transaction prices of newly constructed house, also published by Narodowy Bank Polski (2025). We assume that, for the agglomerations, the dynamics of construction and land prices for residential buildings are closely related to the construction costs, including the land prices of office buildings. Similar materials are used, both types of buildings compete for similar construction land. In the first step we need to find a proxy for the office construction prices for the 7 cities for which Narodowy Bank Polski (2025) does not publish data¹. Comparing house prices of newly constructed housing for those 7 cities we find that they are quite similar to house prices in Łódź. Therefore, we apply the office construction

¹ These cities are: Białystok, Bydgoszcz, Kielce, Olsztyn, Opole, Rzeszów and Zielona Góra. The city of Zielona Góra

has house prices that are lower by 20% than those in Łódź, so we adjusted their office construction costs downwards.

costs from Narodowy Bank Polski for Łódź also for the 7 cities with no available data. In the next step we use the dynamics of the house prices to extend the office construction costs backwards, up to 2025. We use those approximated and extended backwards prices for office buildings, deflating them with the CPI index (with 2024 = 1), so that we obtain real prices. The previously estimated office stock in 2005 is multiplied by the real price in 2005. New construction in 2005 is also multiplied by the real price. The value of the stock is depreciated by the depreciation rate (see step 5) and, in 2006, we add new constructed office space, multiplied by the real price in 2006. In the following years we repeat the same procedure and, in this way, we obtain the value of the office stock in 2024 real prices. This approach is similar to the one used to calculate the capital stock in macroeconomic literature.

The fifth step, depreciation of the stock. We include the depreciation of the existing stock since 2005, both for the square meters and the value. We assume that, before 2005, the stock does not depreciate. The construction of modern office buildings at a reasonably high scale started in Poland in 1995 and expanded after the country's accession to the EU in 2004, when there was inflow of foreign capital. Estimates of the depreciation rate of office buildings by Baum and McElhinney (1997) for the UK, and Bokhari and Geltner (2018) for the US show that a figure between 1% and 2% per year is reasonable. Interestingly, newer buildings tend to depreciate slightly faster, which the authors explain with the fact that older buildings usually have a better location, so even if they depreciate technically, they will still find tenants. We apply an annual depreciation rate² of 2%. One could apply a varying depreciation rate across time and regions. For example, whenever there is a construction boom in a region, old office space should depreciate faster. However, this requires further research and would need to include data about demolitions. However, an outdated building can exist for some time until a new investor decides to demolish it and build something else there, so even data about demolition does not tell us much about the rate of depreciation.

3. Results

The estimate of the office stock for the agglomerations

allows us to analyze its evolution over the years 2005 – 2024, to put it in relation to their economic situation and their office-work related employment.

We find a huge difference between the stock in Warsaw and the remaining cities, both in square meters and monetary values (Figure 1 and 2). This finding is in line with the figures which large real estate advisory firms publish for the 9 largest cities in Poland. In Warsaw, the office stock which is presented by large advisory firms shrunk in 2024, due to the demolition of relatively new office buildings that were constructed in the 1990s. Additionally there are news about the change of use of some new office buildings into residential buildings. This will decrease the available office space even more. The next step is to put these differences in relation to economic growth and office related employment.

The real GDP per capita differs across the agglomerations (Figure 3), but the differences are not as large as the differences in the office stock (Figures 1 and 2). We, therefore, need to look at office employment in the agglomerations, or more precisely at the share of office space and office space related workplaces for each of the agglomerations (Figure 4). Data about office employment is not available for the agglomerations in Poland, so we need to make an estimation.

The data about employment (full-time equivalent) provided by Statistics Poland according to the NACE Rev 2 definition³, available at the NUTS2 level, are used, and employment in the following sectors is considered to be closely related to office work: Section J) information and communication; Section K) financial and insurance activities, Section L) real estate activities; Section M) professional, scientific and technical activities; Section N) administrative and support service activities, and Section S) other service activities. We need to point out that employment data is available only at the NUTS2 level, which means it covers the entire voivodeships. It is possible that the NUTS2 region has a different distribution of jobs than the agglomeration, but it is reasonable to assume that the office related jobs are usually located in the agglomeration of each voivodeship. We therefore use the word "implied" to state that the office employment in each agglomeration is implied based on other data

² We apply this depreciation rate to the physical stock. One can find higher values of the depreciation rate in the literature, but those apply to the value of the stock. For example, if there is fast technological progress in energy efficiency, older buildings will need to undergo significant

modernizations to keep up with the newer buildings. The high depreciation rate reflects this. In our macroeconomic setting, the quality of the building is neglected, and we focus on the pure space.

³ <https://ec.europa.eu/eurostat/web/nace>

for the whole voivodeship. Figure 4 shows, in the left panel, the estimated share of each agglomeration in the estimated office work employment in Poland, while the right panel shows the share of each agglomeration in the total office stock. We find some small disparities, but for most of the biggest cities the two figures seem to be coherent, also at the end of 2023. This

observation could be considered as proof that the estimated office space stocks reflect the factual stock. The disparities and their change over time are an interesting subject for further studies, which should include local parameters like construction costs, rental rates and vacancy rates, and also somehow cover the risk aversion of investors for local markets.

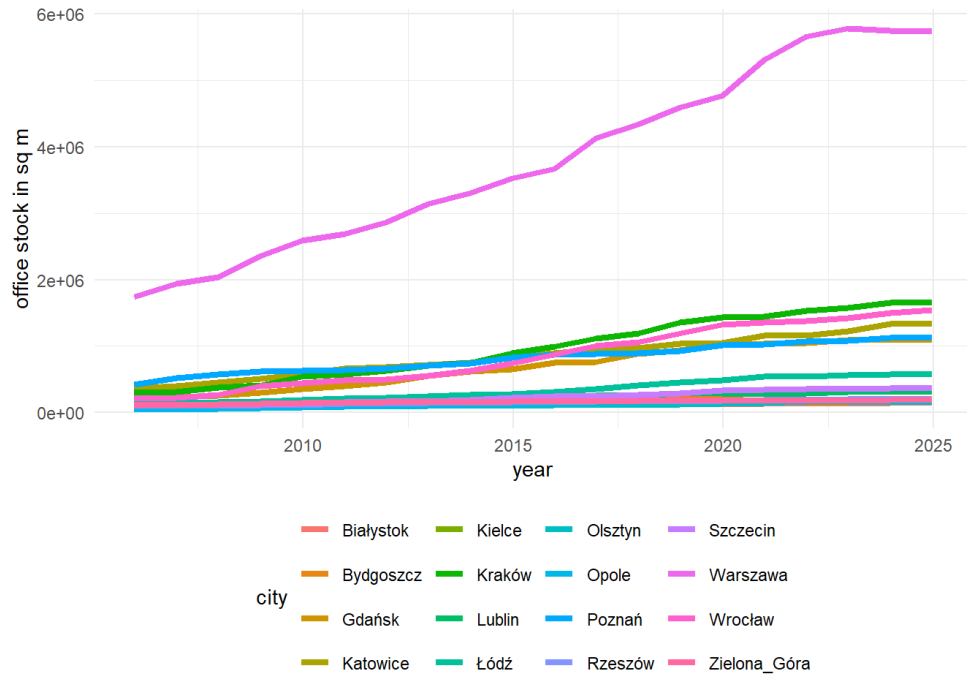


Fig. 1. Estimated office stock in the agglomerations in square meters. *Source:* author's own calculations based on Statistics Poland data.

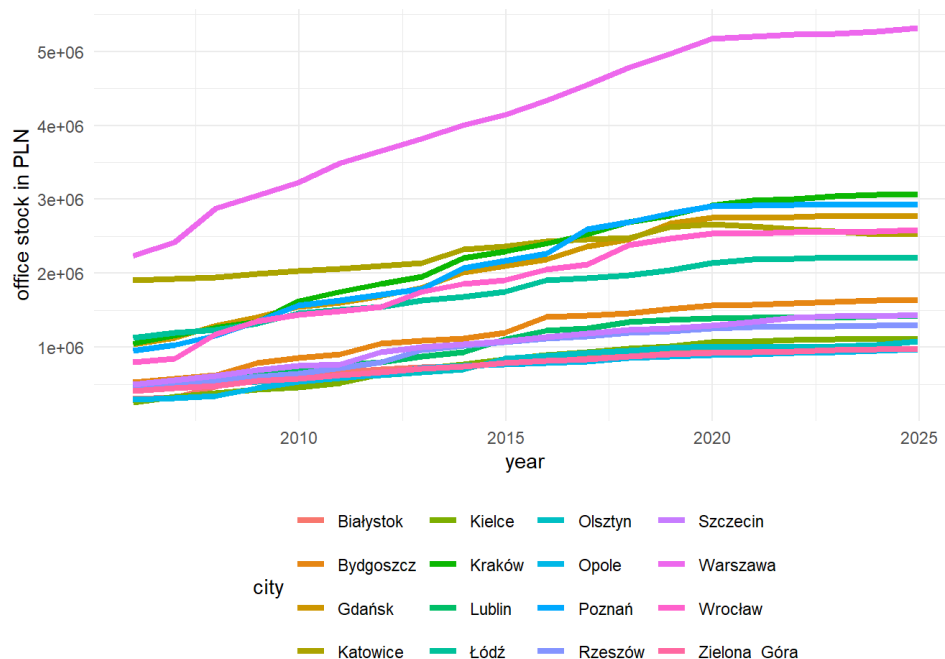


Fig. 2. Estimated office stock in the agglomerations in PLN. *Source:* author's own calculations based on Statistics Poland data.

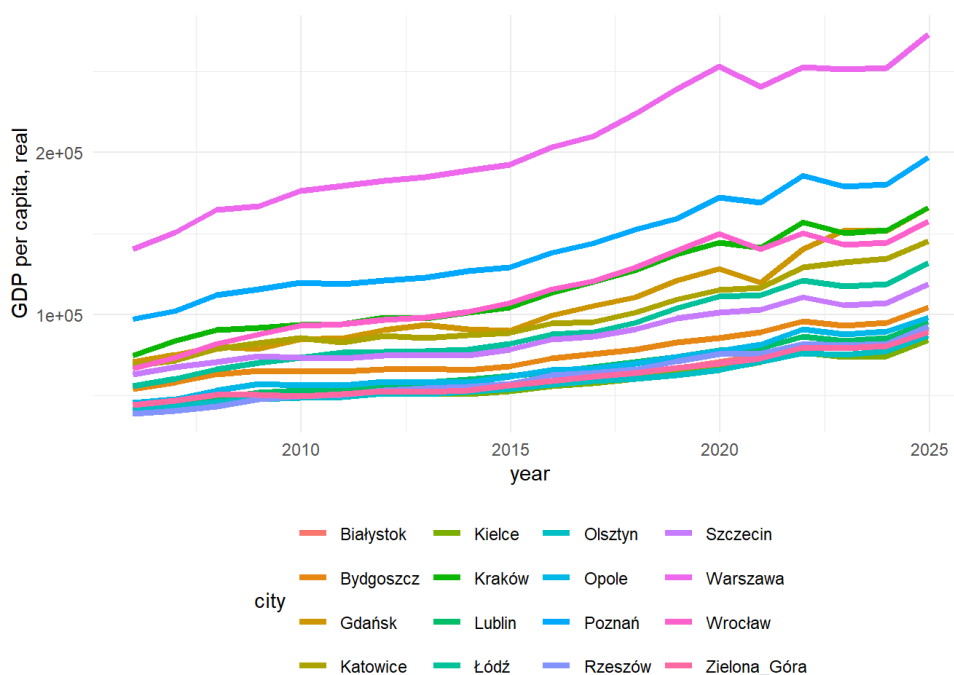


Fig. 3. Real GDP per capita in the agglomerations. Source: Statistics Poland.

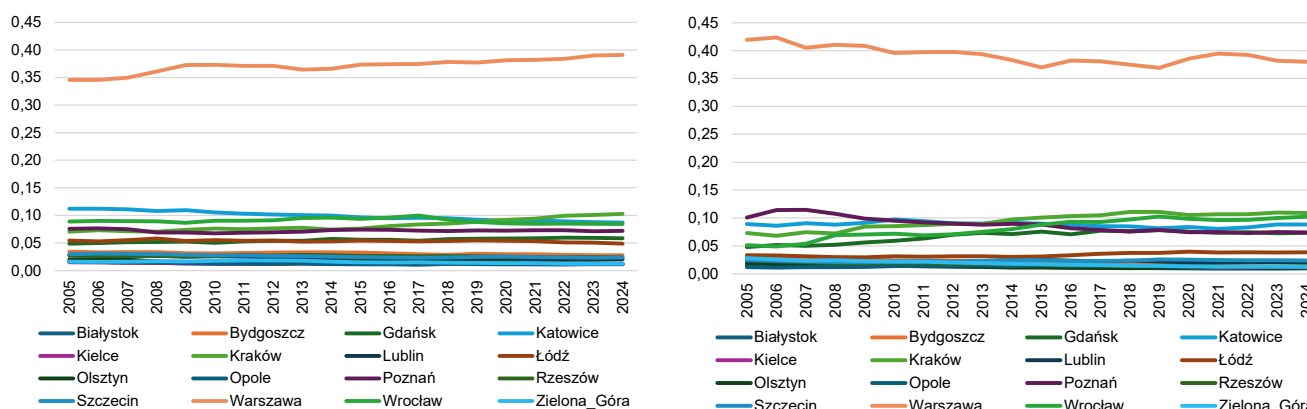


Fig. 4. Share of the agglomerations in the implied employment in office related jobs (left panel) and share of the agglomerations in the total office stock (right panel). Source: authors calculations on Statistics Poland data.

We shall thus move to an analysis of the dynamics of the regional economy, the CPI and the office stock. Figure 4 shows the annual growth rates. The office stock growth (both in square meters and value expressed in PLN) is subject to variation over time, but a pattern can be observed. To make such an analysis easier, Figure 5 presents the Hodrick Prescott filtered trend of the series⁴. The real GDP per capita grew in a

similar fashion across the agglomerations; it observed a significant growth in 2005, after Poland accessed the EU, and declined after the global financial crisis. Since then real GDP has been rising, though it observed a bump when the Russian war in Ukraine broke out. The CPI for the whole of Poland was moderate between 2005 and the beginning of 2022, with 2015-2016 even revealing a deflation. The CPI started to rise rapidly in

⁴ The Hodrick and Prescott (1997) filter is a mathematical method to smooth time series. It is assumed that a time series follows a long term trend, but temporarily deviates from it. Such a deviation is called the cycle and is used widely in the

macroeconomic literature. In this paper we are more interested in the long run developments and thus focus on the trend.

2022 and 2023, which was related to the COVID-19 pandemic and the war, and since then has declined to the usual levels. The office stock, however, shows a different, though understandable picture. It grew at the highest pace in most agglomerations in the initial years

and then the growth rate declined. This is a normal observation because, in 2005, there was little office space, so any new construction increased the stock significantly.

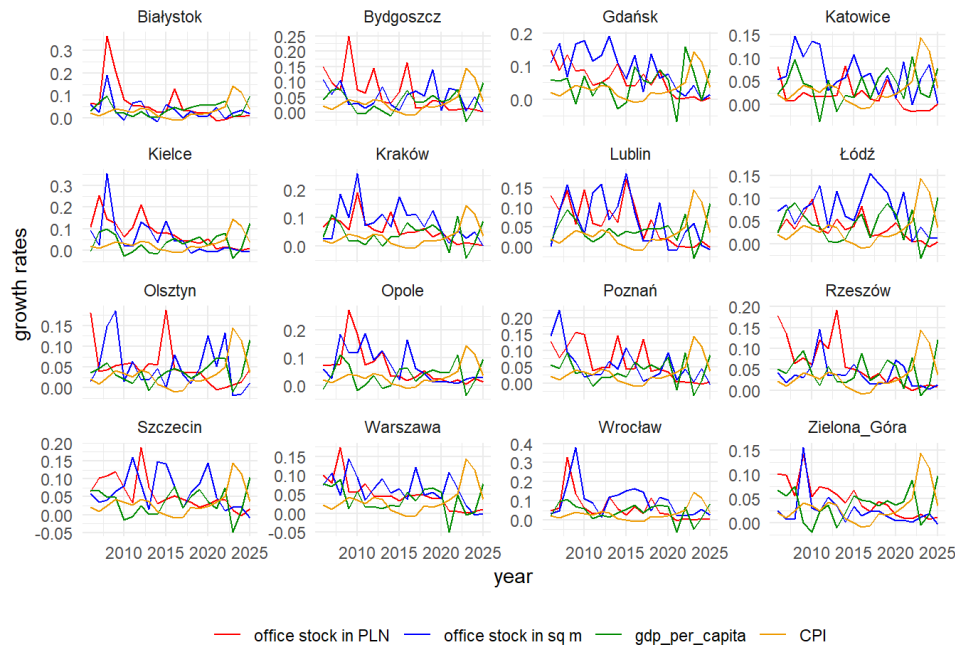


Fig. 5. Growth rates of office stock, real GDP per capita and CPI. *Source:* own study.

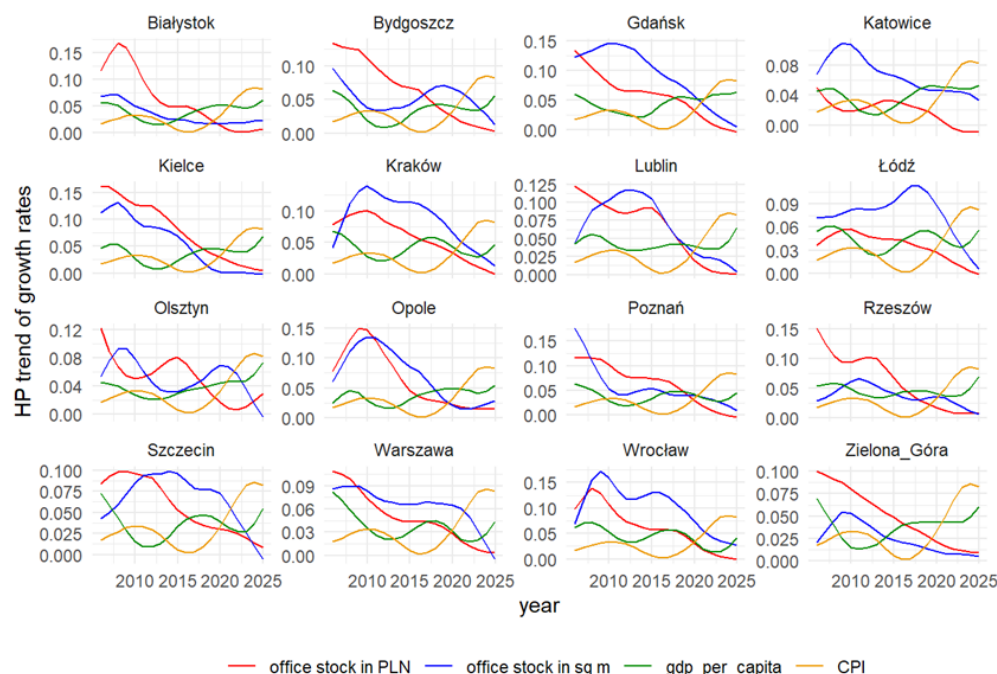


Fig. 6. Hodrick-Prescott trend of growth rates of office stock (in square meters and in PLN), real GDP per capita and CPI. *Source:* own study.

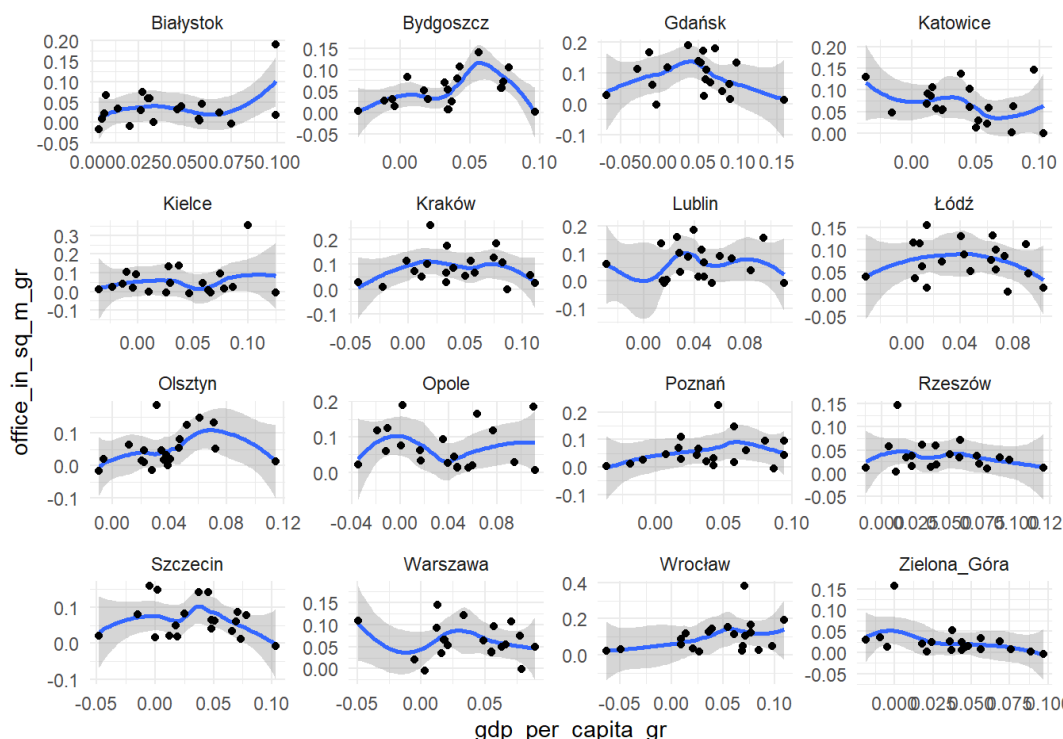


Fig. 7. Loess smooth of the relationship between GDP per capita growth and office space growth (in square meters). Source: own study.

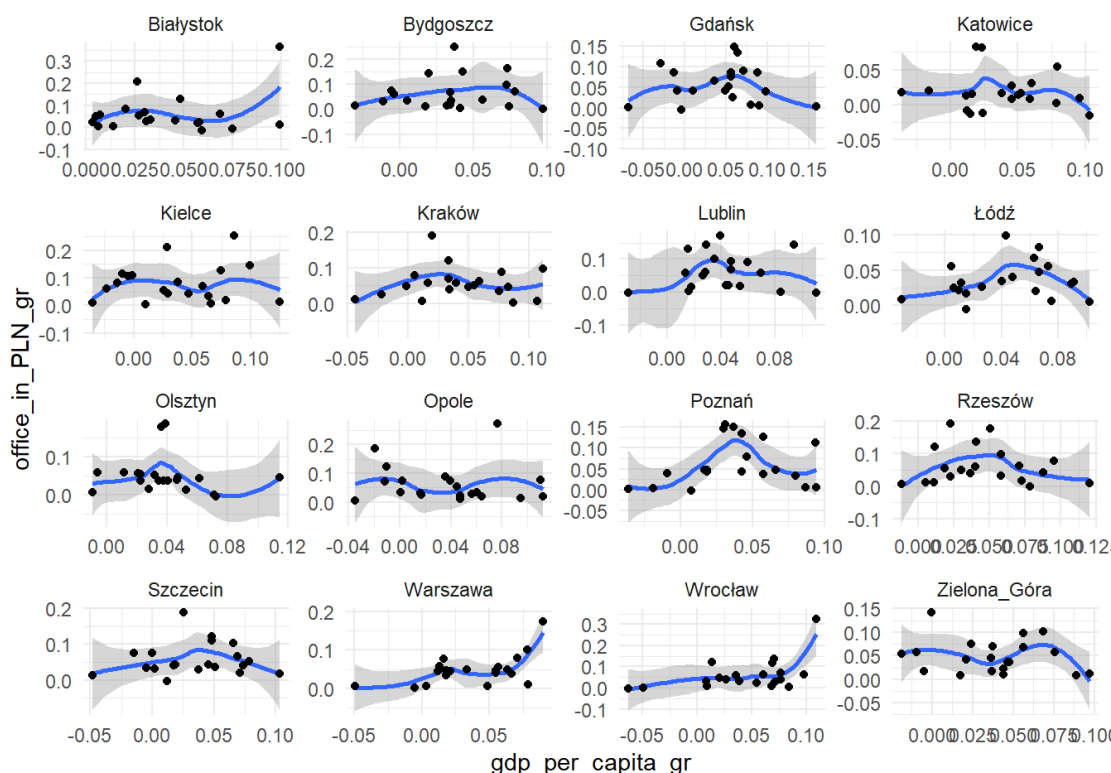


Fig. 8. Loess smooth of the relationship between GDP per capita growth and office space volume growth (in PLN). Source: own study.

As the stock grew, the new construction in relation to it started to decline but was in fact on a rise in absolute terms. When the value of the office stock is considered, we see that the growth rate declines even

faster. The reason is that the estimated value of new office construction declines in relation to the depreciation of the office stock. All agglomerations share the fact that new office construction fell close to

zero after the COVID-19 pandemic, when demand for office space seemingly disappeared. The current news tells us that work in the office is getting back on track, and there will be demand for office space in the future. This might not, however, be simple to supply, as for example some plots of land that were intended for office construction in Warsaw were adjusted to host residential real estate. This calls for further research. Since 2016, Statistics Poland publishes quarterly data which allow changes to be tracked much faster than with the use of annual data. One could add the quarterly new construction to our estimated office stock in 2015 and follow the quarterly changes more precisely, but this is beyond the scope of this paper. Finally, we show how the office growth rate and the GDP per capita growth rate are related. We see that the growth rates vary, which is due to the time one needs to obtain permits and financialization, thus we decided to apply a loess smooth to the scatter plot. The picture for the agglomerations is rather mixed. Warsaw, the capital city and biggest office market in Poland, hardly shows any interpretable pattern. This could mean that, due to investment policies and potential future gains, investors build office space despite some short-term turbulences in the economy. Wrocław and Poznań seem to follow a more expected path, office space growth and economic growth go hand in hand. Gdańsk, however, shows an inverted U-shape, which means a general positive correlation, but after some break-even point is reached, the supply of office space declines. A potential explanation might lie in the large demand for residential buildings, which the developers make good and rather timely profits on, while office investments can take some time to achieve gains.

5. Discussion

The estimation of the office stock and its value for 16 agglomerations in Poland is, to our best knowledge, the first attempt to provide researchers with data that they can use for further investigations of the productivity and competitiveness of the regions of Poland. It is affected by some flaws, which can impact the results and should be mentioned here. The first is the usage of transaction prices of newly constructed residential buildings to extend the value of the office construction before 2015, i.e. before Narodowy Bank Polski data are available. From the empirical point of view, in a broader sense, residential and office buildings use very similar input materials in similar proportions, i.e. land, materials and work. However, there might be some specific components of the office building, as for example cooling devices, which are usually not

included in residential buildings, or high rise parking lots, which can have an impact on the full costs of building an office and the dynamics of those prices. Further, the depreciation of the office stock might vary among the regions, especially in those with a high pace of new construction buildings can become outdated quite fast and require further upgrading. This problem could be covered in further research. There is no simple way to verify the estimated office stock with nothing really to be used as a benchmark, since there are no official statistics as of yet. The big real estate firms cover only few largest agglomerations, while we cover all 16 agglomerations in Poland. However, the estimated share of office space in each agglomeration is quite consistent with the estimated share of estimated related work in each agglomeration. This is true for 14 agglomerations, besides the discussed cases of Warsaw and Poznań, which call for further research.

6. Conclusions

This paper proposes how to estimate the office stock in the biggest agglomerations in Poland in terms of size and value. The construction of the agglomerations from Statistics Poland NUTS3 data is also explained. The estimated office stock is put into perspective of office work related jobs, which should create demand for office space. We find the biggest office stock to be in Warsaw, the capital city agglomeration, which is in line with the biggest office work related employment. We find that, in most agglomerations, the office stock grew faster in the initial years than later, which is the result of a start with a very small office stock, i.e. the base effect.

The algorithm could be used by researchers from other countries to estimate their office stock, both in square meters and in monetary value.

Statement

The estimated office stock in the agglomerations, both in square meters and in monetary value will be provided upon being published on the following page to the readers: <https://repod.icm.edu.pl/>

Acknowledgements

I would like to thank the Editor and two anonymous referees for their detailed comments and questions. Their questions motivated me to present a detailed explanation about how the agglomerations and their composition were selected. Moreover, their comments made me rethink the sectors of the economy that can be considered as being office – work related. They also made me to use a better measure for the value of the

estimated office stock, which now relies on the costs of the complete construction of an office building that is published by Narodowy Bank Polski (2025) and which is extended backwards by the dynamics of newly constructed house prices, also published by Narodowy Bank Polski (2025). One referee pointed out that different depreciation rates could exist for different agglomerations, which is an important fact that has been included in the discussion section.

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Appendices

Table A.1 composition of the 16 agglomerations

Agglomeration	Official attribute of the core NUTS3 region according to the metropolitan typology (Statistics Poland, 2025)	Consists of the following NUTS3 subregions (Polish names)
Białystok	Non-metropolitan regions	Białostocki
Bydgoszcz	Other metropolitan regions	Bydgosko-Toruński
Gdańsk	Other metropolitan regions	Gdański, Trójmiejski
Katowice	Other metropolitan regions	Katowicki, Bytomski, Gliwicki, Sosnowiecki, Tyski
Kielce	Other metropolitan regions	Kielecki
Kraków	Other metropolitan regions	Miasto Kraków, Krakowski
Lublin	Other metropolitan regions	Lubelski
Łódź	Other metropolitan regions	Miasto Łódź, Łódzki
Olsztyn	Other metropolitan regions	Olsztyński

Opole		Opolski
Poznań	Other metropolitan regions	Miasto Poznań, Poznański
Rzeszów	Other metropolitan regions	Rzeszowski
Szczecin	Other metropolitan regions	Miasto Szczecin, Szczeciński
Warszawa	Capital city metropolitan region	Miasto Warszawa, Warszawski Wschodni, Warszawski Zachodni
Wrocław	Other metropolitan regions	Miasto Wrocław, Wrocławski
Zielona_Góra	Non-metropolitan regions	Zielonogórski

Source: Statistics Poland