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THE INTERPLAY OF INCOME GROWTH AND HOUSING PRICES: A DECADE OF REAL ESTATE DYNAMICS IN POLAND'S LARGEST CITIES

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Abstract

This study explores the relationship between income growth and housing prices in Poland's seven largest cities from 2013 to 2024. Through statistical analysis, the research reveals a strong correlation between average gross wages, and both offer and transaction prices in the real estate market, confirming the hypothesis of a relationship between income growth and housing price increases. Despite economic fluctuations, the purchasing power of the average salary in real estate has remained remarkably stable. Moreover, the study introduces Premium and Buying Signal indicators, which can help identify market opportunities for buyers and investors by highlighting periods of undervaluation. These findings underscore and demonstrate the challenges of housing affordability in urban Poland and raise potential questions about the effectiveness of various social policies. The research offers interesting practical insights for policymakers and investors, emphasizing the need for continued monitoring and targeted interventions to ensure sustainable housing affordability.

JEL classification: O18, O10, R20, R21, R30, R31

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Introduction

The challenge of housing is a significant concern in the field of urban economics as it impacts not just individual financial situations but also plays a crucial role in shaping the larger economic and social fabric of countries worldwide. As cities grow and evolve further over time, access to housing becomes a factor influencing both economic prosperity and social equality. In Poland, a nation that has experienced major changes since the end of communism in 1989, the issue of housing affordability has grown more intricate and urgent.

Poland has seen astonishing growth as it shifted from a centrally planned economy to a market-based system. The country's GDP per capita has tripled over the last three decades, demonstrating a period of rapid development and increasing prosperity (Polish Economic Institute, 2024). This progress in the economy has led to improved living standards with salaries in Poland doubling in the last decade (Statistics Poland, 2024). The encouraging signs in the economy showcase Poland's accomplishments in promoting growth and advancement but also shed light on the obstacles linked to advancement.

In Poland's cities such as Warsaw, Gdansk, and Krakow, the cost of housing has surged due to growing demand. Fuelled by rising incomes, property prices have skyrocketed over the last ten years according to a report from National Bank of Poland (2024). Housing prices have risen faster than income in some instances and short-term situations, which has sparked worries about the long-term viability of prevailing trends in the housing market and the ability of the people to simply own a home.

With the growth and development of economies, as well as continuous urbanization and rising demand for housing, it becomes more important to understand how income levels impact housing costs, so policymakers and city planners, along with prospective homebuyers, can make informed decisions in a dynamic real estate market.

That is why this research seeks to explore how the average monthly gross salaries and housing costs in Poland's seven cities-Warsaw, Gdansk, Gdynia, Krakow, Lodz, Poznan and Wroclaw - have been related from 2013 to 2024. Through an examination of data gathered over the course of more than ten years, this study will look into trends and connections that can shed light on how fluctuations in income influence the affordability of housing in cities. The study does not just seek to outline these associations but also aims to provide forecast indicators that could help guide upcoming strategic investment and policy choices.

Literature Review - Understanding the Role of PIR in the Housing Market

The Price-to-Income Ratio (PIR) is a metric used to evaluate housing affordability by comparing the price of a house to the annual/monthly income (gross or net, depending on the measurement) of a potential buyer or household. This ratio indicates the years of income it would take to purchase a home at its current price, with higher PIR values suggesting that houses are less affordable (or could indicate that fewer/more square meters can be purchased for a certain amount of money). The PIR is often monitored over time to detect potential housing market bubbles or overvaluation, as a PIR significantly above its long-term average may indicate that house prices are outpacing income growth, leading to an unsustainable market. The PIR is influenced by various factors, including income growth, house price changes, and interest rates, as monetary policy affects borrowing costs and, consequently, the ability of households to purchase homes. Additionally, the PIR can be used to forecast future housing market trends; for instance, a PIR much higher than its "fundamental" value, based on economic fundamentals like income growth and interest rates, may signal that house prices are overvalued and could decline in the future. Overall, the PIR serves as a vital tool for understanding the dynamics between house prices and income levels, providing insights into housing market conditions and potential risks (Chen & Cheng, 2017; Gray, 2021; Kwon & Kim, 2020).

Some authors argue that the PIR is a persistent metric closely tied to aggregate economic output, and cross-country data confirm a significant, long-term positive correlation between the PIR and GDP (Leung & Tang, 2023). Moreover, their study suggests that the PIR can serve as an early warning indicator for housing market mispricing, with potential applications in formulating housing policy and monitoring market stability

The PIR has been a subject of debate, with its effectiveness as a metric largely depending on its context and application. For example, Malpezzi (1999) suggested using an error correction model (ECM) to better understand how house prices adjust toward a long-term equilibrium relative to income levels. Meen (2002) who compared house price behaviours in the U.S. and U.K., acknowledges that the PIR is an essential measure, particularly in understanding long-term price trends. He suggests that differences in the PIR between the two countries are influenced by variations in price elasticities of supply and local market conditions. Capozza et al. (2002) examined the dynamics of house prices and found that factors like real income growth and population growth influence house price behaviour. The PIR is implicitly connected to these dynamics,

as higher income growth typically leads to higher house prices, thus affecting the PIR, especially in metro areas with high real construction costs where price overshooting can occur.

However, Gallin (2006) challenges the conventional view that house prices and income are cointegrated, using panel-data tests over 95 U.S. metro areas. He found no evidence of a long-run equilibrium relationship between house prices and income, suggesting that the common error-correction models used in the literature may be inappropriate. Svensson (2023) argues that the PIR is a misleading indicator because it ignores crucial factors like mortgage rates, maintenance costs, and taxes, leading to potentially inaccurate assessments of housing affordability and market overvaluation. Also, Muddasir & Dondaş (2023) who demonstrate a positive relationship between real estate prices and inflation, highlight the importance of other variables, such as demography, currency rates, and employment level, not to mention that a crisis can change various trends and suddenly disrupt stable markets (Bochenek, 2011).

In summary, while the PIR is not a fully reliable measure of the entire housing market situation on its own- as it oversimplifies the complexities of the housing market by ignoring important factors-it can provide a quick snapshot of housing affordability and is a valuable part of the toolkit for assessing housing market trends, especially when used alongside other, more comprehensive indicators.

The polish market and need for research

Poland's transition from a centrally planned economy to a market-based system has been accompanied by substantial improvements in living standards and economic performance. Over the past few decades, Poland has successfully integrated into the global economy, achieving significant GDP growth and a notable increase in per capita income (Polish Economic Institute, 2024). This economic success has led to a higher quality of life for many Polish citizens, manifesting in increased consumer spending and improved infrastructure. However, these positive developments have also contributed to a sharp rise in housing demand, particularly in urban areas such as Warsaw, Krakow, and Gdansk (National Bank of Poland, 2024; Statistics Poland, 2024).

The Price-to-Income Ratio can fluctuate significantly due to changes in house prices or incomes. In stable economies such as the United States, the United Kingdom, and even China, the PIR tends to achieve long-term equilibrium as markets adjust to economic fundamentals (Chen & Cheng, 2017; Gray, 2021; Leung & Tang, 2023; Meen, 2002). In Poland, where the housing market and salaries have been growing steadily, and the country is now categorized as a developed economy, similar patterns of stability in the PIR have begun to emerge. In fact, the Polish housing market has shown resilience and stability due to consistent demand, rising salaries, and conservative financial practices and governmental programs, which have mitigated the impact of global economic fluctuations and maintained price stability (Brzezicka et al., 2021; Tomal, 2022). Therefore:

H_1: The house price to income ratio in Poland has exhibited periods of stability over the last decade, indicating that the housing market is gradually aligning with broader economic trends.

Moreover, long-term trends can be identified (Gray, 2021; Malpezzi, 1999). This demonstrates the opportunity for creating predictions and demonstrating possible future strategies, therefore:

H_2: By conducting trend analysis, it is possible to identify out-of-equilibrium moments that could serve as early warning indicators of market instability or potential bubbles.

H_3: Identifying key indicators that signal market opportunities, such as periods when housing is undervalued relative to income, can provide valuable insights for both policymakers and potential buyers.

To address these proposed hypotheses, a comprehensive quantitative research methodology has been designed, which is presented in the subsequent part of this paper. This research aims to analyse the long-term trends in the Polish housing market, examining the relationship between income levels and housing prices across different cities. By utilizing advanced statistical techniques and robust data analysis, the study seeks to uncover patterns and correlations that can inform future housing policies and market strategies.

Methodology

To address the given questions, data on average monthly gross salaries, along with real estate market offers and transaction prices in the housing market, were sourced from official governmental institutions to ensure both reliability and accountability. The analysis focused on Poland's seven largest cities: Warsaw, Gdansk, Gdynia, Krakow, Lodz, Poznan, and Wroclaw (National Bank of Poland, 2024; Statistics Poland, 2024). Data was collected for 46 quarters, beginning in early 2013.

National Bank of Poland calculates average secondary housing market prices per square meter in these cities, weighted with the market housing stock of the city. Concurrently, Statistics Poland computes the average monthly salary in the enterprise sector by dividing the total gross salary by the average employment in companies with at least nine employees each quarter.

Existing stock market prices and average enterprise sector wages were selected as indicators to reflect market conditions more accurately. Secondary market prices, as opposed to new construction from the primary market, are less influenced by large real estate developers, while enterprise sector wages remain directly unaffected by public sector wage regulations. These measures thus capture underlying supply-demand dynamics with fewer distortions, providing a clearer market picture. This approach ensures that our analysis captures the underlying dynamics of Poland's housing and labor markets more accurately, thereby offering an insightful basis for economic assessments.

To assess relationships within the data, a moderated correlation analysis was conducted, examining variations in Pearson's r correlation coefficient to quantify the linear relationships between selected variables. This approach identified any moderating factors that could affect the strength or direction of correlations. Standard deviation was calculated to evaluate data dispersity relative to the mean, enhancing the robustness of the analysis.

Subsequently, a regression analysis was conducted using the method of Ordinary Least Squares regression (OLS) for parameter estimation, aiming to perform linear trend estimation. The regression model included predictors that met a significance threshold of $p < 0.01$, ensuring that only statistically significant variables were incorporated into the final models.

Next, an analysis of percentage differences between both models-derived prices and published by NBP 7 Cities Average Offer Price and 7 Cities Average Transaction Price for each quarter was conducted. The resulting values were normalized to facilitate cross-comparisons, with parameters for the primary and secondary markets designated as "Offer Model Norm" and "Transaction Model Norm," respectively.

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Moreover, two key indicators-Premium and Buying Signal-were developed for all 46 quarters, starting from 2013. The Buying Signal was triggered when the "Offer Model Norm" is negative for at least three consecutive months, suggesting an opportune time to purchase real estate and negotiate prices. This indicator aimed to identify periods where the market presented favourable conditions for buyers.

The Premium indicator, on the other hand, was activated when the "Transaction Model Norm" fell into negative territory. This indicator was categorized as either "Yes" when "Transaction Model Norm" is between -0.2 and -1.2 and "Yes, High," when it goes below -1.2, signalling a particularly high market potential.

Results

Firstly, an analysis of average gross salary (average paid employment and average monthly gross wages and salaries from official governmental statistics) and housing offers (both listed and transacted from governmental reports) allowed for the calculation of a ratio that demonstrates the number of square meters that can be purchased with one average monthly salary, as well as calculating Pearson's r correlation coefficient (with average salary and 7 cities average offer price).

Table 1: Salary and offer/transaction price in 7 largest cities in Poland

Year	Quarter	Average Salary (S)	7 Cities Average Offer Price (O)	7 Cities Average Transaction Price (T)	S/O	S/T
2013	1 QTR.	3,776.97	6,738.25	5,445.36	0.56	0.69
	2 QTR.	3,814.60	6,739.76	5,504.86	0.57	0.69
	3 QTR.	3,860.12	6,746.01	5,587.24	0.57	0.69
	4 QTR.	3,894.93	6,793.68	5,664.32	0.57	0.69
2014	1 QTR.	3,926.54	6,807.13	5,637.28	0.58	0.70
	2 QTR.	3,969.19	6,774.83	5,743.66	0.59	0.69
	3 QTR.	3,990.76	6,764.32	5,751.36	0.59	0.69
	4 QTR.	4,034.25	6,758.91	5,760.08	0.60	0.70
2015	1 QTR.	4,075.39	6,771.12	5,760.60	0.60	0.71
	2 QTR.	4,088.84	6,705.55	5,790.92	0.61	0.71
	3 QTR.	4,134.93	6,713.67	5,869.56	0.62	0.70
	4 QTR.	4,186.00	6,767.31	5,823.18	0.62	0.72

Year	Quarter	Average Salary (S)	7 Cities Average Offer Price (O)	7 Cities Average Transaction Price (T)	S/O	S/T
2016	1 QTR.	4,219.56	6,807.76	5,794.77	0.62	0.73
	2 QTR.	4,259.92	6,866.47	5,798.81	0.62	0.73
	3 QTR.	4,305.92	6,912.59	5,826.04	0.62	0.74
	4 QTR.	4,320.80	6,951.52	5,976.72	0.62	0.72
2017	1 QTR.	4,411.05	7,020.66	5,936.26	0.63	0.74
	2 QTR.	4,483.20	7,116.38	6,178.58	0.63	0.73
	3 QTR.	4,565.41	7,260.56	6,373.44	0.63	0.72
	4 QTR.	4,652.40	7,443.83	6,447.04	0.63	0.72
2018	1 QTR.	4,722.18	7,594.09	6,462.69	0.62	0.73
	2 QTR.	4,814.33	7,780.79	6,673.14	0.62	0.72
	3 QTR.	4,885.87	7,979.00	6,915.53	0.61	0.71
	4 QTR.	4,981.04	8,282.97	7,112.63	0.60	0.70
2019	1 QTR.	5,032.45	8,514.34	7,181.61	0.59	0.70
	2 QTR.	5,142.77	8,721.03	7,392.15	0.59	0.70
	3 QTR.	5,223.17	8,911.37	7,579.71	0.59	0.69
	4 QTR.	5,278.72	9,072.31	7,886.46	0.58	0.67
2020	1 QTR.	5,369.21	9,472.79	8,062.26	0.57	0.67
	2 QTR.	5,251.39	9,393.47	8,298.41	0.56	0.63
	3 QTR.	5,452.82	9,466.60	8,465.29	0.58	0.64
	4 QTR.	5,574.26	9,716.57	8,525.76	0.57	0.65
2021	1 QTR.	5,666.63	9,848.72	8,414.94	0.58	0.67
	2 QTR.	5,776.93	10,095.51	9,194.05	0.57	0.63
	3 QTR.	5,969.38	10,562.26	9,490.01	0.57	0.63
	4 QTR.	6,151.23	10,979.09	9,758.08	0.56	0.63
2022	1 QTR.	6,317.39	11,280.80	10,037.81	0.56	0.63
	2 QTR.	6,557.20	11,599.53	10,487.70	0.57	0.63
	3 QTR.	6,828.11	11,414.98	10,770.45	0.60	0.63
	4 QTR.	6,919.54	11,495.05	10,697.73	0.60	0.65
2023	1 QTR.	7,134.05	11,689.08	10,672.98	0.61	0.67
	2 QTR.	7,353.89	11,998.82	10,797.55	0.61	0.68
	3 QTR.	7,562.22	12,622.96	11,283.26	0.60	0.67
	4 QTR.	7,736.85	13,644.84	11,650.59	0.57	0.66
2024	1 QTR.	8,001.76	14,124.13	12,245.61	0.57	0.65
	2 QTR.	8,163.37	14,684.38	12,708.58	0.56	0.64
Pearson 12Y			0.9893	0.9908		
Average					0.59	0.68
Standard Deviation					0.02	0.03

Source: Author's own work.

Secondly, the two OLS analyses enabled the calculation of linear regression, demonstrating possible trends, variations, and the relationship of individual scores to the main trend line.

In both regression models, the explanatory variable was the average wage in the enterprise sector. Statistical analysis was conducted using the software package "gretl" (Baiocchi & Distaso, 2003).

In the first model, the dependent variable was the average offer price per square meter of housing in the seven largest cities in Poland. The relationship between the explanatory and dependent variables proved to be statistically significant ($p < 0.01$), with the model demonstrating a high goodness-of-fit ($R^2 = 0.978$). This model indicates that a 1 PLN increase in the average enterprise sector wage corresponds to a 1.80 PLN increase in the offer price per square meter in these cities.

In the second model, the dependent variable was the average transaction price per square meter of housing across the same urban areas. The relationship between the explanatory and dependent variables also showed statistical significance ($p < 0.01$), with this model achieving an even higher goodness-of-fit ($R^2 = 0.981$). According to this model, a 1 PLN rise in average enterprise sector wages correlates with a 1.70 PLN increase in the transaction price per square meter of housing in Poland's seven largest cities.

For each quarter Offer Model (% difference) was calculated by dividing 7 Cities Average Offer Price (O) and Offer Model (OLS) minus 1 and Transaction Model (% difference) was calculated by dividing 7 Cities Average Transaction Price (T) and Transaction Model (OLS) minus 1 as mentioned in Table 2.

Table 2: Prices derived for Offer Model & Transaction Model compared with percentage differences between both models-derived prices and 7 Cities Average Offer Price & 7 Cities Average Transaction Price from the same quarter

Year	Quarter	Offer Model (OLS)	Transaction Model (OLS)	Offer Model (% difference)	Transaction Model (% difference)
2013	1 QTR.	6,247.40	5,249.53	7.86%	3.73%
	2 QTR.	6,315.28	5,313.44	6.72%	3.60%
	3 QTR.	6,397.38	5,390.75	5.45%	3.64%
	4 QTR.	6,460.17	5,449.87	5.16%	3.93%
2014	1 QTR.	6,517.19	5,503.56	4.45%	2.43%
	2 QTR.	6,594.12	5,575.99	2.74%	3.01%
	3 QTR.	6,633.02	5,612.63	1.98%	2.47%
	4 QTR.	6,711.47	5,686.49	0.71%	1.29%
2015	1 QTR.	6,785.67	5,756.36	-0.21%	0.07%
	2 QTR.	6,809.93	5,779.21	-1.53%	0.20%
	3 QTR.	6,893.07	5,857.49	-2.60%	0.21%
	4 QTR.	6,985.19	5,944.22	-3.12%	-2.04%
2016	1 QTR.	7,045.72	6,001.22	-3.38%	-3.44%
	2 QTR.	7,118.52	6,069.77	-3.54%	-4.46%
	3 QTR.	7,201.49	6,147.89	-4.01%	-5.24%
	4 QTR.	7,228.33	6,173.17	-3.83%	-3.18%
2017	1 QTR.	7,391.12	6,326.45	-5.01%	-6.17%
	2 QTR.	7,521.26	6,448.99	-5.38%	-4.19%
	3 QTR.	7,669.54	6,588.61	-5.33%	-3.27%
	4 QTR.	7,826.45	6,736.36	-4.89%	-4.29%
2018	1 QTR.	7,952.31	6,854.87	-4.50%	-5.72%
	2 QTR.	8,118.53	7,011.38	-4.16%	-4.82%
	3 QTR.	8,247.57	7,132.88	-3.26%	-3.05%
	4 QTR.	8,419.23	7,294.52	-1.62%	-2.49%
2019	1 QTR.	8,511.96	7,381.83	0.03%	-2.71%
	2 QTR.	8,710.95	7,569.20	0.12%	-2.34%
	3 QTR.	8,855.97	7,705.75	0.63%	-1.64%
	4 QTR.	8,956.17	7,800.10	1.30%	1.11%
2020	1 QTR.	9,119.39	7,953.79	3.88%	1.36%
	2 QTR.	8,906.87	7,753.68	5.46%	7.03%
	3 QTR.	9,270.20	8,095.79	2.12%	4.56%
	4 QTR.	9,489.25	8,302.04	2.40%	2.69%
2021	1 QTR.	9,655.86	8,458.92	2.00%	-0.52%
	2 QTR.	9,854.81	8,646.26	2.44%	6.34%
	3 QTR.	10,201.94	8,973.11	3.53%	5.76%
	4 QTR.	10,529.95	9,281.97	4.27%	5.13%

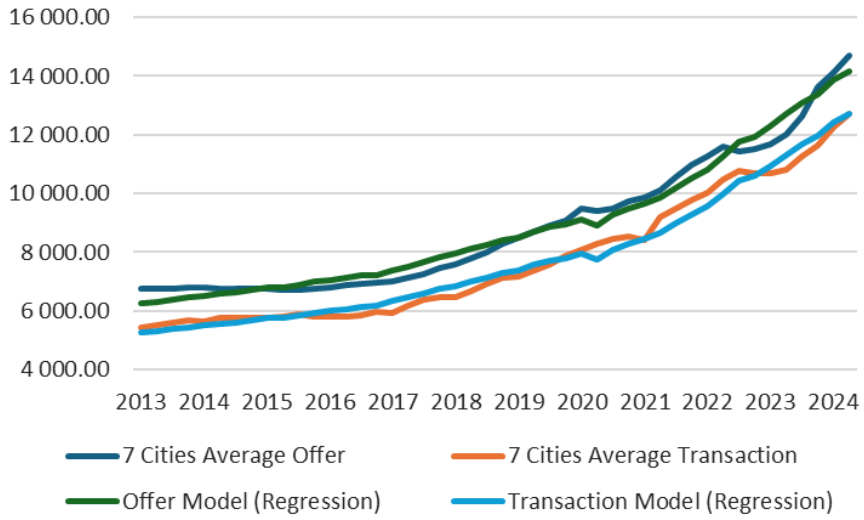
Year	Quarter	Offer Model (OLS)	Transaction Model (OLS)	Offer Model (% difference)	Transaction Model (% difference)
2022	1 QTR.	10,829.66	9,564.18	4.17%	4.95%
	2 QTR.	11,262.21	9,971.47	3.00%	5.18%
	3 QTR.	11,750.87	10,431.58	-2.86%	3.25%
	4 QTR.	11,915.78	10,586.87	-3.53%	1.05%
2023	1 QTR.	12,302.70	10,951.19	-4.99%	-2.54%
	2 QTR.	12,699.24	11,324.57	-5.52%	-4.65%
	3 QTR.	13,075.01	11,678.39	-3.46%	-3.38%
	4 QTR.	13,390.00	11,974.99	1.90%	-2.71%
2024	1 QTR.	13,867.82	12,424.91	1.85%	-1.44%
	2 QTR.	14,159.33	12,699.39	3.71%	0.07%
Average		8,878.39	7,726.86	0.02%	-0.03%
Standard Deviation		2,278.88	2,145.79	3.83%	3.70%

Source: Author's own work.

Moreover, presenting the regression analysis in the form of a chart allows for easier visualization and demonstrates the close relationship between various datasets (Figure 1).

Last, but not least, Premium and Buying Signal indicators were calculated by calculating normalized values derived from a distribution and standard deviation. Offer Model Norm was calculated using Offer Model (% difference) as x, Average Offer Model (% difference) as a mean and standard deviation from all Offer Model (% difference) values. Transaction Model Norm was calculated using Transaction Model (% difference) as x, Average Transaction Model (% difference) as a mean and standard deviation from all Transaction Model (% difference) values.

Figure 1: Regression chart



Source: Author's own work.

Table 3: Premium and buying signal indicators

Year	Quarter	Offer Model Norm	Transaction Model Norm	Premium	Buying Signal
2013	1 QTR.	2.0474	1.0155		
	2 QTR.	1.7506	0.9809		
	3 QTR.	1.4182	0.9923		
	4 QTR.	1.3432	1.0707		
2014	1 QTR.	1.1566	0.6639		
	2 QTR.	0.7101	0.8199		
	3 QTR.	0.5111	0.6753		
	4 QTR.	0.1785	0.3570		
2015	1 QTR.	-0.0624	0.0271		
	2 QTR.	-0.4070	0.0620		
	3 QTR.	-0.6866	0.0629		Yes
	4 QTR.	-0.8216	-0.5432	Yes	Yes
2016	1 QTR.	-0.8891	-0.9226	Yes	Yes
	2 QTR.	-0.9318	-1.1993	Yes, high	Yes
	3 QTR.	-1.0549	-1.4077	Yes, high	Yes
	4 QTR.	-1.0073	-0.8529	Yes	Yes
2017	1 QTR.	-1.3164	-1.6597	Yes, high	Yes
	2 QTR.	-1.4134	-1.1260	Yes, high	Yes
	3 QTR.	-1.4002	-0.8755	Yes	Yes
	4 QTR.	-1.2842	-1.1536	Yes, high	Yes
2018	1 QTR.	-1.1838	-1.5391	Yes, high	Yes
	2 QTR.	-1.0937	-1.2966	Yes, high	Yes
	3 QTR.	-0.8575	-0.8164	Yes	Yes
	4 QTR.	-0.4293	-0.6667	Yes	Yes
2019	1 QTR.	0.0010	-0.7259	Yes	
	2 QTR.	0.0239	-0.6250	Yes	
	3 QTR.	0.1572	-0.4349	Yes	
	4 QTR.	0.3327	0.3064		
2020	1 QTR.	1.0067	0.3758		
	2 QTR.	1.4217	1.9060		
	3 QTR.	0.5475	1.2407		
	4 QTR.	0.6199	0.7355		
2021	1 QTR.	0.5158	-0.1333		
	2 QTR.	0.6321	1.7195		
	3 QTR.	0.9169	1.5641		
	4 QTR.	1.1086	1.3936		
2022	1 QTR.	1.0826	1.3456		
	2 QTR.	0.7766	1.4064		
	3 QTR.	-0.7534	0.8852		
	4 QTR.	-0.9292	0.2902		
2023	1 QTR.	-1.3100	-0.6794	Yes	Yes
	2 QTR.	-1.4480	-1.2506	Yes, high	Yes
	3 QTR.	-0.9100	-0.9073	Yes	Yes
	4 QTR.	0.4912	-0.7250	Yes	
2024	1 QTR.	0.4768	-0.3828	Yes	
	2 QTR.	0.9630	0.0268		

Source: Author's own work.

Discussion and findings

The analysis of average paid gross salaries, and real estate market data across the seven largest cities in Poland revealed several important insights into the dynamics between income levels and housing market trends. One of the most striking findings from this study is the consistent PIR, measured across the last 46 quarters. Despite fluctuations in economic conditions and various macroeconomic factors, the data indicates that approximately 0.6 square meters (0.68 when transaction offers are taken into account) of real estate could be purchased with an average gross monthly salary in Poland's largest cities during this period, confirming Hypothesis 1. This stability is noteworthy given the inherent volatility typically observed in both income levels and real estate markets. In practice, this means that an average Pole has to work for about seven years to afford a place to live, and this situation has remained unchanged for the last 12 years. This resilience is particularly remarkable given the varied economic conditions experienced over the 46 quarters, including periods of economic growth, stagnation, and even crises such as the COVID-19 pandemic, the ongoing war in Ukraine, and the 2023 banking crisis.

The Pearson correlation analysis demonstrated a strong positive correlation (approximately 0.99) between average monthly gross salaries and both offer and transaction prices in the real estate market, confirming Hypothesis 2. This suggests that as salaries increased, housing prices also tended to rise, reflecting the standard economic theory that higher incomes lead to greater purchasing power, which, in turn, drives up demand and prices in the housing market. The correlation coefficients for the 46 quarters under study consistently indicated a significant linear relationship, underscoring the interconnectedness of income levels and housing affordability. By applying regression analysis using the least squares method, a linear trend was estimated, confirming the general upward trajectory of housing prices in response to increasing salaries.

From a broader economic perspective, this situation reflects a market where supply and demand forces have adjusted in tandem, preventing either salaries or housing prices from significantly outpacing the other. This is significant because it suggests that, despite potential economic challenges such as inflation, interest rate changes, and economic downturns, the average worker's ability to purchase real estate has not been substantially eroded. On the other hand, it raises questions about the effectiveness of governmental efforts and programs aimed at increasing housing affordability and improving the situation for individuals who still cannot afford their own place.

Indicators and suggestions

The introduction of the Premium and Buying Signal indicators provided a nuanced view of market opportunities for buyers and can serve as a forecasting measurement. The Buying Signal indicator, which was triggered by a decline in the "Offer Model Norm" for three consecutive months, effectively identified periods when the market was more favourable for purchasing real estate. These periods often coincided with moments of market uncertainty or price stagnation, where buyers could negotiate better deals. The Premium indicator, particularly the "Yes, High" category, identified periods of high market potential when the average of the "Transaction Model Norm" fell significantly below zero. These periods indicated times when the market was undervalued relative to historical norms, presenting a possible higher return of investment. The levels (-0.2; -1.2) for "Yes" and <-1.2 for "Yes, high" were suggested by the authors, although everyone can adjust them to individual preferences.

It is important to notice that Buying Signal indicates that a Premium may occur in the following quarter. This is practically useful, as it provides information about expected forthcoming Premium at the time of data publication (which happens post month/quarter), thereby granting a one-month window for purchasing. Moreover, it is possible to extend this window of opportunity by an additional two months, as offer prices - unlike transaction prices - are publicly accessible and can be estimated using online listings and other readily available sources.

The findings suggest that while income growth generally leads to higher housing prices, there are specific periods where market conditions present opportunities for buyers. The Premium and Buying Signal indicators may serve as valuable tools for both individual buyers and investors to time their market entry and maximize returns, confirming Hypothesis 3. Additionally, the variability in the strength of the correlation over time highlights the importance of considering broader economic conditions when analysing the housing market.

Overall, the study provides a comprehensive understanding of the relationship between income and housing prices in Poland's largest cities, offering practical insights for stakeholders in the real estate market.

Conclusion

The findings from this study underscore the complex interplay between income growth and housing prices in Poland's largest cities over the past decade. The strong correlation between salaries and real estate prices highlights the persistent challenge of housing affordability, even in the face of rising incomes. Despite fluctuations in economic conditions and external

shocks such as the COVID-19 pandemic, the ongoing war in Ukraine, and the 2023 banking crisis, the purchasing power of the average gross salary in relation to real estate has remained remarkably consistent. This suggests a resilient housing market where supply and demand forces have generally moved in tandem, preventing any significant erosion in the ability of the average worker to purchase real estate.

However, this stability also raises critical questions about the effectiveness of governmental policies aimed at improving housing affordability. While the market appears stable on the surface, underlying issues such as limited housing supply and rising property prices continue to make homeownership inaccessible for many individuals, particularly in urban areas. The introduction of the Premium and Buying Signal indicators provide a valuable tool for forecasting and identifying potential market opportunities, yet the broader challenges of housing affordability require sustained attention and targeted policy interventions. Furthermore, the study highlights the need for ongoing monitoring of housing market trends, as external shocks and market volatility pose risks that cannot be fully mitigated by the provided indicators and suggestions.

Limitations and further research

This research was statistically analysed with data collected from official governmental sources. However, there are several challenges that should be addressed and mitigated in future research. First, the 12-year time period analysed is limited, primarily due to the availability and accessibility of official data. It's possible that "black swan" events, such as the 2008 housing crisis, which also affected the Polish market, could disrupt the obtained results, serving as a caution for future analyses and predictions. While the Premium and Buying Signal indicators provide valuable insights into market conditions, their reliability depends on historical data, which may not always accurately predict future trends, especially in volatile markets. Future research should continue monitoring data and consider incorporating new sources to further generalize the findings.

Moreover, the data was obtained for the seven largest cities in Poland, which may not fully represent the entire market, as it focuses primarily on the most urbanized areas. This limitation could be addressed by conducting additional research with a similar methodology but focusing on smaller cities and comparing the results. This approach would help determine whether the observed trends are valid for major cities or extend to a broader geographical area. Comparative studies with other countries and the use of advanced modelling techniques could also provide a more comprehensive understanding of the relationship between income and housing prices, thereby improving the predictive power of the indicators.

Lastly, qualitative research involving industry experts and government officials could be useful in enriching the results and gaining a deeper understanding of the findings. Such insights would also be valuable for predicting future market trends and planning appropriate investment strategies.

Practical implications

The findings of this study have several practical implications for various stakeholders in the real estate market, including individuals, institutional investors, and governmental officials. For individual buyers and investors, the Premium and Buying Signal indicators developed in this research provide valuable tools for identifying favourable market conditions. These indicators can help buyers time their purchases to maximize value, especially during periods when the market is undervalued or when prices are likely to rise in the near future. They also offer a better understanding of housing market mechanisms, enabling more informed and strategic housing investments.

Larger investors may use these insights to identify optimal periods for buying and selling, which could influence their investment strategies and long-term development plans. For real estate developers and planners, the study's insights into the dynamics between income levels and housing prices can guide future development strategies, ensuring that new projects are aligned with market conditions and buyer affordability.

Governmental officials, policymakers, and agencies can use and leverage these findings to enhance the planning of effective housing programs, making housing more affordable and addressing long-term strategies to improve housing accessibility. Such programs may limit spending or establish fixed PIR to reach those in need, ensuring the inclusivity of government efforts. However, it is important to note that this study underscores the need for continuous monitoring of these trends, particularly in light of potential external shocks such as economic crises or policy changes, which could disrupt the observed balance. The indicators and suggestions provided are limited by data availability and market volatility and should be used with caution. While they can help mitigate some risks, they cannot eliminate the inherent risks associated with investments in the housing market.

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