Hedonic analysis of office and retail rents and transaction prices in Poland – data sources, methodology and empirical results

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Abstract

This paper shows how the Narodowy Bank Polski collects data about commercial real estate rents and prices and information about their determinants. First, the mandatory, semiannual survey that is conducted under the Statistical survey program of official statistics is presented and explained. In the second step we show how the data is used for analytical purposes. We present a hedonic rent index for office and retail properties for the major cities in Poland, a transaction price index for the office market for Warsaw and whole Poland and also one for the retail market in the whole country. This information is further used for the analysis of the profitability of investment in office space, which helps to understand the situation of investors and also to make a simple stress test, which accounts for increasing interest rates and/or vacancy rates. We present the methodology which is applied by the Narodowy Bank Polski to get more insight into the commercial real estate sector.

Keywords: office and retail property, rents and prices, data collection, methodology, hedonic regression, return over equity of an investment

1 Introduction

The commercial real estate market plays a major role in the economy, and due to its significance for the stability of the financial system it is of interest to central banks and financial supervisors (see Olszewski, 2013, ESRB, 2015 and ESRB, 2018). In this paper we explain how the Narodowy Bank Polski collects data about commercial real estate rents and transaction prices as well as information about their determinants and uses this data to analyse the situation in the market. In order to make a detailed analysis of the commercial property market, we need to understand which factors determine rents and property prices. We first present the mandatory survey and how the data is collected. Similarly like in the case of

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residential property, commercial property is heterogenous and the average rent or price can change not only due to market conditions, but due to the fact that the composition of the analysed sample changes. The hedonic analysis allows us to solve this problem, but detailed data about the building and single spaces that are rented is needed. We present the hedonic rent index for offices in Warsaw, which is the capital city and also the largest office market in Poland. We also show the construction of the hedonic rent index for shopping malls in Poznań, which is a major city.

An important business segment, financed to a large degree by banks (ESRB, 2015) are the purchases of commercial buildings that are rented out to third parties or used by the purchaser for his own purposes. Transactions of commercial buildings are rare (in comparison to house transactions), so also in this case a hedonic index helps to get a reliable picture about the market. We show the construction of a hedonic transaction price index for the Warsaw office market.

The beforementioned hedonic rent index and hedonic transaction index are used in the next step to analyse the profitability of an investment in office properties, which is financed partially with mortgages. We explain in detail how to calculate the average ROE (return over equity) and show how it depends on the credit cost and the situation in the market, which is expressed with the vacancy rate.

We want to point out that section 2, which introduces the commercial property survey, is based closely on its description (NBP, 2018a). Section 3 contains the description of the empirical analysis and is based closely on research papers of the authors (Olszewski et al., 2018 and Trojanowski et al., 2018) and Narodowy Bank Polski quarterly and annual reports.

2 The commercial real estate survey

The commercial real estate survey was introduced on a mandatory base into the Statistical survey program of official statistics[6] in 2013 and is supervised by the Governor of the Narodowy Bank Polski. The construction of the survey and how it is carried out is based on the survey of the residential real estate market that was introduced by the Narodowy Bank Polski (NBP, henceforth) in voluntary form in 2006 and in mandatory form in 2013, and which is described in Widłak and Łaszek (2008) and Widłak and Tomczyk (2010). Before the operational and official version of the survey was created, the existing literature was studied and also many discussions with market experts were conducted. After the first rounds of data were collected and analysed, some small modifications of the survey were introduced. The data form the survey is augmented with data from public sources. For example, some brokers only manage a part of the building, so data about the whole building has to be collected from

[6] More information can be found here: http://bip.stat.gov.pl/en/statistical-survey-program-24/.

various sources. Some general information about the technical characteristics of the buildings is publicly available, but data on individual rents and transaction prices is a business secret of the owner. All data that is collected underlies the Law on Official Statistics, which guarantees its safety. The survey is conducted by trained analysts of the local branches of the NBP. Owners of commercial property, brokers, administrators and advisory firms active in the commercial real estate market are obliged to fill out the survey on a semiannual basis. Offers are collected as of 30th June and 31th December, while transactions which appeared in the whole previous half year are collected. The survey is conducted between 1st and 20th of March for the half year that ends in December and between 1st and 20th of September for the half year that ends in June. The analysts of the local branches of the NBP need around two months to clean the data and analyse it.

The collected data includes prices, rents and rental or price-building attributes of commercial space and/or commercial properties. The survey[7] for each type of property (office, retail and industrial) has its own set of information, but all surveys share the same design. The survey for each property type has two sheets, the first covers the building, while the second covers rents and rent related attributes. The information about the building contains its address, the total leasable area, number of storeys, the year of the construction, the technical condition of the building, the unleased space, the share of common space, the number of parking places, the type of the building, the number of single premises, operational costs, information about the purchase/sale transaction as well as the information about the last valuation of the building, etc. Some variables are collected only for given property types, for example the number of shops in the retail property survey, or the minimal rental unit in case of industrial property. The second page contains detailed information about the rented premises, such as their size, location in the building (for office and retail buildings) and information about the rental contract (its start, duration, etc.). The full list of collected variables, their description and information for which market segment those variables are collected is presented in tabular form in the Appendix.

[7] The original survey sheets can be found here:
http://www.nbp.pl/home.aspx?f=/publikacje/rynek_nieruchomosci/ankieta.html

Data for the following types of commercial property is collected:

• Office real estate - office space located only in office buildings, with an leasable area of at least 50 m2

• Retail space:

- being part of large retail properties located in the agglomeration of the voivodeship capital city, with an area of at least 100 m2 each

- commercial and service facilities located in office buildings, with an area of at least 50 m2 each

• Warehouses – space in warehouses located in places that constitute storage centers of the voivodships.

3 Empirical applications

In this section we present how the data which is collected through the survey and obtained from other sources is used to get more insight about the commercial real estate market in Poland. We start with the hedonic regressions and move to the analysis of an office investment. But before moving on, we want to give some information about hedonic regressions, which were used to calculate the rent and transaction price indexes. The hedonic regression that we apply was developed by Rosen (1974), who first introduced it into the analysis of heterogeneous goods. According to the methodology, each heterogeneous good can be separated into a set of features of which it consists of. An example can be the location assessment, which is essential for the value of real estate, but de facto cannot be "purchased" separately. It is an inseparable part of the property, but we can indicate its partial impact on the price of the entire property. We use this regression to get price estimates that are robust to random changes of the analysed sample of properties. The precursors of the application of this method in Poland in relation to real estate were Łaszek and Widłak (2008), Tomczyk and Widłak (2010), Widłak (2010 a,b) and Nehrebecka and Widłak (2012). The NBP uses this method to analyze property prices and rents (NBP, 2018b).

3.1 Hedonic analysis of office rents in Warsaw[8]

Rental rates, as of the end of 2017 were obtained by the NBP as part of the Statistical survey program of official statistics. The object of the analysis are monthly transaction rents per m2 of office space. As the dominant part of the premises is rented in euro, this currency was used

[8] This is a modified version of Olszewski et al. (2018).

for the analysis. Rental rates denominated in other currencies have been converted into euro. The analysis covers premises over 100 m2. Because no significant differences between rents for office premises located in the same building were found, the average rent per building is analysed.

In the first step, the data was verified in terms of correctness. Missing information about the building was collected from various public sources. The rents were checked for errors or outliers. The analysis covers only premises in office buildings that are used as offices, that is premises used for retail and auxiliary purposes are excluded.

The list of variables that describe the building includes such features as: sum of parking spaces, modernization, year of the modernization, total rentable area, common space, share of vacant space, number of storeys, average size of the rented premises, location in or outside of the Central Business District, share of retail space, office building class A, B and C, age of the building, dummy for the age of the building in the ranges of 5 to 10 years, from 10 to 15 and above 15 years. We apply logarithms of the rent and all other continuous numerical variables, which allows us to capture the elasticity of rents relative to renting factors.

After running various regressions, that were based on the literature and expert knowledge about the market, we found that the rental rate is influenced by the quality of the building and its location. The model uses dummy variables that distinguish the class of the office building: office_class_B, office_class_C (while office_class_A serves as the reference category). We added 2 to the age of the building (ln_age_plus_2), because some buildings are rented before they are delivered and we can only calculate the log of non-negative values. The quality of the location is measured by the distance to the city center (ln_distance from the_center) and the total size of the office building is described by the variable ln_total_leasable_area.

Class A buildings are modern office buildings with high quality equipment, located in the central zone of the city or in very good communicated parts of the city. Class B facilities are office buildings of a lower standard than A, can be located in the central zone or outside of this zone. Class C buildings are older objects with low quality equipment. The results of the analysis confirm that the transaction rent rate per m2 of office space depends significantly on the office class. With regard to rent rates listed in Class A office buildings, the class B buildings obtain lower rents and class C office buildings even lower rents. Further on, rents decrease with the distance to the city center and also with the age of the building. Interestingly, the gross leasable area turned out to be statistically insignificant. We thought that the size of the building could be a measure of prestige, but could not find empirical evidence for our hypothesis. The regression results are presented in Table 1.

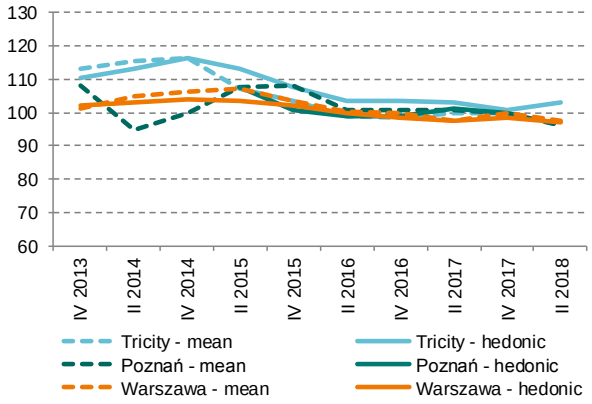
Table 1. Results of the estimation of log office space rents in euro per m2 per month in Warsaw

variable	coefficient	standard error	statistical significance
office class B	-0,268519	0,0348060	***
office class C	-0,405917	0,0572861	***
ln age plus 2	-0,0334447	0,0151385	**
ln distance from the center	-0,107016	0,0164691	***
ln total leasable area	0,00637991	0,0150051	
constant	3,76011	0,182586	***

The regression was run with OLS, using 152 observations, the R2 is 70%.
Source: NBP

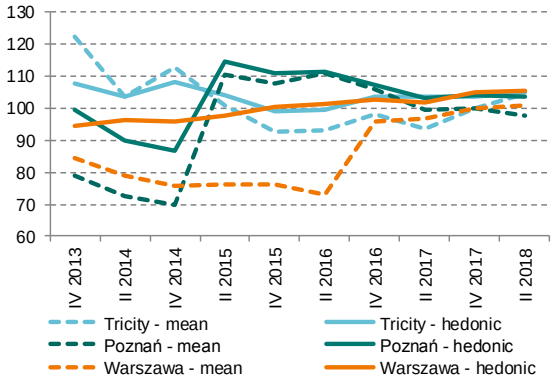
The estimated function is used to calculate the theoretical rent value, which is received by multiplying the values of the variables by the coefficients estimated in the model. The next step is to calculate the exponent to get rid of logarithm. The final step is to calculate the average theoretical rent. We divide the average rent by the average theoretical rent and obtain the hedonic index. This ratio is a direct measure of the pure rent inflation, when it is above 100% and a measure of deflation, when it is below 100%. A similar analysis was run for Poznań and Tricity, the mean and hedonic rent index for office properties is shown in Figure 1.

Figure 1 Index of rents for offices, average and hedonic (2017 IV = 100)



Source: NBP

Figure 2 Index of rents for shopping centres, average and hedonic (2017 IV = 100)



Source: NBP

3.2 Hedonic analysis of retail rents in Poznań[9]

The subject of the retail real estate survey conducted by the NBP are premises in retail objects situated in Poznań and in the neighboring area, that together are customarily treated as the Poznań agglomeration. Rents in retail promises of the size from 100 to 500 m2 were analysed. This restriction allows us to analyse rents for premises that are also subject of analysis of large real estate brokers, as they represent a significant share of all promises located in a retail facility. All rents are converted into euro. For a better fitting of the model all continuous variables were transferred into logarithms. The model for Poznań was estimated on the basis of rents as of the end of 2017. The regression allows us to conclude that the following variables have a significant impact on rents: the number of parking spaces, the size of individual premises, the number of shops in a shopping center, the age of a building and the quality of the shopping center.

The determination of the model amounted to about 41%. It should be evaluated positively, however it shows that there are some factors determining the rents which are not explained by the model. The estimated parameters of the model are listed in table 2.

Table 2. Results of the estimation of log retail space rents in euro per m2 per month in Poznań

variable	coefficient	standard error	statistical significance
const	2,96643	0,253102	***
Log_parkingspace	0,107218	0,0248292	***
Log_leasing space	-0,346554	0,0184646	***
Log_number of shops	0,220312	0,0278825	***
Log_age of the building	0,0875909	0,0362018	***
top_shopping center	0,159862	0,0518214	***

The regression was run with OLS, using 681 observations, the R2 is 41%.
Source: NBP

Rents increase with the number of parking spaces and the number of shops. Paradoxically, in the Poznań retail market the age of building increases the rent as well. This can result from the fact that the vast majority of shopping centers was constructed several years ago, most likely in good locations. We find a negative relationship between the size of the single premise on its rent (also Gerbich, 1998 obtains such a result for US shopping malls), which can be interpreted as economy of scale. A similar relationship can be found between house prices and their size. The variable top shopping distinguishes those centers that are considered to be more prestigious and popular from the remaining ones. The dummy is assigned after the evaluation of the location of the building, its size and quality as well as its retail offer. According to the estimated model rents in top shopping centers are about 16% higher than in the other retail

[9] This is a modified version of Olszewski et al. (2018).

buildings. The hedonic price index and the mean price index is calculated as explained in section 3.1 and the results are presented in figure 2.

3.3 Mean and hedonic transaction prices of office and retail buildings in Poland[10]

The hedonic regression is used also to calculate the transaction price index for office and retail real estate. The majority of transactions is noted in euro, transactions in other currencies are converted into euro. We uses the time dummy version, with dummies for individual years in the analyzed period. The number of observations in each year is relatively small, but we obtain a reasonable model when the whole sample is included in the regression. We estimate the log price per m2 of leasable area of a building *i* at a given point in time *t* $\boldsymbol{ln(p_i^t)}$ on the hedonic characteristics of the building $\boldsymbol{\beta_k z_{ik}^t}$ and the time dummy $\boldsymbol{D_i^\tau}$ that captures the pure price inflation. The model we estimate is:

$$\boldsymbol{ln(p_i^t) = \beta_0 + \sum_{\tau=1}^{T} \delta^\tau D_i^\tau + \sum_{k=1}^{K} \beta_k z_{ik}^t + \varepsilon_i^t}$$

The function defined in this way formally, includes the following variables for office properties:

ln_price_EUR = f (city size, location, building class, age, leasable area, parking spaces, time dummy)
and the following variable for retail properties:

ln_price_EUR = f (city size, location, retail type, age, size of an average store, parking lots, time dummy)
For office buildings in Warsaw, which is the largest office market in Poland, we find that class A offices obtain values larger by 17% than B class buildings, while buildings that are considered prime (very good location and quality) obtain even higher values. The price declines with the age of the building and the distance to the city center, while the total leasable area does not affect it. In case of retail buildings prime property (very good shopping malls) obtain prices that are higher by 68% than the average. Retail parks, on the other hand, obtain values that are by 26% lower than the average. We find that the price increases with the number of single premises in the retail object. The larger the number of single premises, the more diversified is the offer for the client who goes shopping. The number of storeys has a positive effect on the price. Most likely, objects in good locations where land is rather expensive have more storeys than objects that are on the outskirts. All regression results can be found in table 3. The mean and hedonic price index are shown in figure 3 and 4.

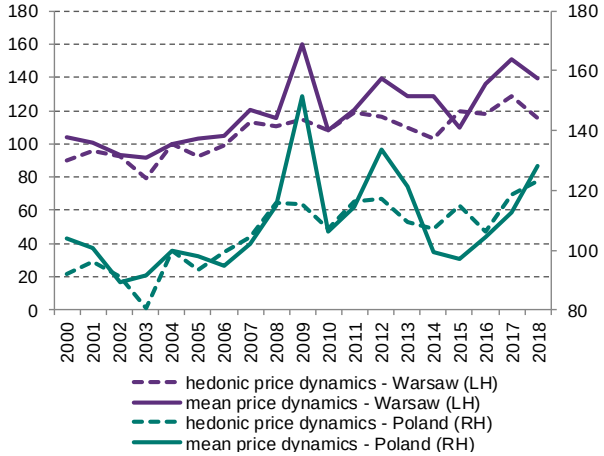
[10] This is a modified version of Leszczyński and Olszewski (2015).

Table 3. Results of the estimation of log transaction price per m2 for office buildings in Warsaw and retail buildings in Poland

Offices				**Retail buildings**			
	coef.	std. Err.	p-value		coef.	std. Err.	p-value
ln_leasable_area	0.001	0.027	0.98	**ln_leasable_area**	-0.051	0.062	0.41
office_class_A	0.173	0.055	0.00	**large_agglomeration**	0.050	0.068	0.47
ln_age_plus_2	-0.115	0.030	0.00	**prime_property**	0.679	0.168	0.00
ln_distance	-0.134	0.025	0.00	**retail_park**	-0.260	0.141	0.07
prime_property	0.375	0.080	0.00	**ln_nr_shops**	0.092	0.052	0.08
d2000	-0.108	0.160	0.50	**ln_number_levels**	0.142	0.060	0.02
d2001	-0.044	0.172	0.80	**ln_age_plus_2**	-0.051	0.042	0.24
d2002	-0.077	0.159	0.63	**d2002**	-0.162	0.278	0.56
d2003	-0.235	0.153	0.13	**d2003**	-0.212	0.304	0.49
d2005	-0.074	0.120	0.54	**d2005**	-0.030	0.221	0.89
d2006	-0.008	0.120	0.95	**d2006**	0.164	0.217	0.45
d2007	0.122	0.123	0.32	**d2007**	0.214	0.222	0.34
d2008	0.099	0.133	0.46	**d2008**	0.471	0.236	0.05
d2009	0.140	0.223	0.53	**d2009**	0.391	0.243	0.11
d2010	0.077	0.131	0.55	**d2010**	0.149	0.228	0.52
d2011	0.170	0.125	0.17	**d2011**	0.153	0.216	0.48
d2012	0.153	0.131	0.24	**d2012**	0.328	0.241	0.18
d2013	0.091	0.124	0.46	**d2013**	0.462	0.215	0.03
d2014	0.030	0.141	0.83	**d2014**	0.253	0.241	0.30
d2015	0.180	0.147	0.22	**d2015**	0.422	0.216	0.05
d2016	0.168	0.145	0.25	**d2016**	0.229	0.243	0.35
d2017	0.250	0.162	0.13	**d2017**	0.351	0.239	0.15
d2018	0.143	0.134	0.29	**d2018**	0.194	0.384	0.62
cons	9.060	0.371	0.00	**cons**	7.447	0.507	0.00

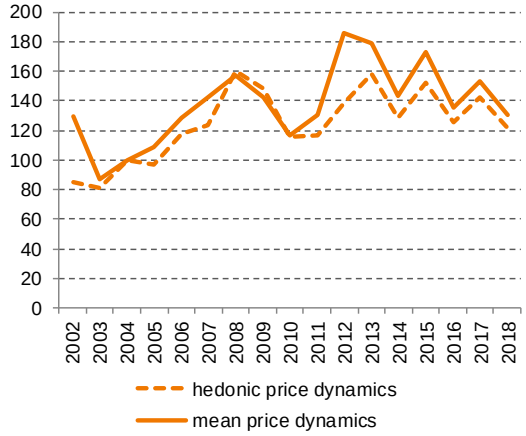
Source: NBP

Figure 3 Mean and hedonic price index for office properties in Warsaw and Poland (2004=100)



Source: NBP

Figure 4 Mean and hedonic price index for retail properties in Poland (2004=100)



Source: NBP

3.4 Analysis of the profitability of office investment in the Tricity market under various mortgage cost and vacancy rate scenarios[11]

The NBP monitors, among others, the risk associated with the financing of commercial real estate investments with mortgages from banks. There is a fast development of the modern office space market in major cities in recent years. We analyse the profitability of investing in office real estate on the example of A class office buildings located in Tricity. The average leasable area of the analysed objects is 15.7 thousand m2, the transaction price is approximately 2,500 euro per m2. In the first half of 2018 the average rent for Class A office buildings in Tricity was EUR 13 per m2 per month. We apply a discount rate of 7% for equity, assume that the investment is financed to 70% by a bank loan with a 25-year repayment period[12]. The remaining amount (30%) is equity. The profitability analysis is carried out with particular emphasis on the evolution of the following indicators over the investment period: EBITDA (earnings before taxes interest, debt service and amortization), net profit, FCFE (free cash flow), DSTI (debt service to income). Also the internal rate of return (IRR) for capital expenditures incurred by shareholders and the net present value (NPV) of discounted future cash flows under the adopted discount rate are analysed. We test, how the indicators react to a growth of mortgage costs and increases in the vacancy rate. The assumptions is that

[11] This is a modified and augmented version of Trojanowski et al. (2018).

[12] The duration of the investment is set to 25 years to match the maturity of the mortgage. In reality most of investments last only 10 years or even shorter, but the mortgage is taken for a longer period, by which the annual mortgage instalments are reduced. But, at the end of the investment there is outstanding debt which has to be paid back with the money obtained from the sale of the building.

everything is deterministic and once a variable is changed, it remains at the new level. The calculations of each economic indicator is explained in detail in Trojanowski et al. (2018).

Table 3. Economic results (in euro), assuming a 2.5% interest rate on the loan and a 5% vacancy rate.

year	EBITDA	net profit	FCFE	DSTI
1	2 186 401	460 695	597 033	0.71
2	2 197 333	485 941	602 043	0.71
3	2 237 445	535 237	630 592	0.70
4	2 277 497	584 909	658 993	0.69
5	2 315 838	633 629	685 906	0.68
6	2 354 681	683 202	713 121	0.68
7	2 394 146	733 735	740 732	0.67
8	2 434 242	785 248	768 745	0.66
9	2 474 979	837 761	797 164	0.65
10	2 516 369	891 294	825 997	0.64
11	2 558 420	945 869	855 247	0.63
12	2 601 145	1 001 507	884 920	0.63
13	2 644 553	1 058 229	915 023	0.62
14	2 688 655	1 116 057	945 561	0.61
15	2 733 463	1 175 015	976 539	0.60
16	2 778 988	1 235 126	1 007 964	0.60
17	2 825 242	1 296 413	1 039 842	0.59
18	2 872 235	1 358 900	1 072 178	0.58
19	2 919 981	1 422 613	1 104 978	0.57
20	2 968 490	1 487 577	1 138 249	0.57
21	3 017 776	1 553 817	1 171 997	0.56
22	3 067 850	1 621 360	1 206 228	0.55
23	3 118 725	1 690 233	1 240 947	0.54
24	3 170 414	1 760 463	1 276 163	0.54
25	3 222 930	1 832 079	1 311 880	0.53
26*	3 276 287	1 893 814	2 832 059	-

*/first year where the mortgage is fully paid back
Source: own calculations.

In each of the analyzed periods (25 years of loan repayment plus 1 year after the repayment) the balance of cash flows indicates a positive value with a certain margin of safety. The financial flows guarantee the repayment of loan liabilities within the assumed time horizon. The basic economic indicator EBITDA (earnings before taxes interest, debt service and amortization) increases slowly over the duration of the investment.

The net profit increases gradually due to the decrease in interest charges, from around 461 thousand PLN in the first year to over 1832 thousand PLN in the twenty-fifth year of the investment. It should be pointed out that as the outstanding mortgage is reduced, also the interest payments decrease. The highest net profit was recorded in the first year after

repayment of loan liabilities. The office building generates positive FCFE flows (free cash flow for capital owners) in every period. This means that the revenues generated fully cover the expenses incurred.

Also the DSTI (inverse of the DSCR - debt service coverage ratio) in all years of the repayment of loan liabilities remains below 0.8, which is a level that is considered as safe. This means that the investor allocates less than 80% of taxable income to repay the loan. Thus, he has a financial buffer of around 20% of taxable income.

Table 4. The profitability of the office building's activity measured by NPV and IRR with the assumption of 2.5% of the loan interest rate and 5% of the vacancy rate

IRR (for the equity of the investor at the initial date of the investment)	**9.46%**
NPV (discounted value of the future cash flows, after considering the investment expenditure and the residual value.)	4 957 566 euro
Residual value (cash flow in the 26th year/ discount rate)	40 457 986 euro
Discount rate	7.0%

Source: own calculations.

Under our deterministic assumptions the price of a property (residual value) that can be obtained at the end of the investment (after 25 years) is over EUR 40 million. This makes the investment profitable. For the assumptions made, the IRR for expenditures incurred by the shareholders is 9.46%, which is higher than the assumed discount rate - 7%. The investment should be considered as profitable. The NPV for the adopted discount rate and the analyzed period is PLN 4957 thousand. This amount shows today's value of the future income from the investment, after deducting the initial expenditure, i.e. what profit from the project can be expected in today's value. It can be concluded that the purchase of an office building with the assumptions made allows for a stable loan servicing which is important for the crediting bank.

In order to do the stress test we repeat the calculations with increased mortgage costs (now 5%) and a higher vacancy rate (now 20%). Under such a scenario, the economic indicators have deteriorated significantly and the investment has become unprofitable (the IRR is below the assumed discount rate, see table 6). The level of debt burden threatens the financial stability of the investment. The first nine years of operation of the investment would result in losses, because due to the excessive burden of credit obligations the expenditures exceed the proceeds (see table 5).

Table 5. Economic results (in PLN) during the investment, assuming a 5.0% loan interest rate and 20% vacancy rate.

Year of the investment	EBITDA	net result	FCFE	DSTI
1	1 728 277	-464 271	-94 233	1.05
2	1 736 919	-433 824	-92 733	1.05
3	1 768 744	-383 404	-72 735	1.04
4	1 800 828	-331 519	-52 822	1.03
5	1 831 542	-279 423	-34 327	1.02
6	1 862 637	-225 633	-15 850	1.01
7	1 894 229	-169 983	2 688	1.00
8	1 926 326	-112 393	21 276	0.99
9	1 958 937	-52 776	39 903	0.98
10	1 992 069	8 954	58 556	0.97
11	2 025 732	72 891	77 221	0.96
12	2 059 934	139 133	95 884	0.95
13	2 094 682	207 782	114 530	0.94
14	2 129 987	278 944	133 142	0.94
15	2 165 856	352 732	151 703	0.93
16	2 202 300	429 264	170 195	0.92
17	2 239 326	508 664	188 597	0.91
18	2 276 945	591 060	206 888	0.90
19	2 315 166	676 589	225 046	0.90
20	2 353 998	765 394	243 048	0.89
21	2 393 452	857 624	260 867	0.88
22	2 433 536	953 436	278 478	0.87
23	2 474 263	1 052 994	295 851	0.87
24	2 515 640	1 156 471	312 956	0.86
25	2 557 680	1 264 049	329 762	0.85
26*	2 600 393	1 346 339	2 284 585	-

**/first year where the mortgage is fully paid back*
Source: own calculations.

Table 6. The profitability of office building operations measured by NPV and IRR, assuming an increased loan rate of up to 5% and a vacancy rate of up to 20%.

IRR (for the equity of the investor at the initial date of the investment)	**4.56%**
NPV (discounted value of the future cash flows, after considering the investment expenditure and the residual value.)	**-4 815 126 euro**
Residual value (cash flow in the 26th year/ discount rate)	**32 636 927 euro**
Discount rate	**7.0%**

Source: own calculations.

In table 7 we present the main results of our model investment for different mortgage costs or vacancy rate increases. This simple exercise gives us some insight on how the investment profitability depends on various economic factors.

Table 7. Analysis of the sensitivity to the increase in interest rates on loans and the vacancy rate and the decrease in the net rent rate (base values: 2.5% interest on the loan, 5% vacancy rate, 13 euro / sq m / m-c rent).

Category	Change	IRR	NPV (euro)	DSTI*	ROE*
Mortgage cost	0%	9.46%	4 957 566	0.71	5.1%
	+0.5 p.p.	9.09%	4 245 257	0.74	4.6%
	+1.0 p.p.	8.72%	3 508 725	0.78	4.0%
	+1.5 p.p.	8.34%	2 748 435	0.81	3.5%
	+2.0 p.p.	7.95%	1 964 914	0.84	2.9%
	+2.5 p.p.	7.56%	1 158 738	0.87	2.4%
	+3.0 p.p.	7.16%	330 534	0.91	1.7%
Vaccancy rate	0%	9.46%	4 957 566	0.71	5.1%
	+5%	8.49%	2 966 278	0.76	4.0%
	+10%	7.50%	974 990	0.81	3.0%
	+15%	6.47%	-1 016 298	0.87	1.9%
Net rent	0%	9.46%	4 957 566	0.71	5.1%
	-0.5 euro/m2/month	8.89%	3 790 628	0.74	4.5%
	-1.0 euro/m2/month	8.32%	2 623 691	0.77	3.8%
	-1.5 euro/m2/month	7.74%	1 456 753	0.80	3.2%
	-2.0 euro/m2/month	7.15%	289 815	0.83	2.6%
	-2.5 euro/m2/month	6.54%	-877 122	0.86	2.0%

**/ value calculated at the time the mortgage was taken*
Source: own calculations.

4 Conclusions

This paper explains how the NBP conducts the survey about rents and transaction prices of commercial property (office, retail and industrial buildings) and shows how the data is used to get more insight about the market. The construction of a hedonic rent index and a hedonic transaction price index is presented. Finally, we show how the information can be used to get insight about the situation in the market, by calculating the profitability of an office investment. A simple stress test is applied to show how the rate of return and other economic indicators change when mortgage costs or the vacancy rate increases.

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Appendix – variables collected in the survey and layout of the survey

The table below contains all collected variables, their detailed description and the type of property, for which the given variable is collected. The survey for the office sector has the signature NBP-NK/B (*biura* means offices in Polish, NK stands for *nieruchomość komercyjna*, which means commercial property), the survey for retail properties it is called NBP-NK/H (*handel* means retail in Polish) and the one for industrial properties is called NBP-NK/M (*magazyny* means industrial property in Polish).

Table A1. List of variables and their explanation

	Nr.	Variable	Name of the survey	Instruction on how to fill out the survey
HEADER	1	Respondent's number	NBP-NK/B, NBP-NK/H, NBP-NK/M	The respondent's number will be assigned by the NBP Regional Branch.
LOCALISATION OF THE PROPERTY	2	City	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the city where the property is located.
	3	District	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the district in which the property is located.
	4	Street	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the street name at which the property is located.
	5	Street nr.	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the building's address number (or the number assigned by the developer).

DATA ABOUT THE BUILDING	6	The name of the building	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the name adopted by the developer / owner for a given building.
	7	Year of completion	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the year of completion of the property, YYYY format.
	8	Technical condition (after modernization, without modernization)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter if the property has undergone modernization since its completion (after modernization / without modernization). Modernization does not mean the ongoing maintenance of the object. Modernization includes: extension, façade replacement, replacement of elevators, replacement of installations, etc.
	9	The year of the latest modernization	NBP-NK/B, NBP-NK/H, NBP-NK/M	If the property has undergone modernization, please enter the year of the latest modernization. YYYY format.
	10	Total net rentable area (m^2)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the total net leasable area in m^2. The **net leaseable area** determines the area that tenants actually use for direct business operations. For example, it is the size of a shop or service point, office space, etc., excluding social, administrative or common areas. This includes surfaces used by the owner of the building, if he runs business there himself. An example is a large grocery store operated by the owner of a shopping center.
	11	Net vacant space (m^2)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the amount of currently vacant net space for rent in m^2. For office buildings with a retail and services part, please provide only the indicator regarding office space. For retail property, please take into account only retail space, not including any office space. For industrial buildings, please only take into account industrial space, not including any office space.
	12	Share of common areas in the gross lease area (%)	NBP-NK/B, NBP-NK/H,	This is the share of common area in the gross leasable area of the whole building expressed in %. The **common area** includes the entrances to the building, the building reception, lift halls, corridors, toilet areas, smoking rooms and other auxiliary rooms

			available to all or part of the tenants. This list is not closed, please enter the share according to the building specification. The **gross leasable area** is the net lease area of the whole building plus the area of the auxiliary premises of the tenants, such as administrative and social rooms, storage rooms, reception desks and tenant's participation in exploiting the common areas of the building, such as corridors, staircases, public toilets.
13	Number of parking spaces	NBP-NK/B, NBP-NK/H,	Please enter the number of underground parking spaces and above-ground parking spaces belonging to the property.
14	Number of overground storeys	NBP-NK/B, NBP-NK/H,	Please enter the number of overground storeys of the building, e.g. for a one-story building enter 1, for a single-story building, number 2, etc. The number of storeys in the building does not include those with a garage.
15	Office class (A, B, C)	NBP-NK/B,	Please enter the office building class. A - modern building (less than 10 years have passed since the construction or major renovation) with high quality equipment, located in the city center, well connected; B - building constructed or modernized more than 10 years ago, of a lower standard than the A class building located in the center city or a building with good technical parameters, but located outside the city center. C - a building constructed or modernized more than 10 years ago with low quality equipment and located outside the center or a building built or modernized more than 20 years ago with low quality equipment located in the city center.
16	Share of retail and services area net%	NBP-NK/B,	Please enter the share of the retail and services area in the net rentable area in %.
17	Operating costs per month	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the operationg costs incurred by the owner of the property for a month. Please enter the average for the half-year for the entire property. Operating costs of the business include maintaining the technical condition of the real estate, repairs and modernizations, ensuring safety, cleaning works, taxes and other fees related to the property and, possibly, the costs of the management. Fixed costs are independent of the level of renting the building.
18	Currency of the operating costs	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please select the currency of the operating costs per month. PLN or EUR

19	Transaction price of purchase / sale of the real estate (gross)	NBP-NK/B, NBP-NK/H, NBP- NK/M	Please enter the transaction price of the real estate (gross).
20	Currency of the transaction price for buying / selling real estate (gross)	NBP-NK/B, NBP-NK/H, NBP- NK/M	Please select the currency of the transaction price for the purchase / sale of the real estate (gross). PLN or EUR
21	The date of the offer to sell the property	NBP-NK/B, NBP-NK/H, NBP- NK/M	Please enter the date of the offer (DD-MM-YYYY).
22	Date of purchase / sale of real estate	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the date of the purchase / sale transaction (DD-MM-YYYY format).
23	The value of the property resulting from the last valuation	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the value resulting from the last valuation.
24	Currency of the property value resulting from the last valuation	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the currency of the value resulting from the last valuation. PLN or EUR
25	The capitalization rate resulting from the last valuation	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the capitalization rate resulting from the last valuation.
26	The day on which the last valuation was made	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the date of the last valuation (format DD-MM-YYYY).
27	COMMENTS	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter additional information about the offer / transaction, which should be considered particularly important.
28	Type of building (shopping center, local shopping center, outlet, retail park, retail and service premises)	NBP-NK/H	Please enter the type of building: shopping center, local shopping center, outlet, retail park, retail and services premises (in an office building).
29	Number of retail and service premises in the building	NBP-NK/H	Please enter the number of all retail and services premises located in the building.

30	Office space (m^2)	NBP-NK/M	Please enter what is the office space in the total warehouse space in m^2.
31	Warehouse adapted for production (YES / NO)	NBP-NK/M	Please enter whether the warehouse is also adapted for production, YES / NO.
32	The name of the building	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the name of the building, using the name that has been given to the property in the description of the building in the NBP-NK / B or NBP-NK / H or NBP-NK / M form (from column 1).
33	No. of the leased area	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the no. of the area for which the offer or lease transaction applies. Please give each surface a unique number and use this number in subsequent editions of the survey.
34	The size of each area, rented or for rent (m^2)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please specify the size of each rented area or area offered for rent in m^2.
35	Fees related to the operation and maintenance of space per sqm in a month	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the fees associated with the use of space, per m^2 for a month in PLN or EUR (please specify the currency). Please enter the average value for the half year under review. Net charges related to the exploitation of space per m^2 for a month are fees for utilities such as gas, electricity, water, central heating, as well as ongoing repairs and maintenance. The net fees are borne by the building owner and then either directly transferred to the lessee (then the net rent is quoted) or covered by the building owner from the cash flow he receives from the tenant (then the gross rent is quoted, e.g. in the case of cooperatives).
36	Currency (PLN / EUR)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Applies to fees associated with the operation and maintenance of space per m^2 in a month.
37	Net rent applicable on the day of quotation / offered per m^2 in PLN or EUR per month	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the net amount of the rent (remuneration for the landlord, i.e. gross rent resulting from the contract, reduced by fees related to the operation and maintenance of space) per m^2 per month in PLN or EUR (please enter the currency in the next item of the questionnaire). **In case there is a contractual rent**, please enter the contractual amount without taking into account the no-rent period and other short-term discounts. If the rent is calculated on the turnover, please enter the average of the last six months. These costs should be entered in the column Net charges related to the space per m^2 in a month. Applies to individual premises. If, in the case of cooperatives, the Net

DATA ABOUT THE RENTS

			charges related to the space per m^2 in a month, are already included in the rent, please specify this rent (then we refer to the gross rent).
38	Currency (PLN / EUR)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Applies to the net rent applicable on the day of quotation / offered per m^2 per month. (PLN / EUR)
39	The office space tenant sector	NBP-NK/B	Please provide the main sector of the office space tenant: 1 - financial sector, insurance, 2 - logistics, trade, 3 - technologies, 4 - IT and telecommunications, 5 - public sector, 6 – other.
40	The type of service offered by the tenant of office space	NBP-NK/B	Please provide the main type of services offered by the tenant of office space: 1- direct customer service from outside (i.e. natural persons or business entities) e.g. by consulting companies, 2- remote customer service, e.g. call center, 3 - office service of the activity of the firm or its mother company (including external customer service and / or customer service of the company remotely, e.g. call center for its clients).
41	Location of the area in the building	NBP-NK/H	Please give the location of the rented space in relation to the entrance (this may be in relation to the main entrance or an important entrance from the car park): 1- near the entrance, 2 relatively well located (at the same level as the entrance, but at some distance from the entrance), 3 - far from the entrance (the location is not very favorable, requires looking for the shop, using stairs, elevators).
42	The business sector of the renter of the retail space	NBP-NK/H	Please enter the industry of the tenant of the retail space: 1 - fashion and accessories, 2 - jewelery, 3 - shoes, art. leather, 4 - Television, household appliances, 5 - cosmetics, pharmacy, 6 - catering, 7 - banks, insurance, etc. 8 - other).
43	Floor	NBP-NK/B, NBP-NK/H	Please enter the number of the floor on which the rented space is located. If the entire multi-storey building is rented by one tenant, enter 0 (ground floor level). If one tenant occupies a part of the building on many floors (eg. 0, 1, 2, 3, 4, 5) then the number of the lowest storey should be entered, and if the number of one of the floors occupied by the lessor is under the ground floor (e.g. -1) then enter 0.
44	Lease terms - contract length (years)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter for how many years the current lease contract has been signed. **If the contract was annexed**, please indicate for how many years the latest contract was signed. Please enter the value for each premise.

45	Lease terms - length of the period free of rent (months)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter, for how many months the tenant, with current contracts, is exempt from paying rents. Please enter the value for individual surfaces.
46	Date of issuing the lease offer (DD-MM-YYYY)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter the date of issuing of the lease offer, format DD-MM-YYYY.
47	Date of the lease transaction (DD-MM-YYYY)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please **enter the date of the transaction of the currently valid lease contract**, format DD-MM-YYYY. If the contract was **annexed, please enter the date of the latest annex** concerning the change in the rent.
48	Valorisation of the rent (yes, no)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please state if the rent is subject to valorisation.
49	Area status (rented, for rent)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter whether the space is rented or unoccupied.
50	Green building (YES / NO)	NBP-NK/B, NBP-NK/H, NBP-NK/M	Please enter if the building is a green building (YES / NO). A green building is a building that uses environmentally friendly solutions throughout its life cycle, meeting the requirements of BREEAM, LEED.

Figure A1 First page of the office survey, with data about the building and its price and valuation - example of the office sector survey

NARODOWY BANK POLSKI		
Name and address of the reporting unit	**NBP-NK/B** The survey for the office sector NBP-NK/B	NBP Regional Branch .....

Time needed to fill out the questionnaire		
Please enter the time (in minutes) needed to prepare the data	1	
Please enter the time (in minutes) needed to fill out the form	2	

NBP-NK/B 1 DATA FORM FOR SURVEYING THE COMMERCIAL REAL ESTATE MARKET - OFFICES

1	The respondent's number will be assigned by the NBP Regional Branch.

Office real estate - office spaces located only in office buildings - with an area no less than 50 m2

Location					Description of the building												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
The number of the building	City	District	Street	Street nr.	The name of the building	Year of completion	Technical condition (after modernization, without modernization)	The year of the latest modernization	Total net rentable area (m2)	Net vacant space (m2)	Share of common areas in the gross lease area (%)	Number of parking spaces - underground	Number of parking spaces - above-ground	Number of overground storeys	Office class (A, B, C)	Share of retail and service area net%	Operating costs per month
l1																	
l2																	
l3																	
itd.																	

19	20	21	22	23	24	25	26	27	28	29
Currency of the operating costs (PLN/EUR)	Transaction price of purchase / sale of the real estate (gross)	Currency of transaction price for buying / selling real estate (gross)	The date of the offer to sell the property	Date of purchase / sale of real estate	The value of the property resulting from the last valuation	Currency of the property value resulting from the last valuationy (PLN/EUR)	The capitalization rate resulting from the last valuation (%)	The day on which the last valuation was made	Green building (YES / NO)	COMMENTS

Figure A2 Second page of the office survey, with data about the rents and attributes of single premises in the building described on the first page

Office real estate - RENTS															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
The number of the building from form NBP-NK office 1	No. of the leased area	Floor	The type of service offered by the tenant of office space	The business sector of the renter of the retail space	The size of each area rented / for rent (m2)	Fees related to the operation and maintenance of space per sqm in a month	Currency of exploitation fees and maintenance of space per sqm. per month (PLN / EUR)	Net rent applicable on the day of quotation / offered per m2 in a month	Currency (PLN / EUR)	Lease terms - contract length (years)	Lease terms - length of the period free of rent (months)	Date of issuing the lease offer (DD-MM-YYYY)	Date of the lease transaction (DD-MM-YYYY)	Valorisation of the rent (yes, no)	Area status (rented, for rent)