Effect of Productive Age on the Real Estate Market

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Abstract

Purpose of the article: With the ever-increasing development of property prices and the disproportionate number of new housing developments, the question is which factors have an impact on this phenomenon from the-out-of-the-box perspective. For the article, the main variables which influence the real estate market were selected by secondary research. These variables were chosen as independent variables. The dependent variable was explicitly created for this research as the Index of the Productive Age (IPA).

Methodology/methods: Using statistical and econometric tools allowed us to determine which variables have a statistically significant effect on the development of prices and the whole nature of the real estate market.

Scientific aim: The study deals with the effect of the size of the productive population on the real estate market, more precisely on the price of real estate.

Findings: Finding that the "fuzzy" variable of age can have a significant influence on the real estate market. As a result, it can be stated that the larger the population of the productive age, the more real estate is being built, but also its prices increase.

Conclusions: The sensitivity of IPA changes to selected variables. Also, within rising prices on the real estate market, it is possible to observe an increase in demand for alternative housing. Based on the research, the hypotheses were addressed in the discussion and conclusion.

Keywords: real estate, productive age, housing development, mortality

JEL Classification: E43, R15, R31

1. Introduction

The issue of economic development is one of the widely discussed factors in both economic and social sciences. The first of the authors was Thomas Malthus. His conclusions are unambiguous. "The power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will show the immensity of the first power in comparison of the second." The development of the population is, therefore, an integral part of the development of society (Malthus, 1986).

Until these days, studies have used the Human Development Index (HDI). The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions (Alkire, 2002).

The HDI was created to emphasise that people and their capabilities should be the ultimate criterion for assessing the development of a country, rather than the economic growth alone. The HDI can also be used to enquire about national policy choices, asking how two countries with the same level of GNI per capita can end up with different human development outcomes. These contrasts can stimulate the debate about government policy priorities (Musai, Mehrara, 2013).

The health dimension is assessed by life expectancy at birth, while the education dimension is measured by the mean of years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering age. The standard of living dimension is measured by the gross national income per capita. The HDI uses the logarithm of income in order to reflect the critical importance of income with the increasing GNI (Ogwang, 2000).

Nevertheless, the second half of the 20th century was dominated by theoretical discussions related to natality and development. An influential report of the U.S. National Research Council presented a view that departed, in essential respects, from the traditional interpretation of the natality-development relationship. A one of an important conclusion is the correlation between slower population growth, and decreased poverty does not imply causation (Mason, 1997).

Recent research suggests that the negative relationship between human development and natality in industrialized countries reverses when the Human Development Index (HDI) progresses beyond the threshold of 0.85–0.9 (Myrskylä *et al.*, 2009).

Natality rates in some European countries have plummeted within the last decade, thus creating the phenomenon of "lowest-low natality", defined as total natality below 1.3. As of today, the lowest natality levels are found in the Eastern European and Mediterranean countries (Balbo *et al.*, 2013). At the same time, in highly developed countries, either the centuries-long natality decline has stalled, or an opposite trend has been observed simultaneously with continuing socio-economic development.

Previous studies confirm the validity of the impact of demographic parameters on the company's economic development. However, the natality indicator, but the birth rate, will not be used in further processing. It is for several reasons: the first reason is to create a separate indicator of productive age. A natality indicator will be used to maintain the same dimensions, as this indicator is converted to a standardised sample of 1000 individuals in the statistical data.

The second reason is practically identical statistical parameters of both files. The birth rate and natality correlation are statistically significant, with the Kendall Tau correlation reaching 0.7. Similar values are achieved by skewness and sharpness. The last reason for the birth rate is the fact that in the following

calculations, multi-factor regression will be used. Also, to assess the strength of the influence of other variables, it is necessary to use just the number of births because by using the natality indicator, there would be distortions given by the lower dimension of the variable.

There are several studies on the variables that have a significant influence on productive ageing. The study (Solcová, 2011) describes negative stereotypes about ageing and old age and draws attention to the latest findings of differential gerontology. The author focuses on the so-called successful ageing and its self-assessment which should have a positive impact on the state economy and thus good health of all sectors. There is a more specified study by Börsch-Supan *et al.* (2002), which reacts to population ageing and its impact on the whole economy, focusing on capital markets. The younger generations in western and central Europe countries are quite aware of the need to provide for more retirement income through their private saving than depending on the public sector. Population ageing changes households' savings behaviour and portfolio composition, which has a significant impact on the real estate market and all variables associated with those issues. As a large number of jobs are dependent on the age of the employee, the ageing of the population reduces the supply. It increases the relative price of skills and total demand, which decreases with age. This trend and correlation can be determined by integrating the nationality and mortality in order to find out if and how quickly the population ages (Cai, Stoyanov, 2016).

Housing is one of the most crucial goals of a socialised person in the present arrangement. In the context of the Central European region, this is achieved through the real property ownership, and the real estate market and thus the state of the economy either directly or indirectly influence this trend. From the perspective of the monetary policy, adjusting the interest rate serves as one of the instruments of possible regulation precisely to prevent the emergence of a bubble in the real estate market (Reed, Ume, 2019).

The factor that undoubtedly affects the country's economy is the productive age of its population as mentioned above. The more significant is the proportion of the productive population to the total population, resulting in the greater the demand for funds, goods and services in the economy which in turn leads to a multiplication of financial transactions (Gontis, Kaulakys, 2004).

Therefore, it is essential to monitor the development of the productive age of the population, which can significantly influence the economy in future years and set conditions so that the economic environment is stable. One of the main aspects of the future healthy economy of the state is the support families so that there is no obstacle to having more children so that the gradual growth of the GDP is maintained and the population does not age and support the natality of the population. This aspect may take the form of keeping the population in tax benefits, parental bonuses, education and sports contributions and much more or even have a focus on population healthcare (Hill *et al.*, 2019).

2. IPA index

For the research hypotheses, it was necessary to define a variable which combines the important factors of productive age, birth rate, and mortality. This new variable will be the representative of the so-called dependent variable Y. Therefore, the variable of the productive age index (IPA) was defined. This variable was calculated using the productive age variable, which is determined between 19 and 64 within the EU area, along with inputs (birth rate) and outcomes (mortality and retirement). The first calculated input data for the IPA was directed to 2008. Statistically, it was found out what the birth rate in 1989 was, as well as the average mortality

rate of young people in the years 0–19, *i.e.* how much the resulting population will enter the working age, *i.e.* the "productive population growth" (PPG).

The productive population growth (PPG) can be obtained from statistical database data. If we are focusing on the initiation year of 2008, it is necessary to take the birth rate from 1989. Next, it is necessary to find out the mortality rate in the 0–19 year category, which is approx. 0.7 per 1000 inhabitants, where:

$$PPG_{TY} = Natality_{TY-19} - \left(\frac{Natality_{TY-19}}{1000} \times 0.7 \right), (1)$$

where TY is the target year and therefore:

$$PPG_{2008} = Natality_{1989} - \left(\frac{Natality_{1989}}{1000} \times 0.7 \right)$$

To determine the output data for the IPA, it was necessary to count the number of residents of the productive age interval (*i.e.* the age of 19–64 years). This was found again by secondary research from the data of the Czech Statistical Office, where the number of people who retired in the target year and the number of people who went to full disability pension were found. Therefore, the productive population decrease (PPD) has been defined and calculated just by the sum between the old-age pension and the full disability pension in the specific target year.

Therefore:

$$PPD_{TY} = Pension_{T.Y.} + Disability\ pension_{T.Y.}, (2)$$

where TY.is the target year and therefore:

$$PPD_{2008} = Pension_{2008} + Disability\ pension_{2008}.$$

The IPA productive age index is then mathematically calculated as the PPG proportionally to the PPD.

Where:

$$IPA_{TY} = \frac{PPG_{TY}}{PPD_{TY}}, \qquad (3)$$

where TY is the target year and therefore:

$$IPA_{TY} = \frac{128\ 266}{76\ 211}.$$

If IPA for 2008 is 1.68, *i.e.* greater than 1, the increase in the productive population is greater than its decline, *i.e.*

$$IPA_{2008} \geq 1 \supset 1.68, \qquad (4)$$

then:

$$PPG \geq PPD.$$

The IPA for selected statistical methods had to be calculated between 2008 and 2018, where it had to be divided quarterly every year because of the correspondence of the independent data. In order to determine the quarterly data accurately, the method of the Polynomial regression trendline of 6th grade was used.

Therefore the graph equation is:

$$y = -0.0007x^6 + 9.0073x^5 - 45316x^4 + \\ + 1E+08x^3 - 2E+11x^2 + \\ + 1E+14x - 5E+16. \qquad (5)$$

In this manner, the dependent variable Y was defined for a more in-depth analysis of the issue under investigation to confirm or refute the hypothesis (6) by using other independent variables, defining the issue obtained from the literature search and secondary research.

There is no doubt that the productive age of the population, and therefore the IPA affects the whole economy. It is crucial to be able to use long-term liabilities in the economy, for instance mortgage credit to finance housing. As signalling variables from the perspective of equity financing, the volume of mortgage loans and the interest rate offered by financial institutions for households were selected. It is precisely the number of productive population that fundamentally affects these two variables. The more productive the population is, then the greater need for housing. This will lead to an increase in the supply of residential real estate and, in parallel, the

Figure 1. IPA trend. Source: The author's work.

volume of loaned money in the form of mortgage loans to realize these purchases.

Following the supply of real estate, the volume of mortgage loans and the interest rate, influenced by the development of the market itself and by the possible regulation by the central bank, is changing to "steer" the economy in a given direction (Della Posta, 2018). In the general principle of starting the economy, in our case, real estate supply and thus increasing the volume of mortgage loans, low-interest rates and benevolent conditions for obtaining mortgage loans (creditworthiness and credit terms) will be set. Otherwise, the interest rate will increase, and the conditions will be set substantially stricter to prevent the economy from overheating.

On the other hand, there are two ways to satisfy this need, namely to reside in one's own property or rent. Both these variants are closely intertwined. As property prices rise, rent increases (Braakmann, McDonald, 2020). Rising property prices affect significantly more variables. Following the productive age of the population, the relationship between the price of real estate, the volume of mortgages, the consumer price index and the number of building permits issued for the new real estate exhibition will be monitored in this study.

The opposite of interest and volume of mortgages is a building permit. Rising prices will result in increasing demand for real estate investment plans and their subsequent implementation (Fernandez-Kranz, Hon, 2006). In this context, the time factor has to be taken into consideration. As property prices begin to rise, investors start to buy investment projects, for example, to build apartment buildings. Nevertheless, that does not mean that they will immediately start selling individual apartments. This is preceded at least by a building permit, which carries several administrative requirements and slows down the process over time. If in the first phase, when property prices rose, a large number of investors reacted and invested in these investment projects and at the same time start to handle all permits, in the near future the market may be oversaturated with new apartments, real estates and the tendency of their price will be slowly falling.

3. Theoretical hypotheses

The hypotheses have been defined to meet the primary purpose of the research, both how productive age affects the real estate market and, on a larger scale, the overall state of the economy. The Productive Age

Index (4) was created as a representative of the productive age, which will be compared as a dependent variable with other independent variables determined by secondary research using selected statistical tools. Based on the results of econometric calculations, the selected hypotheses will be confirmed or refuted.

Based on theoretical literature and the results of previous empirical studies on determinants of the IPA, some research hypotheses (H_1—H_5) have been formulated below.

The following research hypotheses, concerning the Index of the Productive Age, influencing the economy and thereby more specified real estate market within all market participants.

H_1: With the higher IPA rate, there is the direct dependence with the higher index of housing prices and the number of building permits.

H_2: With the lower IPA, there is a direct increase in the central bank's interventions in the form of monetary restrictions on interest rate increases.

H_3: In dependency of H_2 with the increasing of the IPA, there is an observable decrease in the number of house loans.

H_4: If the IPA is increasing, then the general mortality is supposed too be decreasing.

H_5: With the increasing IPA, there is an observed dependence on increasing the CPI. The research hypotheses allowed model specification for panel data:

$$
\begin{aligned}
\ln \text{IPA} = {} & \alpha_0 + \alpha_1 \ln \text{EMO} + \alpha_2 \ln \text{GDP} + \\
& + \alpha_3 \ln \text{IR} + \alpha_4 \ln \text{PRE} + \\
& + \alpha_5 \ln \text{IRNB} + \alpha_6 \ln \text{SL} + \\
& + \alpha_7 \ln \text{BP} + \alpha_8 \ln \text{VM} + \\
& + \alpha_9 \ln \text{CPI} + \alpha_{10} \ln \text{NAT} + \\
& + \alpha_{11} \ln \text{MORT} .
\end{aligned}
\tag{6}
$$

The description of each variable and the sources of data used are presented in Table 1.

4. Model estimation

Estimation of the panel data model was made using the Gretl software (GNU Regression

Table 1. The description of each individual variables.

Variables	Description of variables, math type
IPA	Index of productive age-dependent variable see. 2 – IPA Index.
EMP	Number of the employed – it is a variable which defines the number employed people in the target period.
GDP	Gross domestic product (GDP); the data of the Czech Republic divided quarterly for statistical analysis as the primary indicator of economic performance.
IR	Interest rate – the average interest rate for a natural person.
HPI	Index of housing prices – accordingly to FHFA as House Price Index (HPI) is a broad measure of the movement of single-family house prices. The HPI is a weighted, repeat-sales index, meaning that it measures average price changes in repeat sales or refinancing on the same properties.
THL	Housing loans in total – the number of total housing loans concluded in a given target period, the difference from a volume of mortgages is that it does not count the amount of money but the number of contracts.
BP	Building permits – the number of building permits issued by the competent building authority in a given period.
IRCB	CB interest rates – the interest rate value determined by the central bank.
VM	Volume of mortgages – the total amount of money issued on mortgages intended to purchase real estate to private ownership.
CPI	Consumer price index – the price level of consumer goods market and services purchased by households.
NAT	Natality – the number of births in a given target year.
MORT	Mortality – the number of deaths in a given target year.

Source: The authors' own calculations.

Table 2. The results of selected statistical tests.

Statistical Test	Test Statistic	P – value
WALD test	F = 36,0484	2,82807e–007
BREUSH – PAGAN test	LM = 29,6888	5,07266e–008
HAUSMAN test	H = 2,86044	0,413647

Source: The authors' own calculations.

Econometrics Time-Series Library version 2019b). The previous equation, defined by the formula (6) will be used for the calculation. The significance and occurrence of effects, as well as the nature of fixed or random effects themselves, were not assumed a priori. The choice of the final calculation method (pooled OLS, fixed effects, random effects) was made using the decision procedure proposed in the econometrics literature (Baltagi, 2001). Models with fixed and random effects were assessed, and diagnostic tests were carried out. The results of the statistical tests are scheduled in Table 2.

Based on the statistical tests in the table Table 2, it was found that an appropriate model for estimating the is the fixed effects model (F.E.). Thus, the parameters of the fixed effects model were estimated. However, a phenomenon of heteroscedasticity means heterogeneity of variances of random components within the sample. Previous tests show a partial presence of heteroscedasticity. A typical case is the overstatement of the statistical significance of individual variables. Therefore, the WLS (weighted least square) is used for the calculation. The scales are inverse to the scattering elements random components estimated for each variable in the model.

5. Results of estimation and discussion of the findings

The values of statistically significant parameters of the model calculated by the formula (6) are scheduled in Table 3.

Table 3. The results of the estimation of the model describing the determinants of IPA.

Depended variable IPA					
Independent Variable	Coefficient	Std. Error	t – ratio	p – value	Significance
Constant	58.7767	39.9023	1.473	0.1505	
CPI	2.58897	2.05144	1.262	0.2161	
HPI	0.0994974	1.50997	0.06589	0.9479	
THL	−0.408502	1.28869	−0.3170	0.7533	
BP	0.141114	0.150282	0.9390	0.3548	
IRCB	0.203983	0.0970553	2.102	0.0435	**
MORT	−1.21994	0.606484	−2.011	0.0528	*
Observation	43				
Standard error of residuals	1.135086				
R^2	0.645244				
Adjusted R^2	0.534382				
$F(10, 32) = 5.820274$	P – value for test F = 0.000060				

** Statistically significant variable at the level of 5%, * Statistically significant variable at the level of 10%.
Source: The authors' own calculations.

The presented model is statistically correct. Only two out of ten variables are statistically significant. The overall reliability of the models is higher than 50%. It can use the following interpretation method to interpret the results. This procedure includes a validated logarithm of variables. Changing the independent variables by 1% causes the variables to be increased or decreased by α_n%. An example is as follows. 1% change in building permits will result in a positive IPA change of 0.14%

The Housing Price Index (HPI) is a dependent variable on the independent IPA and its positive dependencies can be interpreted that if the IPA increases by 1%, the Housing Price Index increases by approximately 0.1%. In practice, this should mean that if the population of productive age increases, so should the price of real estate on the market rise. Along with the HPI, the BP (building permits) is also related. In such a case, we can also see a positive dependence on the IPA variable. If the range population of the productive age increases again by 1%, the number of building permits increases by 0.14%. Owing to these dependencies, the hypothesis H_1 can be confirmed.

The results of the study also confirm that it is possible to see a positive dependence of the IRCB variable, which is the central bank's interest rate on the IPA variable. As the price of real estate increases, the number of productive populations increases, as the H1 has proven, the central bank enters the market with a restrictive monetary policy as one of the tools to prevent the creation of a financial bubble in the real estate market. Thus, a positive effect of the IPA on the IRCB can be observed, with the IPA rising by 1% and the IRCB rising by 0.2%, where the IRCB is statistically significant at the level of 5%. Base on the result, we refute the hypothesis H_2.

The factor which is negatively influenced by the IPA is paradoxically the THL (total house loans); this can be explained by the intervention of the central bank and its monetary restrictions, where we can observe a decrease in the total amount of mortgage loans for individuals by 0.41% to 1% increase in the IPA. In this case, we refute the hypothesis H_3.

The overall mortality is the statistically significant variable at 10%, which is essential for the independent IPA variable due to the Productive Population Decrease (2), where it represents part of the deceased population. According to the research, mortality is negatively dependent on the Index of productive age, *i.e.* if the IPA increases by 1%, mortality decreases by about 1.22%, in which case we can confirm the hypothesis H_4.

As the Index of Productive Age increases, *i.e.* the productive population is increasing, this phenomenon will also have an impact on the overall economy. For this general comparison, the CPI (consumer price index) variable was chosen, where we can observe a direct dependence with a 1% increase in the IPA to a CPI increase of approx. 2.6%. This phenomenon can be explained based on the increasing number of productive population and the rise in inflation and thus the prices of measurable goods. In this case, it is appropriate to confirm the hypothesis H_5.

Conclusions

The results indicate that two variables, namely the IRCB (interest rate set by the central bank) and MORT (mortality rate), are statistically significant in direct comparison with the IPA. Each variable is substantial at a different statistical level. The IRCB variable is significant at 5% and the MORT variable at 10%. Obviously, with the growing IPA, the number of building permits increases, as well as the cost of housing, though. Due to this phenomenon, the central bank's restrictive policy, preventing, by means of raising interest rates, the bubble on the property market from inflating the whole economy of the state.

The dependence of other independent significant variables with the IPA was also examined, where, for example, an indirect proportion with THL (total housing loans) to the IPA can be observed. The CPI variable had the most significant recorded change to a 1% increase of the IPA, which is reflected most in the general state of the economy.

As a result, it can be stated that the larger the population of productive age, the more real estate is built, but also their price increases. In contrast, a restrictive central bank policy acts as a regulator. The results of the study show that the 1% increase in the IPA rises the housing prices by 0.1%, housing construction by 0.14% and the interest rate of the central bank by 0.2%. The increase in the IPA is logically inversely proportional to the mortality of the population, and in proportion to the increase in IPA by 1% is a decrease in MORT by 1.2%.

In conclusion, it can be said that with rising prices on the real estate market, it is possible to observe an increase in demand for alternative housing, which may be, for example, rental housing or cooperative housing.

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