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Abstract:

We test the effect of an increase in longevity on housing prices. The results show that workers and retirees react differently towards the impact of longer lifespans, and thus the housing price is influenced by the relative weight of the retirees vis-à-vis workers in the total population.

Keywords: Longevity, Housing prices, Semi-parametric analysis

JEL classifications: J11, R21

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Introduction

Life expectancy has increased across the world over the past half century. The data from the World Bank shows that the average life expectancy for the world population as a whole in 2016 was 72 years, a jump from 52 years in 1960. The increasing longevity is one of the reasons for the aging population around the world, and its economic impacts need to be investigated. In this study, we examine how the longevity increases might affect housing prices.

This study is of particularly interest because the literature investigating the impact of aging on house prices provides mixed conclusions: some suggesting that aging will have a positive impact on house prices while others arguing the opposite. For example, Mankiw and Weil (1989), Takáts (2012) and Essafi and Simon (2015) argue that an aging population has a significant effect on house prices. In contrast, Engelhardt and Poterba (1991) and Eichholtz and Lindenthal (2014) find that the effect is either insignificant or mixed in terms of the impact of demographic changes on house prices. In this circumstance, investigating the reasons of aging population separately would contribute to clear the discussion. Specifically, we use the Life Cycle Hypothesis (LCH) to show that the ambiguous findings from the literature on the impact of aging on house prices can be reconciled.

According to the LCH, workers save while retirees dis-save. With an increase in longevity, the retirees need additional funds for consumption while the workers are motivated to save more in anticipation of living longer. In the case where housing is the main vehicle for saving, the demand for houses by workers increase while the supply of houses by the retirees rise as they liquidate their holdings. Consequently, the impact on house prices of the above-mentioned forces depends on which of the two is the stronger.

The above-mentioned conjecture is tested using econometric methods on a panel data constructed for this purpose. We draw the regression model from Takáts (2012) and modify it according to the LCH. To capture the behaviour changes of households, we use the method of Generalized Additive Models (GAM), the details of which are explained in the next section.

The rest of the paper is organised as follows. The next section presents the model and discusses its economic meaning. The data and empirical results are presented in Section III. Section IV provides robustness check on the results, and Section V concludes.

Model

We derive our benchmark model in two steps. In the first step, we modify the regression model in Takáts (2012) by dividing the population into workers and retirees, while children are omitted for simplicity. The model to be estimated has the following form:

$$\Delta lnP_{it} = \alpha + \beta_I \Delta \ln Income_{it} + \beta_w \Delta \ln Workers_{it} + \beta_r \Delta \ln Retirees_{it} + \phi_t + \varepsilon_{it} \quad (1)$$

where P denotes real house prices, α is the intercept, $Income$ represents real GDP per capita, and $Workers$ / $Retirees$ denote the population of workers and retirees, respectively. Additionally, ϕ denotes the time fixed effect which captures factors such as oil price shocks, global financial crisis, etc. Subscript i denotes country and Subscript t represents time (year). The log-difference form of the variables is used to eliminate unit root in series (Takáts 2012). According to the LCH, the coefficient β_w should have higher value than that of the coefficient β_r since workers are net savers in the total population.

In the second step, we extend the model above to have life expectancy incorporated. Here, the coefficients of workers and retirees will no longer be viewed as constants but as functions of life expectancies. The properties of these functions will provide insights into the relationship between life expectancy and households' life-cycle behaviour. The model is as follows:

$$\begin{aligned} \Delta lnP_{it} = \alpha + \beta_I \Delta \ln Income_{it} + \beta_w(l_{it}) \Delta \ln Workers_{it} \\ + \beta_r(\Delta l_{it}) \Delta \ln Retirees_{it} + \phi(t) + \varepsilon_{it} \end{aligned} \quad (2)$$

, where the variables l and Δl denote the length of life expectancy and the growth rates of life expectancy respectively.

The model specification is based on the following discussion. According to the LCH, workers will plan their saving and consumption across their lifespan. Thus, the length of this lifespan will be essential for these decisions. From this perspective, the workers' behaviour would be changed according to their expected life expectancy. In contrast, retirees do not make plans for their whole lifespan but need to make changes to their existing plans. According to the LCH, if life expectancy increases / decreases, a greater / lesser fraction of houses would be sold than planned. Thus, the retirees' behaviour should be sensitive to the growth rates of the life expectancy.

Data and Results

We use annual data from 1970 to 2016 on house prices, income, and the population of retirees and workers from 19 advanced economies[1]; namely, Australia, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, the United Kingdom, Ireland, Italy, Japan, Korea, Netherlands, Norway, New Zealand, Sweden, and the United States. The data for house prices is downloaded from the Bank of International Settlement[2] (BIS) while that for the remaining variables is sourced from the World Bank. The panel is unbalanced because of data coverage but yields a total of 858 observations.

The regression result of the linear model is shown in the first column in Table 1[3]. The result shows that the coefficient of workers is higher than that of the retirees, and thus confirms the conjecture from the LCH. Next, we highlight the results of the benchmark model by presenting the figures of the coefficient functions in figure 1 and 2. Meanwhile, the results of the parametric and non-parametric terms are shown in Table 1 and 2 respectively.

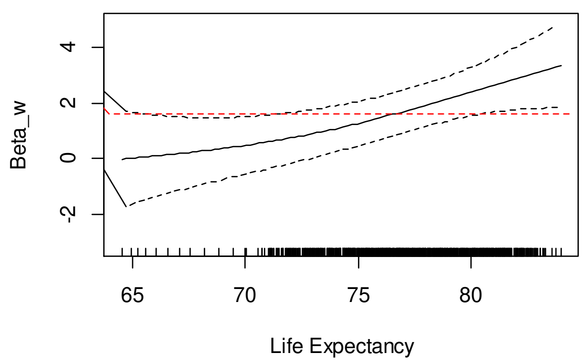

Figure 1 Workers' Coefficient

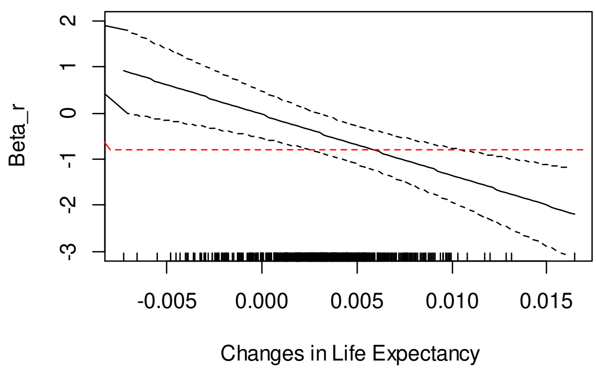

Figure 2 Retirees' Coefficient

Note: the estimates are computed with the gam function from package mgcv-1.8-24[4]. The continuous line shows the estimate of the smooth; the dashed lines represent 95% confidence bands. The horizontal (red) dash line is the estimated value of this coefficient in the simple model.

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[1] We use the advanced economies because: 1) they have longer data series, and 2) the economy operations are more stable. Thus, we can focus on the effect of longevity changes.
[2] Source: National sources, BIS Residential Property Price database (http://www.bis.org/statistics/pp.htm). Download date: 09 Oct 2018
[3] For the linear model, Hausman test (Chisq = 57.637, p-value = 1.879e-12) indicates fixed effect model should be used. Breusch-Pagan Lagrange Multiplier Test (p-value < 2.2e-16) shows significant time fixed effect.
[4] The package mgcv is written by Simon Wood to estimate the GAM models with R (Wood 2017).

In Figure 1, the coefficient of workers, $\beta_w(l)$, is shown as an increment function with respect to life expectancy. This result indicates that the workers' motivation to purchase houses increases with the expected lifespan, which corresponds with the theoretical prediction.

In Figure 2, the coefficient of retirees, $\beta_r(\Delta l)$, decreases with higher growth rates of life expectancy. This result implies that the retirees adjust their plans for investment in housing according to the growth rates of life expectancy, and the negative slope in Figure 4 is consistent with the conjectures of the LCH.

Robustness check

Our benchmark model could suffer from problems of endogeneity or having omitted other relevant variables. Besides, the results could vary due to changes in sample periods or country selections. In this section, we test the robustness of our core findings given the problems noted above.

First, we follow Essafi and Simon (2015) and use lagged explanatory variables instead of the contemporaneous ones. This method addresses possible endogeneity problems (Arellano and Bond 1991). We report the parameter estimates as column labelled M1 in Table 1. Second, the housing prices could be influenced by interest rates. Thus, we add interest rates, a possible omitted variable, into the model and report the parameter estimates in column M2. Third, the economic crisis from 2007 could have influenced the parameter estimates. Therefore, we examine the results in an alternative sample period 1970-2006 (M3). Lastly, we omit Korea[5] as an example to check if the results would vary by country selections (M4).

Table 1 Results of parametric coefficients

	LM	BM	M1	M2	M3	M4
(Intercept)	-	-0.0085*	0.0046	-0.01312**	-0.0085*	-0.0163***
Income	1.168***	1.237***	0.6382***	1.242***	1.416***	1.331***
Workers	1.621***	-	-	-	-	-
Retirees	-0.8055***	-	-	-	-	-
Interest rate	-	-	-	-0.0059***	-	-
R-square	0.176	0.305	0.192	0.346	0.351	0.313
Observations	858	858	839	715	668	817

*Note: ***, **, * indicate significant at 1%, 5% and 10%. For the LM, the estimates are computed with the plm function from package plm-1.6-6. For the rest of the models, the*

[5] Choosing Korea is because it becomes an advanced economy later than the others in our country samples.

estimates are computed with the gam function from package mgcv-1.8-24. In M2, we use the differences in long term interest rates and the data is from the OECD data[6].

Table 2 Results of non-parametric terms

	BM	M1	M2	M3	M4
$\beta_w(l)$	2.558***	3.157***	2.000***	2.596***	2.163***
$\beta_r(\Delta l)$	2.000***	2.000**	2.000**	2.725***	2.000*
s(Year)	8.509***	8.484***	8.689***	8.671***	8.571***

*Note: the values denote the degree of freedom of the fitted function. Symbols ***, **, * indicate significant at 1%, 5% and 10%.*

For the results of these alternative models, we present the coefficients of workers and retirees in figures 3 to 10. In these figures, the parameter estimation of β_w is an increasing function of life expectancy, while β_r decreases with higher growth rates of life expectancies. Therefore, the results of our benchmark model remain robust to the above-mentioned modifications to the basic model.

[6] https://data.oecd.org/interest/long-term-interest-rates.htm

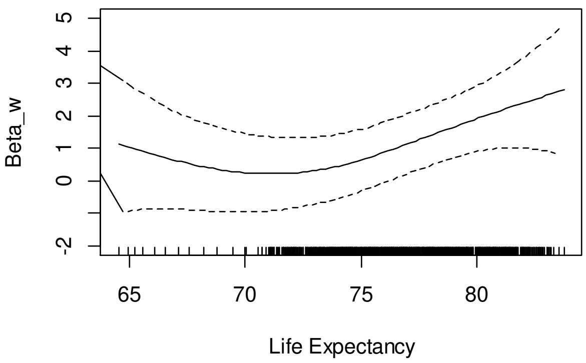

Figure 3 Workers’ Coefficient (M1)

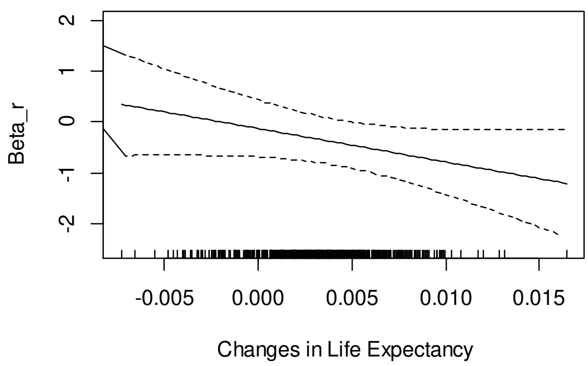

Figure 4 Retirees’ Coefficient (M1)

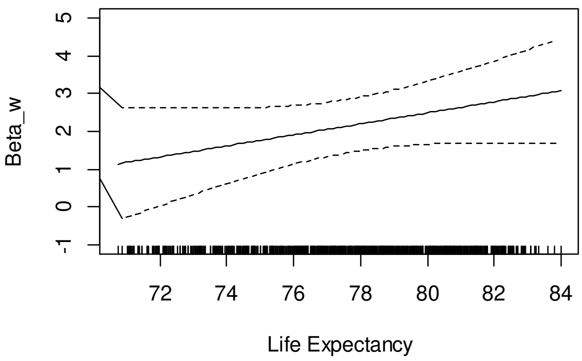

Figure 5 Workers’ Coefficient (M2)

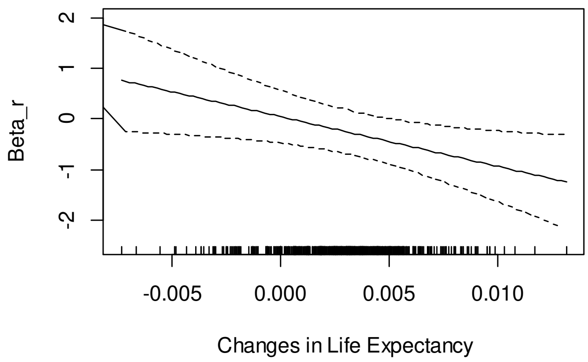

Figure 6 Retirees’ Coefficient (M2)

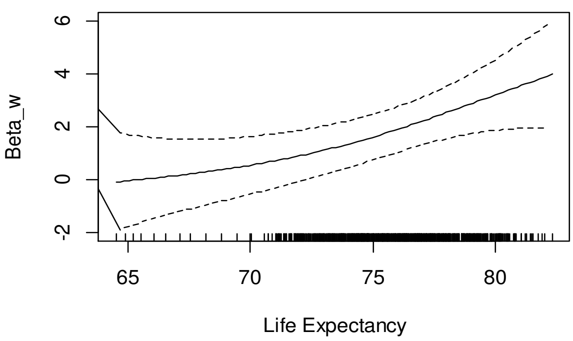

Figure 7 Workers’ Coefficient (M3)

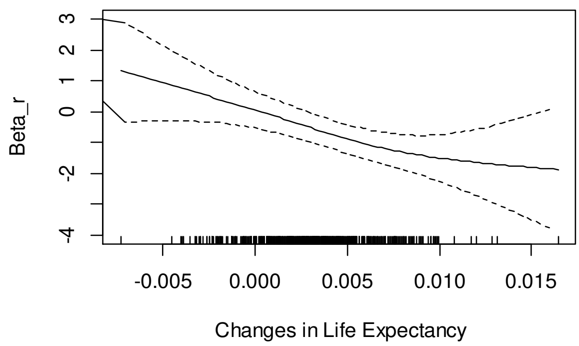

Figure 8 Retirees’ Coefficient (M3)

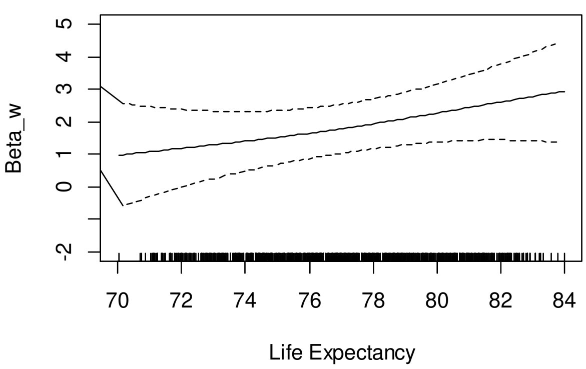

Figure 9 Workers’ Coefficient (M4)

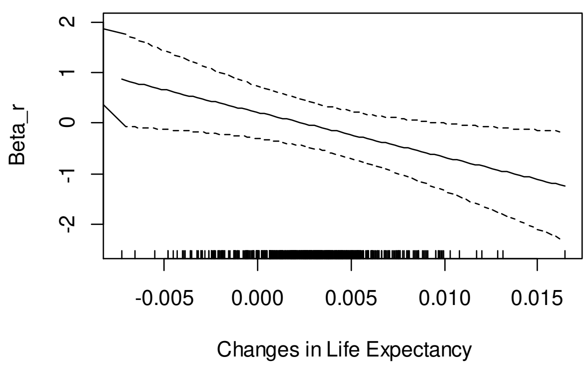

Figure 10 Retirees’ Coefficient (M4)

Conclusion

We test the effect of increases in longevity on house prices using a semi-parametric regression method (the GAM method). Our findings are consistent with the theoretical conjecture arising from the Life-Cycle Hypothesis; that is, an increase in longevity has a statistically significant impact on house prices. The parameter estimates from the base-model show that an increase in longevity raises savings and house prices, with the impact of rising life expectancy on house prices being non-linear. In contrast, a higher growth rate of life expectancy leads to retirees selling an increased fraction of houses to fund their consumption. Consequently, house prices decline. Our results contribute to the study of the effect of aging population on house prices. Besides, the varying coefficient can be explained from the perspective of the workers and retirees in terms of their saving decisions, as revealed by the GAM method.

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