1. Introduction

Nowadays it has become important for public and private institutions around the world, especially for western countries, to study the retirement behaviours of individuals, Hakola and Uusitalo (2004). The ageing of the baby boomer generation has enhanced this importance, Beehr and Bennett (2007). Pension systems in several countries have lost their balance due to the ageing of this generation. This has awakened the interest of Governments, institutions and researchers to investigate which factors, besides natural ageing, affect the financial solvency of the pension schemes. Another alarming factor that has strengthened the study in this issue is the drastic fall in the labour participation rate of old individuals in all OECD countries. The latter derives the economic concern that ageing is exacerbated as more and more people become solely consumers rather than both consumers and producers.

It is clear that the increase in life expectancy, demographic structure and decrease in birth rate are factors that weaken the financial health of pension schemes, as well as the point in time in which the worker's retirement plans are consumed. The moment in which the decision of retirement is taken for a worker determines whether the retirement is early or late. Early retirement is usually defined as definitively leaving a long career before the age of 65 years old, Feldman (1994) and Wang and Alterman (2017). Early retirement begins to be built during the work stage of individuals and evolves to consummate in retirement at some point.

Over the years, the proportion of men over 65 years old in the workforce decreased from 31% in 1951 to 12% in 1981 in western countries. This was caused by early retirement and because unemployment is common among individuals close to retirement, Munnell (2006). The major interest on understanding retirement is the provision, level of retirement pension, and consequences on the economy of a country, Walker (1982).

Many people decide to delay their retirement age because economic conditions allow it. In other cases, as explained by Bosworth and Burtless (2010), when the unemployment rate grows, people decide to retire early. Some individuals want to meet the retirement requirements as quickly as possible because they prefer enjoying leisure activities than working as explained by Muldoon and Kopcke (2008).

Economic crisis in general also has an impact on retirement decisions as explained by Hurd and Rohwedde (2010). Using HRS data between 2008 and 2009, the authors showed that many were planning to work longer and delay their retirement as result of the crisis experienced by USA in those years.

Coile and Levine (2009) find that workers between 62 and 69 years old are affected by fluctuations in the unemployment rate and the long-run stock market. In particular, workers with lower education are affected by the unemployment rate and those with higher education are affected by the stock market. In the same line, Bosworth and Burtless (2010) conclude that a decrease in the value of stock market and housing prices cause a delay in retirement because people decide to stay in the labour market longer to rebuild their lost wealth. Following this line, another important variable to take into account that may affect the retirement decisions is petroleum prices.

Petroleum prices have experienced fluctuations that range from 60 USD per barrel to a peak of 146 USD in 2009 and subsequently descended again to below 50 USD in 2015, Organization of the Petroleum Exporting Countries (2015). These changes in prices affect in different ways the economy of the countries involved in the international trade of petroleum. In Brazil, as an exporting oil country, the decrease in petroleum prices caused a slowdown in the growth of GDP, investment strategies, construction sector and industries linked to the oil

production, Cavalcanti and Jalles (2013) and Florêncio (2016). In China, as an importing country, the falling prices led to better economic growth especially in the industrial sector due to a decrease on the expenditures. Industries, such as airline and agricultural, might experience a reduction in their sale prices provoking less inflation and more consumption when oil prices remain low, Qianqian (2011) and Tian (2016).

Mexico is the eighth largest oil producer in the world. The production of petroleum, and related products, represent between 7 and 10.5 percent of GDP, and the income from sales represents about 33 percent of tax revenue. The fall in oil prices between 2014 and 2016 caused a cut reduction in federal and sub-federal public spending which affected the investments in several sectors such as education, health and various social and internal investment programs[1]. For all this is natural to think that petroleum prices may influence the retirement of individuals.

This study contributes to written literature about the effect of macroeconomic variables on retirement decisions. It expands in the inclusion of oil prices as an important variable that can affect retirement, specifically in countries that export oil whose economy depends on this income. It also contributes making the analysis by gender.

Following this introduction, in Section II, we briefly explain the Mexican pension system. Section III presents the methodology and model used. Section IV shows the data used. The paper ends with the main results and conclusions.

2. Pension System in Mexico

The IMSS (Mexican Institute of Social Security) is financed by contributions from workers, companies and the government. The IMSS covers workers in the private sector. Public workers are affiliated to the (Institute of Security and Social Services of State Workers (ISSSTE) while the armed forces are covered by PEMEX (Mexican Petroleum). At the inception, the pension system in Mexico was financed on a pay-as-you-go (PAYG) basis where contributions of active workers pay for retirees' pensions for a particular period of time. Over time, the PAYG scheme began to weaken and lose sustainability due to its strong dependence on the demographic structure.

In December 1995, the Social Security Law was reformed and implemented individual defined contribution accounts managed by the (National Commission of Savings System for Retirement (AFORE). The law began to be effective on July 1, 1997.

The group of individuals analysed in this research corresponds to pensioners under the pay as you go scheme.

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[1]Ministry of Finance and Public Credit (SHCP) 2017, Opportunistic Public Finance Statistics. Gentleman, J. 1984. "Mexican Oil and Dependent Development". New York: P. Lang.

3. Methodology and Model

In this paper, we model the frequency of new pensioners using unemployment rate, stock market and petroleum prices as explanatory variables.

For the purpose of this study, the frequency of the retirement in a period of time $"t"$ will be observed through the following proportion[2]:

$$\frac{N_t^{i,j}}{T_t^{i,j}} \quad (1)$$

Where:

$N_t^{i,j}$: is the number of new pensioners at time $"t"$ with individual characteristics $"i"$,$"j"$.

$T_t^{i,j}$: is the total population at time $"t"$ with individual characteristics $"i"$, $"j"$.

Where $"i"$ and $"j"$ can correspond to gender, age or level of education of the individuals.

The proportion $\frac{N_t^{i,j}}{T_t^{i,j}}$ can also be interpreted as the probability of new retirees with characteristics $"i"$, $"j"$ in the period $"t"$.

If the series frequency of retirement, unemployment rate, stock market and petroleum prices are stationary of the same order, cointegration tests are carried out following the methodology of Johansen (1991), otherwise the relationship cannot be determined.

This approach considers the following VAR model of $"p"$ order,

$$y_t = \phi_1 y_{t-1} + \ldots + \phi_p y_{t-p} + B d_t + \varepsilon_t \quad (2)$$

This, in turn, can be rewritten as a vector error correction model (VECM),

$$\Delta y_t = \pi y_{t-1} + \sum_{i=1}^{p-1} \psi_i \Delta y_{t-i} + B d_t + \varepsilon_t \quad (3)$$

Where y_t is a vector of $"k"$ non stationary variables integrated of order 1, $I(1)$, d_t is a vector of deterministic variables, and ε_t it is a vector of innovations.

Johansen's method estimates the rank of the matrix $"\pi"$ which gives information about the number of cointegration relationships.

If the variables are effectively cointegrated, the estimation by OLS (Ordinary Least Squares) is consistent to estimate the long-term effects, Engle and Granger (1987). To estimate the short-term effects of the macroeconomic variables on the probability of retiring, the following expression is used:

$$\Delta y_t = \sum_{i=1}^{n} \theta_i \Delta x_{it} + \delta(y_{t-1} - \alpha - \sum_{i=1}^{n} \beta_i x_{it-1}) + \eta_t \quad (4)$$

Where $\sum_{i=1}^{n} \theta_i \Delta x_{it}$ represents the adjustments for short-term movements and $\delta(y_{t-1} - \alpha - \sum_{i=1}^{n} \beta_i x_{it-1})$ is the linear combination of long-term variables.

The coefficient of the second term, $"\delta"$ is the error correction coefficient that represents the speed of adjustment of the variables. When this coefficient is significant, the existence of cointegration is confirmed.

4. Data

The variables available on a quarterly basis are converted into monthly following the methodology of Boot, Feibes and Lisman (1967) and for the variables available on a daily basis, the average per month is calculated. Two sources of data are used for this analysis.

The National Employment and Occupation Survey (ENOE)

Since 2005, this survey is carried out by INEGI on a monthly basis. From this source, the number of retired people and total population by age, gender and level of education from 2005 to 2016 are obtained quarterly. The ENOE divides the information of pensioners into 4 schooling ranges which are incomplete primary education, complete primary education, complete secondary education and high school or higher. In our analysis, incomplete primary education will be considered as incomplete elementary education and complete primary and secondary education will be considered as complete elementary education[2]. The ENOE presents information in different age ranges, but for the purposes of this study, attention is only given to pensioners over 55 years old. The pensioners will be divided into two groups, aged 55 to 64 and over 65, to analyse if workers who decide to retire before 65 years old are affected in different way than those who retire after 65 years old.

Bank of Mexico (BM)

The Bank of Mexico generates and disseminates the statistics of the main macroeconomic and financial variables in Mexico on a daily, monthly or quarterly basis. From this database, we obtained[3] a series of unemployment rate, stock market and petroleum prices with a quarterly, monthly and daily frequency respectively. Petroleum prices are in US dollars and will be deflated using the US consumer price index. Figure 1 shows the trend of the explicative variables over the period 2005-2016. It is observed that stock market and petroleum prices seem to be non-stationary and unemployment rate stationary. These hypotheses will be proved using unit root and augmented dickey fuller test.

Figure 1. Evolution of the explicative variables.

Source: Own design, monthly series from 2005 to 2016.

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[2]There was not difference in the estimates when we considered complete primary and secondary education as separate variables.

[3]Initially, variables such as housing price and interest rate were considered. However, the strong correlation with stock market forced to keep only stock market in the model, according to principal component analysis. GDP, public debt and budgetary deficit were also considered in the study as measures of economic activity and impact of fiscal resources. Nevertheless, they were also strongly correlated with the stock market and it was decided to keep the stock market in the study following the pattern of variables used by Coile and Levine (2011) and Bosworth and Burtless (2010).

5. Results

After doing cointegration and unit root tests we proved that all the series are integrated of order 1 and cointegrated. The results of the estimates are shown below in Table 1 and Table 2.

Table 1. Long-term effects on the proportion of retired people by gender and age.

	Unemployment Rate	Stock Market	Petroleum Prices	Unemployment Rate	Stock Market	Petroleum Prices
	Men			**Women**		
From 55 to 64 years old	.0060384***	3.80e-07***	-.000167***	.0048007***	7.55e-07***	-.0001518***
	(7.54)	(6.87)	(-6.15)	(10.39)	(23.63)	(-9.67)
Over 65 years old	.0050913***	1.59e-06***	-.0001384***	.0039252***	8.57e-07***	-.0001307***
	(4.89)	(22.11)	(-3.92)	(8.31)	(26.22)	(-8.15)

Own source. The symbol "*" expresses that the coefficient is significant at 10%, "**" significant at 5% and "***" significant at 1%. The value in parentheses is the t statistic.

Table 2. Short-term effects on the proportion of retired people by gender and age.

	ΔUnemployment Rate	ΔStock Market	ΔPetroleum Prices	ECT	ΔUnemployment Rate	ΔStock Market	ΔPetroleum Prices	ECT
	Men				**Women**			
From 55 to 64 years old	-.0009579	-2.12e-07	-.0000233	-.0633231**	-.0000519	9.47e-08	.0000374	-0.0872553***
	(-1.23)	(-0.99)	(-0.56)	(-2.01)	(-0.11)	(0.73)	(1.47)	(-2.65)
Over 65 years old	-.0020413**	3.78e-07	-.000041	-.0838594***	-.0008502*	-6.95e-08	6.89e-06	-0.0895238**
	(-2.05)	(1.37)	(-0.75)	(-2.73)	(-1.80)	(-0.54)	(0.26)	(-2.58)

Own source. The symbol "*" expresses that the coefficient is significant at 10%, "**" significant at 5% and "***" significant at 1%. The value in parentheses is the t statistic. ECT is the Error Correction Term.

In the long term, the proportion of retired men and women, no matter the retirement age, are affected positively by the unemployment rate and stock market, i.e if unemployment rate and stock market increase, the number of new pensioners increase. However, it is negatively affected by petroleum prices, i.e. if oil prices increase, the number of new pensioners decrease. In the short term, as shown in Table 2, only the unemployment rate has a negative effect on the proportion of retired men and women over 65 years old.

Table 3. Long-term effects on the proportion of retired people by gender and level of education.

	Unemployment Rate	Stock Market	Petroleum Prices	Unemployment Rate	Stock Market	Petroleum Prices
	Men			**Women**		
Incomplete Elementary Education	-.0006012	1.76e-07***	.0000371*	.0013118***	-5.50e-09	-.0000342***
	(-0.97)	(4.10)	(1.76)	(7.24)	(-0.44)	(-5.56)
Complete Elementary Education	.006617***	-2.37e-08	-.000061**	.0016769**	-3.62e-08	-.000024
	(7.50)	(-0.39)	(-2.04)	(2.37)	(-0.74)	(-1.00)
High School or Higher	.0108124***	8.43e-07***	-.0004633***	.0161058***	2.49e-07*	-.0000572
	(6.33)	(7.13)	(-7.99)	(8.15)	(1.82)	(-0.85)

Own source. The symbol "" expresses that the coefficient is significant at 10%, "**" significant at 5% and "***" significant at 1%. The value in parentheses is the t statistic.*

Table 4. Short-term effects on the proportion of retired people by gender and level of education.

	ΔUnemployment Rate	ΔStock Market	ΔPetroleum Prices	ECT	ΔUnemployment Rate	ΔStock Market	ΔPetroleum Prices	ECT
	Men				**Women**			
Incomplete Elementary Education	-.0019783***	-8.04e-08	.000038	-.0885679**	-.000559**	6.13e-09	.0000122	-.176771***
	(-2.95)	(-0.43)	(1.03)	(-2.56)	(-2.34)	(0.10)	(0.92)	(-4.03)
Complete Elementary Education	.0017255	1.50e-07	-7.54e-06	-.141031***	-.0007802	7.61e-08	.0000251	-.0875397***
	(1.50)	(0.47)	(-0.12)	(-3.37)	(-1.15)	(0.40)	(0.63)	(-2.69)
High School or Higher	-.0046261**	1.10e-07	-.0002318**	-.1118527***	.0060549**	-6.22e-07	.0003586***	-.0909926**
	(-2.48)	(0.21)	(-2.27)	(-3.20)	(2.59)	(-0.96)	(2.81)	(-2.38)

Own source. The symbol "" expresses that the coefficient is significant at 10%, "**" significant at 5% and "***" significant at 1%. The value in parentheses is the t statistic. ECT is the Error Correction Term.*

When the analysis is done by gender and level of education, as observed in tables 3 and 4, the results are more varied. In the long term, the unemployment rate affects positively the proportion of retired men and women except those men with incomplete elementary education. The stock market has a positive effect on the proportion of retired men and women with high school or higher and men with incomplete elementary education. Petroleum prices have a negative effect on the proportion of retired men with complete elementary education and high school or higher. For men with incomplete elementary education, the effect of petroleum prices is positive. As for the proportion of retired women, petroleum prices have a negative effect on those with incomplete elementary education.

In the short term, the unemployment rate has an impact on the proportion of retired men and women with incomplete elementary education and high school or higher. Petroleum prices have an impact on the proportion or retired men and women with high school or higher. Stock market seems not to have impact on retirement.

Taking up the new variable of interest in this study, petroleum prices, the negative effect may be related to the income received from the sales of this natural resource. When oil prices are low, the government receives less income what implies less investment in the creation of new companies. An example of this is SEDESOL (Social Welfare Secretariat in Mexico) that through INADEM (National Entrepreneur Institute) finances its social programs of creation of companies from public resources. Thus, the lack or reduction of jobs in the economy would encourage people to retire early.

6. Conclusions

In this paper we show that unemployment rate has an impact on the retirement of men and women in the long and short term. Stock market and petroleum prices have an impact mainly in the long term. In particular, petroleum prices have a negative effect on retirement and mainly affect men.

In the long term, the effects of unemployment rate and stock market on the proportion of retired people coincide with the results obtained by Coile and Levine (2011) and Boswoth and Burtless (2010). In the short term, the effects of these variables change.

In recent years, it has been observed that petroleum prices have decreased due to geopolitical problems and the increase in its production. As shown in this paper, this can influence the retirement decisions of workers in the short and long term. The government should consider this effect to take measures to ensure the sustainability of the system when petroleum prices fluctuate outside the normal pattern.

Future research aims to analyse the pattern of new retirees' decisions for other oil producing countries with different economic and political conditions such as Norway and, in particular, to analyse the relationship between oil prices and retirement decisions.

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